NOTICE INVITING TENDER (NIT)

SUPPLY, INSTALLATION, COMMISSIONING & TESTING OF VRF/VRV HVAC SYSTEM

NIT No.: CMC/BY/25-26/RS/SkS/SS/27

[RFx Number: 2200000155 dated 13/11/2025]

Due Date for Submission: 03.12.2025, 15:00 HRS

BSES YAMUNA POWER LIMITED (BYPL)
CONTRACTS & MATERIALS DEPT.,
SHAKTI KIRAN BUILDING, KARKARDOOMA,
DELHI-110032
CIN: U40109DL2001PLC111525
WEBSITE: www.bsesdelhi.com

NIT INDEX

VOLUME – I: INFORMATION TO BIDDER (ITB)

SECTION – I: REQUEST FOR QUOTATION

1.00 EVENT INFORMATION

1.01 BSES Yamuna Power Ltd (hereinafter referred to as **"BYPL"**) invites **Open Tender** in the E-Tender Bidding Process on a "Single Stage: Two Parts" from interested Bidders to enter into a **contract** as detailed below:

Tender Description	Tender Fee (₹)	Estimated Cost (₹)	EMD Amount (₹)	Delivery at
Supply, Installation, Commissioning and Testing of VRF/VRV HVAC System.	1,180	2.20 Crore	4.40 Lakh	Site/Stores/Offices

The bidder must qualify the requirements as specified in clause 2.0 stated below.

1.02 The tender document is available for downloading from our website www.bsesdelhi.com **--> BSES YAMUNA POWER LTD --> Tender --> Open Tenders** or through our E-Tendering portal link (https://srmprdportal.bsesdelhi.com:50001/irj/portal).

1.03 **Tender Fee**: The bidder has to compulsorily submit the non-refundable tender fee of **₹ 1,180/-** as demand draft or online transfer of the requisite amount through IMPS/NEFT/RTGS covering the cost of bid documents. Any such bid submitted without this Fee shall be rejected.

1.04 **Earnest Money Deposit (EMD)** of ₹ 4,40,000/- (Rupees Four Lakh Forty Thousand only) valid for 120 days from the due date of bid submission in the form of BG/FD/online transfer of the requisite amount through IMPS/NEFT/RTGS. Any such bid submitted without EMD shall be rejected.

1.05 **TIME SCHEDULE**

The bidders should complete the following events within the dates specified as under:

S. No.	Events	Due date & Time
1	Date of availability of tender documents from BYPL Website & SRM	Till 03.12.2025 up to 15:00 Hours
2	Date & Time of Pre-Bid Meeting Pre-Bid Meeting will be done online, Register in advance for this meeting via, the Zoom Meeting link: https://zoom.us/meeting/register/tJEtdOGhrzIsE9JoVbgRphrPtqQWzAljB2o9 After registering, you will receive a confirmation email containing information about joining the meeting.	25.11.2025, 14:30 Hours
3	Last Date of receipt of pre-bid queries, if any (Queries to be submitted via e-mail)	26.11.2025 up to 17:30 Hours
4	Last Date of replies to all the pre-bid queries as received	01.12.2025 up to 17:30 Hours
5	Last date and time of receipt of Complete Bids (Tender Fees, EMD, Part A & Part B)	03.12.2025 up to 15:00 Hours
6	Date & Time of Opening of PART A – EMD and Technical Bid	03.12.2025 up to 16:00 Hours
7	Date & Time of opening of Price/RA of qualified bids	Will be notified to the qualified bidders through our website/e-mail

Note: In the event of the last date specified for submission of bids and the date of opening of bids is declared as a closed holiday for the BSES office, the last date of submission of bids and date of opening of bids will be the following working day at the appointed times.

1.06 The Bid shall be submitted online in two (02) parts. Details of the parts are as follows:
Part A – Techno Commercial Bid
Part B – Price Bid
Bids will be submitted online and received up to **03.12.2025, 15:00 Hr.** at the address given below.
Part A of the Bid shall be opened online on **03.12.2025, 16:00 Hr.**
Part B of the Bid will be opened in case of Techno-Commercially Qualified Bidders and the date of opening of same shall be intimated in due course. It is the sole responsibility of the bidder to ensure that the bid documents are submitted online and reach this office on or before the last date.

Head of Department
Contracts & Materials Dept.
BSES Yamuna Power Ltd
Reception, Ground Floor
Shaktikiran Building, Karkardooma
Delhi 110032

"**BID FOR SUPPLY, INSTALLATION, COMMISSIONING & TESTING OF VRF/VRV HVAC SYSTEM" "NIT No. :** CMC/BY/25-26/RS/SkS/SS/27 **[RFx Number: 2200000155] DUE ON 03.12.2025, 15:00 Hr.**"

1.07 BSES Yamuna Power Ltd reserves the right to accept/reject any or all tenders without assigning any reason thereof in the event of the following:

a) Tender is received after the due date and time.
b) Tender fee of requisite value is not submitted.
c) Earnest Money Deposit (EMD) of requisite value & validity is not submitted in the shape of a Bank Guarantee drawn in favour of BSES Yamuna Power Ltd, payable at Delhi or Online transfer of requisite amount through IMPS/NEFT/RTGS.
d) Price Bid as per the Price Schedule is not submitted.
e) Incomplete Bids.
f) Necessary documents against compliance to Qualification Requirements mentioned in Section 1 Clause 2.0 of this Tender Document.
g) Complete documents/details are not enclosed as per the Bid Index for Part-A (Technical Bid) at APPENDIX I ANNEXURE – 1.01.
h) Filled in Schedule of Deviations as per Annexure is not submitted.

2.00 QUALIFICATION CRITERIA

The prospective bidder must qualify for all of the following requirements and shall be eligible to participate in the bidding who meets the following requirements and management has a right to disqualify those bidders who do not meet these requirements.

2.01 **Technical Criteria:**

S. No.	Criteria	Documents to be submitted by the bidder
1.	The Bidder shall be either of the following: a. An original equipment manufacturer (OEM) of the offeredequipment. (OR) b. The Bidder should be authorized supply partner as on the	i) In case bidder is an authorized partner of OEM, Manufacturer Authorization Form (MAF) in the format specified in tender document stating that 'Bidder is an authorized partner of OEM and authorized to participate in

	date of the tender with an authority to sell, supply, service and maintain the proposed products.	this tender and in case the bidder is not able to perform obligations as per contract during the contract period, contracted services will be provided by OEM within the stipulated time'.
2.	The bidder should have successfully executed work of similar nature in office/institutional/industrial buildings with minimum Three (3) works of minimum ₹0.85 Cr each, OR Two (2) works of minimum ₹1.30 Cr each, OR One (1) work of minimum ₹1.75 Cr each during the last five (05) financial years from the bid submission date.	i. PO Copies of SITC of the system executed. ii. Delivery and Completion certificate with successful handing over /taking over of the project executed in the last 5 years from the date of bid submission.
3.	The Bidder (OEM or their authorized partner) should have atleast 5 years of experience in design, fabrication, supply, installation, testing, commissioning and execution of the VRF / VRV HVAC System.	List of executed projects with copies of orders. 'OR' Any supporting documents to establish five years relevant expereince.
4.	The bidder shall submit Performance Certificates of atleast two (02) projects showing satisfactory operation for more than one (1) year of the VRF / VRV HVAC system supplied and executed in atleast 02 (Two) nos office/institutional/industrial buildings of the offered equipment. In case the bidder has previously been associated with BRPL/BYPL for similar product and service, the performance feedback for that bidder by BRPL/BYPL may be considered irrespective of performance certificate issued by any third organization.	i. Peformance Certificate from client. ii. PO/WO Copies of the offered capacity with details of scope of supply and service w.r.t PO/WO.
5.	Bidder should have authorized service center in Delhi or NCR.	Details of OEM /OEM Authorized partner/bidder Support and service support capabilities.

2.02 **Commercial Criteria:**

S. No.	Criteria	Documents to be submitted by the bidder
1.	Bidder should have Average Annual Sales Turnover of INR 6 Crore or more in the last three (03) Financial Years (i.e. 2022-23 & 2023-24 and 2024-25).	Audited balance sheets / Duly certified CA certificate with UDIN to be submitted.
2.	The Bidder shall submit an undertaking that "No Litigation" is pending with the BYPL or its Group/Associates Companies.	Self Undertaking on letter head.
3.	An undertaking (self-certificate) that the bidder has not been blacklisted/debarred by any central/state government institution/Electricity utilities.	The firm shall submit a self-undertaking of non-blacklisting by central/state government institution/Electricity utilities.
4.	The bidder must have valid PAN No., GST Registration Number, in addition to other statutory compliances. The bidder must submit the copy of registrations.	i) Relevant Statutory documents of GST Registration certificate, PAN No. etc. ii) Copy of ESI, PF, Labor License document.
5.	The bidder must submit an undertaking that the bidder shall comply all the statutory compliance as per the applicable laws/rules etc.	Self Undertaking on letter head.

Notwithstanding anything stated above, BYPL reserves the right to assess the bidder's capability to perform the contract, assess the capability and installed capacity of the Bidder for carrying out the supplies, should the circumstances warrant such assessment in the overall interest of the purchaser. In this regard the decision of the purchaser is final.

3.00 BIDDING AND AWARD PROCESS

Bidders are requested to submit their offer strictly in line with this tender document. Normally, the deviations to tender terms are not admissible and the bids with deviations are liable for rejection. Hence, the bidders are advised to refrain from taking any deviations on this Tender. Still, in case of any deviations, all such deviations shall be set out by the Bidders, clause by clause in the "Annexure - Schedule of Deviations" and the same shall be submitted as a part of the Technical Bid.

3.01 BID SUBMISSION

BIDS ARE INVITED THROUGH THE E-PROCUREMENT PORTAL:
BSES will carry out E-Procurement through its e-procurement portal (https://srmprdportal.bsesdelhi.com:50001/irj/portal).

Interested Non-registered bidders are requested to obtain the portal user name and password (if not available) for bid submission. For participating in e-Tenders of BYPL, please write a mail to
1. Mr Rakesh Sharma, E-mail: Rakesh.Ku.Sharma@reliancegroupindia.com,
2. Mr Sisir Sahu, E-mail: Sisir.Sahu@@reliancegroupindia.com, with your details as per below:

a) Existing Vendor Code with BYPL or its Group/Associates Companies (if available): …….
b) Trade Name: …….
c) Address of Principal Place of Business: …….
d) Contact Person's Name: …….
e) Contact Person's Designation: …….
f) Contact Person's Mobile No.: …….
g) Contact Person's email ID: …….
h) Also, attach a valid copy of the Power of Attorney in favour of the above-mentioned Contact Person for being authorized to receive user ID and password on behalf of their organization.

The login ID details shall be sent through email to the email ID mentioned by you for the same.

Bids shall be submitted in 2 (Two) parts on the assigned folder of the e-procurement site. Please refer to the user manual available at https://srmprdportal.bsesdelhi.com:50001/irj/portal and enclosed with the tender.

Bids have to be mandatorily submitted only through the e-procurement portal of BSES Delhi. Bids submitted through any other form/ route shall not be admissible.

However, documents that necessarily have to be submitted in originals like Tender Fee (in the form of DD) or EMD (in the form of BG/FD/DD as applicable) and any other documents mentioned in the tender documents have to be submitted at the BYPL office before the due date & time of submission.

Please mention our NIT Number: - ……on the Tender and drop the same in our Tender Box placed at **BSES Yamuna Power Ltd, Reception, Ground Floor, Shaktikiran Building, Karkardooma, Delhi 110032**

The bids and the outer envelope shall be addressed to the following:

Head of Department
Contracts & Materials Deptt.
BSES Yamuna Power Ltd, Shaktikiran Building, Karkardooma, Delhi 110032
Kindly Note:

- The bidder has to ensure that the tender is dropped in the correct box designated for tender submission only.
- BYPL shall not be responsible for any wrong placement of tender documents by the bidder.

This is a two-part bid process. Bidders are to submit the bids online in 2(Two) parts **PART-A TECHNICAL BID & COMMERCIAL TERMS & CONDITIONS** and **Part-B FINANCIAL BID** and shall be submitted before the due date & time specified.

PART A: TECHNICAL BID comprising of the following, do not contain any cost information whatsoever and shall be submitted within the due date:

S. No.	Descriptions	Type of Documents/Format
A.1	**Bid Details**	
1	**Bid Index for Part-A (Technical Bid)**	In the prescribed format enclosed at APPENDIX I ANNEXURE – 1.01
2	**Cover Letter, if any**	Standard Format
3	**Bid Form (Unpriced) Duly Signed**	Duly Signed Bid Form as per enclosed format at APPENDIX I ANNEXURE – 1.02
4	**Tender Fee**	Non-refundable demand draft or online transfer of the requisite amount through IMPS/NEFT/RTGS for Rs 1,180/-, Duly filled and signed as per enclosed format at APPENDIX I ANNEXURE – 1.03
5	**EMD**	Online transfer of the requisite amount through IMPS/NEFT/RTGS or FD or BG in the prescribed stamp paper & format enclosed at APPENDIX I ANNEXURE – 1.05, EMD Details Duly filled and signed as per enclosed format at APPENDIX I ANNEXURE – 1.04
6	**Power-of-Attorney/ Authorization Letter**	In the standard stamp paper/letter
A.2	**Technical Bid**	
7	**Communication Details of the Bidder**	Duly filled and signed as per enclosed format at APPENDIX I ANNEXURE – 1.06
8	**Manufacturer Authorization Form (as applicable)**	Duly filled and signed as per enclosed format at APPENDIX I ANNEXURE – 1.07
9	**Technical Qualifying Criteria Compliance Index & Documents**	Documentary evidence in support of qualifying criteria mentioned in Section 1 Clause 2.00. Duly filled and signed as per enclosed format at APPENDIX I ANNEXURE – 1.08, ANNEXURE – 1.09 & ANNEXURE – 1.10
10	**Schedule of Deviations - Technical**	Duly filled and signed as per enclosed format at APPENDIX I ANNEXURE – 1.11
11	**Technical Details/ Filled in Guaranteed Technical particulars (GTP) as per specification**	Bidder shall submit duly filled GTP with all Technical documents (If Applicable)
12	**Technical Drawings as per specification**	Bidder shall submit all Drawings as per the specification (If Applicable)

13	**Type Test Reports**	Bidders shall submit a copy of type test reports in their technical bids in support of technical specifications. Duly filled and signed as per enclosed format at APPENDIX I ANNEXURE – 1.12 (If Applicable)
14	**Sample Submission Details (if applicable as per specification)**	Duly filled and signed as per enclosed format at APPENDIX I ANNEXURE – 1.13 (If Applicable)
15	**Product Catalogue (If applicable)**	Bidders shall submit a copy of the product catalogue in their technical bids in support of technical specifications
16	**Manufacturer's Quality Assurance Plan**	Bidders shall submit a copy of MQP in their technical bids in support of technical specifications
17	**Other drawings/ documents mentioned in technical specification**	Bidders shall submit a copy of documents in their technical bids in support of technical specifications(If Applicable)
18	**Testing Facilities**	Bidder shall submit the details of testing facilities available at their works/factory.
A.3	**Commercial Bid**	
19	**Company Profile, Organization Chart & Manpower Details.**	Bidder shall submit the details of Organization & Manpower with qualification and experience.
20	**Commercial Qualifying Criteria Compliance Index & Documents**	Documentary evidence in support of qualifying criteria mentioned in Section 1 Clause 2.00. Duly filled and signed as per enclosed format at APPENDIX I ANNEXURE – 1.14
21	**Undertakings**	Duly signed self-undertakings as per enclosed format at APPENDIX I ANNEXURE – 1.15
22	**Schedule of Deviations - Commercial**	Duly filled and signed as per enclosed format at APPENDIX I ANNEXURE – 1.16
23	**Acceptance Form For Participation in Reverse Auction Event**	Duly signed Acceptance Form For Participation In Reverse Auction Event as per enclosed format at APPENDIX I ANNEXURE – 1.17
24	**Commercial Terms and Conditions**	Acceptance of Commercial Terms and Conditions viz. Delivery Schedule/Period, Payment terms, PBG etc. Duly filled and signed as per enclosed format at APPENDIX II ANNEXURE – 2.05
25	**Unprice Bid Duly Signed**	Item wise marked as "Quoted" & Duly Signed Un price Bid as per enclosed format at VOLUME – II - PRICE BID FORMAT
26	**Signed Tender document**	Original Tender documents duly stamped & signed on each page as a token of acceptance

PART B: FINANCIAL BID comprising of

- Price strictly in the Format enclosed at VOLUME – II - PRICE BID FORMAT indicating Break up of basic price, taxes & duties, etc.
- The Bidder has to submit the item-wise price bifurcation in the bid. An unpriced copy must be attached with the Part A (Technical Bid).

This will be opened internally after techno-commercial evaluation and only of the qualified bidders.

REVERSE AUCTION CLAUSE: Purchaser reserves the right to use the reverse auction as an optional tool through SAP-SRM as an integral part of the entire tendering process. All techno-

commercially qualified bidders shall participate in the reverse auction. Reverse Auction will be carried out on individual item-wise rates or Package-wise.

Notwithstanding anything stated above, the Purchaser reserves the right to assess the bidder's capability to perform the contract, should the circumstances warrant such assessment in the overall interest of the purchaser. In this regard the decision of the purchaser is final. Bidder is to submit their acceptance as per the format APPENDIX I ANNEXURE – 1.17.

BIDS RECEIVED AFTER THE DUE DATE AND TIME MAY BE LIABLE FOR REJECTION

4.00 AWARD DECISION

4.01 Purchaser intends to award the business on the lowest bid basis, so suppliers are encouraged to submit the bid competitively. The decision to place a Rate Contract/Purchase Order/LOI solely depends on the purchaser on the cost competitiveness across multiple lots, quality, delivery and bidder's capacity, in addition to other factors that Purchaser may deem relevant.

4.02 In the event of your bid being selected by the purchaser (and/or its affiliates) and you subsequent DEFAULT on your bid; you will be required to pay the purchaser (and/or its affiliates) an amount equal to the difference in your bid and the next lowest bid on the quantity declared in NIT/RFQ.

4.03 In case any supplier is found unsatisfactory during the delivery process, the award may be cancelled and BYPL reserves the right to award other suppliers who are found fit.

4.04 Rate Contract: Not Applicable.

4.05 Quantity Variation: The purchaser reserves the right to vary the quantity by (+/–) 30% of the tender quantity during the execution of the rate contract.

4.06 Quantity Splitting: Not Applicable.

5.00 MARKET INTEGRITY

We have a fair and competitive marketplace. The rules for bidders are outlined in the Terms & Conditions. Bidders must agree to these rules before participating. In addition to other remedies available, we reserve the right to exclude a bidder from participating in future markets due to the bidder's violation of any of the rules or obligations contained in the Terms & Conditions. Bidders who violate the marketplace rules or engage in behaviour that disrupts the fair execution of the marketplace restrict a bidder to the length of time, depending upon the seriousness of the violation. Examples of violations include, but are not limited to:

- Failure to honour prices submitted to the marketplace.
- Breach of the terms of the published in Request for Quotation/NIT.

6.00 SUPPLIER CONFIDENTIALITY

All information contained in this RFQ is confidential and shall not be disclosed, published or advertised in any manner without written authorization from BYPL. This includes all bidding information submitted.

All RFQ documents remain the property of BYPL and all suppliers are required to return these documents to BYPL upon request.

Suppliers who do not honour these confidentiality provisions will be excluded from participating in future bidding events.

7.00 CONTACT INFORMATION

Technical clarification, if any, as regards this RFQ shall be sought in writing and sent by e-mail / post/courier to the following addresses. The same shall not be communicated through phone

Address	Name/ Designation	E-mail Address
Technical		
Admin Dept. 3rd Floor, B-Block, BSES Yamuna Power Ltd Shaktikiran Building, Karkardooma, Delhi 110032	Sanjay Grover AsVP – Admin Dept	Sanjay.K.grover@reliancegroupindia.com
	Ajay Gupta Head – Admin Dept	Ajay.S.Gupta@reliancegroupindia.com
Commercial		
C&M Dept. 3rd Floor, A-Block, BSES Yamuna Power Ltd Shaktikiran Building, Karkardooma, Delhi 110032	Sisir Kumar Sahu Buyer - Procurement	Sisir.Sahu@reliancegroupindia.com
	Santosh Kumar Singh Additional VP (Head-Procurement)	Santosh.kum.Singh@reliancegroupindia.com
	Robin Sebastian Vice President (Head-Contracts & Materials)	Robin.Sebastian@reliancegroupindia.com

SECTION – II: INSTRUCTION TO BIDDERS

A. GENERAL

1.00 BSES Yamuna Power Ltd, hereinafter referred to as "The Purchaser" is desirous of implementing the various Systems Improvement/Repair & Maintenance works at their respective licensed area in Delhi The Purchaser has now floated this tender for procurement of material notified earlier in this bid document.

2.00 SCOPE OF WORK

The scope shall include Supply, Installation, Commissioning and Testing of VRF/VRV HVAC System conforming to the Technical Specifications along with Packing, Forwarding, Transportation Unloading and proper stacking at Purchaser's stores/site.

3.0 DISCLAIMER

3.01 This Document includes statements, which reflect various assumptions, which may or may not be correct. Each Bidder/Bidding Consortium should conduct its estimation and analysis and should check the accuracy, reliability and completeness of the information in this Document and obtain independent advice from appropriate sources in their interest.

3.02 Neither Purchaser nor its employees will have any liability whatsoever to any Bidder or any other person under the law or contract, the principles of restitution or unjust enrichment or otherwise for any loss, expense or damage whatsoever which may arise from or be incurred or suffered in connection with anything contained in this document, any matter deemed to form part of this Document, provision of Services and any other information supplied by or on behalf of Purchaser or its employees, or otherwise a rising in any way from the selection process for the Supply.

3.03 Though adequate care has been taken while issuing the Bid document, the Bidder should satisfy itself that the Documents are complete in all respects. Intimation of any discrepancy shall be given to this office immediately.

3.04 This Document and the information contained herein are Strictly Confidential and are for the use of only the person(s) to whom it is issued. It may not be copied or distributed by the recipient to third parties (other than in confidence to the recipient's professional advisors).

4 COST OF BIDDING

The Bidder shall bear all costs associated with the preparation and submission of its Bid and the Purchaser will in no case be responsible or liable for those costs.

B. BIDDING DOCUMENTS

5.01 The Scope of Work, Bidding Procedures and Contract Terms are described in the Bidding Documents.

5.02 The Bidder is expected to examine the Bidding Documents, including all Instructions, Forms, Terms and Specifications. Failure to furnish all information required by the Bidding Documents or submission of a Bid not substantially responsive to the Bidding Documents in every respect may result in the rejection of the Bid.

6.0 **AMENDMENT OF BIDDING DOCUMENTS**

6.01 At any time before the deadline for submission of Bids, the Purchaser may for any reason, whether at its initiative or in response to a clarification requested by a prospective Bidder, modify the Bidding Documents by Amendment.

6.02 The Amendment shall be part of the Bidding Documents, pursuant to Clause 5.01, and it will be notified on the website **www.bsesdelhi.com** and the same will be binding on them.

6.03 To afford prospective Bidders reasonable time in which to take the Amendment into account in preparing their Bids, the Purchaser may, at its discretion, extend the deadline for the submission of Bids. The same shall be published as a corrigendum on the website **www.bsesdelhi.com**

6.04 Purchaser shall reserve the rights to the following:
a) Extend the due date of submission,
b) Modify the tender document in part/whole,
c) Cancel the entire tender

6.05 **Bidders are requested to visit the website regularly for any modification/clarification/corrigendum/addendum of the bid documents.**

C. PREPARATION OF BIDS

7.0 LANGUAGE OF BID

The Bid prepared by the Bidder, and all correspondence and documents relating to the Bid exchanged by the Bidder and the Purchaser, shall be written in the English Language. Any printed literature furnished by the Bidder may be written in another language, provided that this literature is accompanied by an English translation, in which case, for purposes of interpretation of the Bid, the English translation shall govern.

8.0 DOCUMENTS COMPRISING THE BID

The Bid prepared and submitted by the Bidder shall comprise the following components:

(a) All the Bids must be accompanied by the required Tender Fees and EMD as mentioned in the tender.

(b) PART A – Technical Bid and

(c) PART B - Financial Bid

9.0 BID FORM

9.01 The Bidder shall submit Bid Form with the Bidding Documents.

9.02 **EMD**

Pursuant to Clause 8.0 (a) above, the bidder shall furnish, as part of its bid, an EMD amounting to as specified in Section I. The EMD is required to protect the Purchaser against the risk of Bidder's conduct which will warrant forfeiture.
The EMD shall be denominated in any of the following forms**:**

(a) Bank Guarantee drawn in favour of BSES Yamuna Power Ltd, payable at Delhi or
(b) Fixed Deposit (lien marked in favour of BSES Yamuna Power Limited) payable at Delhi.
(c) Online transfer of requisite amount through IMPS/NEFT/RTGS to BYPL account mentioned herein in Appendix II - **BYPL BANK DETAILS WITH IFSC CODE**.

EMD shall be valid for One Hundred Twenty (120) days after the due date of submission drawn in favour of BSES Yamuna Power Ltd.

The EMD may be forfeited in the case of:

(a) the Bidder withdraws its bid during the period of specified bid validity

or

(b) the case of a successful Bidder, if the Bidder does not

(i) Accept the Purchase Order, or

(ii) Furnish the required performance security BG.

10.0 **BID PRICES**

10.01 Bidders shall quote for the entire Scope of Supply/Work with a break-up of prices for individual items. The total Bid Price shall also cover all the Supplier's obligations mentioned in or reasonably to be inferred from the Bidding Documents in respect of Design, Supply, and Transportation to the site, all in accordance with the requirement of the Bidding Documents. The Bidder shall complete the appropriate Price Schedules included herein, stating the Unit Price for each item & total Price.

10.02 The prices offered shall be inclusive of all costs as well as Duties, Taxes or Levies paid or payable during the execution of the supply work, a breakup of price constituents, should be there.

10.03 Prices quoted by the Bidder shall be **"Firm"** and not subject to any price adjustment during the performance of the Contract. **A Bid submitted with an adjustable price/ Price Variation Clause will be treated as non-responsive and rejected.**

11.0 **BID CURRENCIES**

11.01 Prices shall be quoted in Indian Rupees Only.

12.0 **PERIOD OF VALIDITY OF BIDS**

12.01 Bids shall remain valid for 120 days from the due date of submission of the Bid.

12.02 Notwithstanding Clause 12.01 above, the Purchaser may solicit the Bidder's consent to an extension of the Period of Bid Validity. The request and the responses thereto shall be made in writing and sent by post/courier/E-mail.

13.0 **ALTERNATIVE BIDS**

13.01 Bidders shall submit Bids, which comply with the Bidding Documents. Alternative Bids will not be considered. The attention of Bidders is drawn to the provisions regarding the rejection of Bids in the terms and conditions, which are not substantially responsive to the requirements of the Bidding Documents.

14.0 **FORMAT AND SIGNING OF BID**

14.01 The original Bid Form and accompanying documents, must be received by the Purchaser at the date, time and place specified pursuant to Clauses 15.0 and 16.0.

14.02 The original Bid shall be typed or written in indelible ink and shall be signed by the Bidder or a person or persons duly authorized to sign on behalf of the Bidder. Such authorization shall be indicated by written Power-of-Attorney accompanying the Bid. The Bid submitted on behalf of companies registered with the Indian Companies Act, for the time being in force, shall be signed by persons duly authorized to submit the Bid on behalf of the Company and shall be accompanied by certified true copies of the resolutions, extracts of Articles of Association, special or general Power of Attorney etc. to show clearly the title, authority and designation of persons signing the Bid on behalf of the Company. Satisfactory evidence of the authority of the person signing on behalf of the Bidder shall be furnished with the bid. A bid by a person who affixes to his signature the words 'President', 'Managing Director', 'Secretary', 'Agent' or other designations without disclosing his principal will be rejected.

The Bidder's name stated on the Proposal shall be the exact legal name of the firm.

14.03 The Bid shall contain no interlineations, erasures or overwriting except as necessary to correct errors made by the Bidder, in which case such corrections shall be initiated by the person or persons signing the Bid.

D. SUBMISSION OF BIDS

15.0 SEALING AND MARKING OF BIDS

15.01 Bid submission: Bids have to be mandatorily submitted only through the e-procurement portal of BSES Delhi. Bids submitted through any other form/ route shall not be admissible.

15.02 However, documents that necessarily have to be submitted in originals like EMD or Tender Fee (in the form of BG/ DD /FD as applicable) and any other documents mentioned in the tender documents have to be submitted at the BYPL office before the due date & time of submission. The Technical Documents and the EMD shall be enclosed in a sealed envelope and the said envelope shall be superscribed with — "Technical Bid & EMD". All the envelopes should bear the Name and Address of the Bidder and mark for the Original. The envelopes should be superscribed with — "Tender No. & Due date of opening".

15.03 The Bidder has the option of sending the Bids in person. Bids submitted by Email/Telex/Telegram /Fax will be rejected. No request from any Bidder to the Purchaser to collect the proposals from Courier/Airlines/Cargo Agents etc. shall be entertained by the Purchaser.

16.0 DEADLINE FOR SUBMISSION OF BIDS

16.01 The Bid must be received by the Purchaser on or before the due date & time of submission.

16.02 The Purchaser may, at its discretion, extend the deadline for the submission of Bids by amending the Bidding Documents in accordance with Clause 6.0, in which case all rights and obligations of the Purchaser and Bidders previously subject to the deadline will thereafter be subject to the deadline as extended.

17.0 ONE BID PER BIDDER

17.01 Each Bidder shall submit only one Bid by itself. No Joint venture is acceptable. A Bidder who submits or participates in more than one Bid will cause all those Bids to be rejected.

18.0 LATE BIDS

18.01 No Bid will be received by the Purchaser after the deadline for submission of Bids prescribed by the Purchaser, pursuant to Clause 16.0.

19.0 **MODIFICATIONS AND WITHDRAWAL OF BIDS**

19.01 The Bidder is not allowed to modify or withdraw its Bid after the Bid's due date & time of submission subject to any corrigendum/addendum/modifications in the tender documents uploaded to the website.

E. EVALUATION OF BID

20.0 **PROCESS TO BE CONFIDENTIAL**

Information relating to the examination, clarification, evaluation and comparison of Bids and recommendations for the award of a contract shall not be disclosed to Bidders or any other persons not officially concerned with such process. Any effort by a Bidder to influence the Purchaser's processing of Bids or award decisions may result in the rejection of the Bidder's Bid.

21.0 **CLARIFICATION OF BIDS**

To assist in the examination, evaluation and comparison of Bids, the Purchaser may, at its discretion, ask the Bidder for a clarification of its Bid. All responses to requests for clarification shall be in writing and no change in the price or substance of the Bid shall be sought, offered or permitted.

22.0 **PRELIMINARY EXAMINATION OF BIDS / RESPONSIVENESS**

22.01 Purchaser will examine the Bids to determine whether they are complete, whether any computational errors have been made, whether required sureties have been furnished, whether the documents have been properly signed and whether the Bids are generally in order. Purchaser may ask for submission of original documents to verify the documents submitted in support of qualification criteria.

22.02 Arithmetical errors will be rectified on the following basis. If there is a discrepancy between the unit price and the total price per item that is obtained by multiplying the unit price and quantity, the unit price shall prevail and the total price per item will be corrected. If there is a discrepancy between the Total Amount and the sum of the total price per item, the sum of the total price per item shall prevail and the Total Amount will be corrected.

22.03 Prior to the detailed evaluation, Purchaser will determine the substantial responsiveness of each Bid to the Bidding Documents including production capability and acceptable quality of the Goods offered. A substantially responsive Bid is one, which conforms to all the terms and conditions of the Bidding Documents without material deviation.

22.04 Bid determined as not substantially responsive will be rejected by the Purchaser and/or the Purchaser and may not subsequently be made responsive by the Bidder by correction of the non-conformity.

23.0 **EVALUATION AND COMPARISON OF BIDS**

23.01 The evaluation of Bids shall be done based on the delivered cost competitiveness basis.

23.02 The evaluation of the Bids shall be a stage-wise procedure. The following stages are identified for

evaluation purposes: In the first stage, the Bids will be subjected to a responsiveness check. The Technical & qualifying Proposals and the Conditional ties of the Bidders will be evaluated.

Subsequently, the Financial Proposals along with Supplementary Financial Proposals, if any, of Bidders with Techno-commercially Acceptable Bids shall be considered for final evaluation.

23.03 The Purchaser's evaluation of a Bid will take into account, in addition to the Bid price, the following factors, in the manner and to the extent indicated in this Clause:

(a) Delivery Schedule

(b) Conformance to Qualifying Criteria

(c) Deviations from Bidding Documents

Bidders shall base their Bid price on the terms and conditions specified in the Bidding Documents.

The cost of all quantifiable deviations and omissions from the specification, terms and conditions specified in the Bidding Documents shall be evaluated. **The Purchaser will make its own assessment of the cost of any deviation to ensure a fair comparison of Bids.**

23.04 Any price adjustments that result from the above procedures shall be added for comparative evaluation only to arrive at an "Evaluated Bid Price". Bid Prices quoted by Bidders shall remain unaltered.

F. AWARD OF CONTRACT

24.0 CONTACTING THE PURCHASER

24.01 If any Bidder wishes to contact the Purchaser on any matter related to the Bid, from the time of Bid opening to the time of contract award, the same shall be done in writing only.

24.02 Any effort by a Bidder to influence the Purchaser and/or in the Purchaser's decisions in respect of Bid evaluation, Bid comparison or Contract Award, will result in the rejection of the Bidder's Bid.

25.0 THE PURCHASER'S RIGHT TO ACCEPT ANY BID AND TO REJECT ANY OR ALL BIDS

Submission of bids shall not automatically construe qualification for evaluation. The Purchaser reserves the right to accept or reject any Bid and to annul the Bidding process and reject all Bids at any time prior to the award of the Contract, without thereby incurring any liability to the affected Bidder or Bidders or any obligation to inform the affected Bidder or Bidders of the grounds for the Purchaser's action.

26.0 AWARD OF CONTRACT

The Purchaser will award the Contract to the successful Bidder whose Bid has been Determined to be the lowest-evaluated responsive Bid, provided further that the Bidder has been determined to be qualified to satisfactorily perform the Contract. Purchaser reserves the right to award the order to other bidders in the tender, provided it is required for the timely execution of the project & provided he agrees to come to the lowest rate. Purchaser reserves the right to distribute the entire tender quantity at its own discretion without citing any reasons thereof.

27.0 THE PURCHASER'S RIGHT TO VARY QUANTITIES

The Purchaser reserves the right to vary the quantity i.e. increase or decrease the numbers/quantities without any change in terms and conditions during the execution of the Order.

28.0 **LETTER OF INTENT/ NOTIFICATION OF AWARD**

The letter of intent/ Notification of Award shall be issued to the successful Bidder whose bids have been considered responsive, techno-commercially acceptable and evaluated to be the lowest (L1). The successful Bidder shall be required to furnish a letter of acceptance within 7 days of the issue of the letter of intent /Notification of Award by Purchaser.

29.0 **PERFORMANCE BANK GUARANTEE (PBG)**

The successful bidder shall furnish the Performance Bank Guarantee within fifteen (15) days from the Purchase Order Date for an amount of 10% (Ten percent) of the Total Contract value (both for Supply and Service). The Performance Bond shall be valid for a period of Sixty months (60) from the date of the commissioning or Sixty Six months (66) from the date of receipt of material (last consignment) at site/stores whichever is earlier plus 3 months towards claim period. Upon receipt of the PBG by BYPL, the EMD shall be released post award of subject tender.

30.0 **CORRUPT OR FRAUDULENT PRACTICES**

30.01 The Purchaser requires that the Bidders observe the highest standard of ethics during the procurement and execution of the Project. In pursuance of this policy, the Purchaser:

(a) Defines, for this provision, the terms set forth below as follows:

(i) "Corrupt practice" means behaviour on the part of officials in the public or private sectors by which they improperly and unlawfully enrich themselves and/or those close to them, or induce others to do so, by misusing the position in which they are placed, and it includes the offering, giving, receiving, or soliciting of anything of value to influence the action of any such official in the procurement process or contract execution; and

(ii) "Fraudulent practice" means a misrepresentation of facts to influence a procurement process or the execution of a contract to the detriment of the Purchaser, and includes collusive practice among Bidders (before or after Bid submission) designed to establish Bid prices at artificial non - competitive levels and to deprive the Purchaser of the benefits of free and open competition.

(b) Will reject a proposal for award if it determines that the Bidder recommended for award has engaged in corrupt or fraudulent practices in competing for the contract in question;

(c) Will declare a firm ineligible, either indefinitely or for a stated period, to be awarded a contract if it at any time determines that the firm has engaged in corrupt or fraudulent practices in competing for, or in executing a contract.

30.02 Furthermore, Bidders shall be aware of the provision stated in the Terms and Conditions of the Contract.

31.0 **STATUTORY GUIDELINES & REGULATIONS**

The bidder shall make himself fully aware & familiarize himself with all applicable laws/guidelines/regulations.

32.0 **SAFETY**

Safety related requirements as mentioned in our safety Manual put on the Company's website which can be accessed at http://www.bsesdelhi.com. All bidders shall strictly abide by the guidelines provided in the safety manual at all relevant stages during the contract period.

33.0 PRIORITY OF CONTRACT DOCUMENTS

The several documents forming the Agreement are to be taken as mutually explanatory of one another, but in case of ambiguities or discrepancies, the same shall be explained and adjusted by the company, who shall, accordingly, issue suitable instructions thereon to the Contractor. In such event, unless otherwise provided in the agreement or explained by way of instructions by the company, as mentioned above, the priority of the documents forming the Agreement shall be as follows:

i) Contract Agreement/Purchase Order.
(a) Special Conditions of Contract
(b) General Conditions of Contract
(ii) The Letter of Acceptance/ Intent
(iii) Agreed Minutes of the Tender Negotiation Meetings
(iv) Agreed Minutes of the Tender Technical Meetings
(v) The Priced Bill of Quantities
(vi) The Technical Specifications / Scope of work
(vii) The Tender document, including all Appendices and/or Addenda, Corrigendum the latest taking precedence.

In the event of any conflict between the above-mentioned documents, the more stringent requirement or conditions which shall be favourable to the company shall govern and the decision of the company/BYPL shall be final and binding upon the parties.

APPENDIX I ANNEXURE – 1.01

BID INDEX FOR PART-A (TECHNICAL BID)

(To be filled & submitted on Bidder Letter Head, Bidders document submission should have following main categories as outlined below and should have page numbers printed at the bottom of each page with this page as page number 1. The page number should be in "Page X of Y" format. Separator with document description shall be provided before each document)

NIT & RFX No.:

Bidder's Name:

Bidder's Bid Reference No. & Date:

S. No.	Particulars	Bid Pdf Page No.	
		From	To
A.1	**Bid Details**		
1.	Bid Index for Part-A (Technical Bid) as per APPENDIX I ANNEXURE - 1.01	1	
2.	Cover Letter, If any		
3.	Bid Form (Unpriced) Duly Signed as per APPENDIX I ANNEXURE - 1.02		
4.	Tender Fee Details as per APPENDIX I ANNEXURE - 1.03		
5.	EMD Details as per APPENDIX I ANNEXURE - 1.04 & 1.05		
6.	Power-of-Attorney / Authorization Letter		
A.2	**Technical Bid**		
7.	Communication Details of the Bidder as per APPENDIX I ANNEXURE - 1.06		
8.	Manufacturer Authorization Form (as applicable) as per APPENDIX I ANNEXURE - 1.07		
9.	Technical Qualifying Criteria Compliance Index & Documents as per APPENDIX I ANNEXURE - 1.08, 1.09, 1.10		
10.	Schedule of Technical Deviations (along with soft editable Excel copy) as per APPENDIX I ANNEXURE - 1.11		
11.	Guaranteed Technical particulars (GTP) as per specification (If Applicable)		
12.	All Drawings as per specification (If Applicable)		
13.	Type Test Reports (Sequence of Tests shall be strictly in accordance with relevant IS/IEC) as per APPENDIX I ANNEXURE - 1.12		
14.	Sample Submission Details (If applicable as per Specification) as per APPENDIX I ANNEXURE - 1.13		
15.	Product Catalogue (If applicable)		
16.	Manufacturer's quality assurance plan (as applicable)		
17.	Other drawings/ documents mentioned in technical specification		
18.	Testing Facilities		
A.3	**Commercial Bid**		
19.	Company Profile/Organogram/Organization Chart & Manpower Details		
20.	Commercial Qualifying Criteria Compliance Index & Documents as per APPENDIX I ANNEXURE - 1.14		
21.	Undertakings as per APPENDIX I ANNEXURE - 1.15		
22.	Schedule of Commercial Deviations (along with soft editable Excel copy) as per APPENDIX I ANNEXURE - 1.16		
21.	Acceptance form for participation in reverse auction event as per APPENDIX I ANNEXURE - 1.17		
24.	Acceptance of Commercial Terms and Conditions as per APPENDIX II ANNEXURE - 2.05		
25.	Un Price Bid Duly Signed (Volume - II Price Bid Format)		
26.	NIT Document complete Signed & Stamped		

ANNEXURE – 1.02

BID FORM

To

Head of Department
Contracts & Material Deptt.
BSES Yamuna Power Ltd
Shaktikiran Building, Karkardooma,
Delhi 110032

Sir,

1. We understand that BYPL is desirous of procuring…… for it's licensed distribution network area in Delhi.
2. Having examined the Bidding Documents for the above-named works, we the undersigned, offer to deliver the goods in full conformity with the Terms and Conditions and technical specifications for the sum indicated in the Price Bid or such other sums as may be determined in accordance with the terms and conditions of the contract. The amounts are in accordance with the Price Schedules attached herewith and are made part of this bid.
3. If our Bid is accepted, we undertake to deliver the entire goods as per the delivery schedule mentioned in Section IV from the date of award of the purchase order/letter of intent.
4. If our Bid is accepted, we will furnish a performance bank guarantee for due performance of the Contract in accordance with the Terms and Conditions.
5. We agree to abide by this Bid for 120 days from the due date of bid submission and it shall remain binding upon us and may be accepted at any time before the expiration of that period.
6. We declare that we have studied the provision of Indian Laws for the supply/services of equipments/materials and the prices have been quoted accordingly.
7. Unless and until Letter of Intent is issued, this Bid, together with your written acceptance thereof, shall constitute a binding contract between us.
8. We understand that you are not bound to accept the lowest or any bid you may receive.
9. There is provision for Resolution of Disputes under this Contract, by the Laws and Jurisdiction of Contract.

Dated this..... day of..... 20XX

Signature..... In the capacity of ……

.....duly authorized to sign for and on behalf of

(IN BLOCK CAPITALS).....

ANNEXURE – 1.03

TENDER FEE DETAILS

a. Amount (Rs.) : **1,180/- (One Thousand One Hundred Eighty Only)**

b. Mode of Payment : DD or online transfer through IMPS/NEFT/RTGS (select any one)

c. DD /UTR No. (As applicable) : .....

d. Dated : .....

e. Bidders Bank Account No. : .....

f. Name of the Bank : .....

g. Address of the Bank : .....

h. IFSC Code of the Bank : .....

ANNEXURE – 1.04

EMD DETAILS

a. EMD Amount (Rs.) : ……

b. Mode of Payment : BG/FD/online transfer through IMPS/NEFT/RTGS (select any one)

c. BG/FD/UTR No. (As applicable): ……

d. Dated : ……

e. BG valid up to : ……

f. BG Claim period up to : ……

g. Bidders Bank Account No. : ……

h. Name of the Bank : ……

i. Address of the Bank : ……

j. IFSC Code of the Bank : ……

ANNEXURE – 1.05

(FORMAT FOR EMD BANK GUARANTEE)

(To be issued in a Non-Judicial Stamp Paper of Rs.50/-purchased in the name of the bank)

Whereas [*name of the Bidder*] (hereinafter called the "Bidder") has submitted its bid dated [*date of submission of bid*] for the supply of [*name and/or description of the goods*] (hereafter called the "Bid").

KNOW ALL PEOPLE by these presents that WE [name of bank] at [*Branch Name and address*], having our registered office at [*address of the registered office of the bank*] (hereinafter called the "Bank"), are bound unto BSES Yamuna Power Ltd., with its Corporate Office at Shaktikiran Building, Karkardooma, Delhi -110032, (hereinafter called - the "Purchaser") in the sum of Rs…… (Rupees…….. only) for which payment well and truly to be made to the said Purchaser, the Bank binds itself, its successors, and assigns by these presents.

Sealed with the Common Seal of the said Bank this_____ day of_____ 20____.

The conditions of this obligation are:

1 If the Bidder withdraws its Bid during the period of bid validity specified by the Bidder on the Bid Form; or

2. If the Bidder, having been notified of the acceptance of its Bid by the Purchaser during the period of bid validity:
(a) fails or refuses to execute the Contract Form, if required; or
(b) fails or refuses to furnish performance security, In accordance with the Instructions to Bidders/Terms and Conditions;

We undertake to pay to the Purchaser up to the above amount upon receipt of its first written demand, without the Purchaser having to substantiate its demand, provided that is its demand the purchaser will note that amount claimed by it is due to it, owing to the occurrence of one or both of the two condition(s), specifying the occurred condition or condition(s).

This guarantee will remain in force up to and including One Hundred Twenty (120) days after the due date of submission bid, and any demand in respect thereof should reach the Bank not later than the above date.

(Stamp & signature of the bank)

Signature of the witness

ANNEXURE – 1.06

COMMUNICATION DETAILS OF THE BIDDER

Sl. No.	Designation	Name	Mobile No.	E-mail id
1	CEO / MD			
2	Sales / Marketing Head			
3	Sales Representative / Key Account Manager (KAM)			
4	Technical Head			
5	Manufacturer Plant / Operations Head			
6	Post Order Execution In Charge			
7	Authorized contact person (Primary responsibility for the Bid)			
8	Authorized contact person (Secondary responsibility for the Bid)			

ANNEXURE – 1.07

MANUFACTURER AUTHORIZATION FORM
(To be submitted on OEM's Letter Head)

Date : ……..

Tender No.: ……..

To

Head of Department
Contracts & Material Deptt.
BSES Yamuna Power Ltd
Shaktikiran Building, Karkardooma,
Delhi 110032

Sir,

WHEREAS M/s. *[name of OEM]*, who are official manufacturers of …… having factories at *[address of OEM]* do hereby authorize M/s *[name of bidder]* to submit a Bid in relation to the Invitation for Bids indicated above, the purpose of which is to provide the following Goods, manufactured by us ……and to subsequently negotiate and sign the Contract.

We hereby extend our full guarantee and warranty by the Conditions of the Contract or as mentioned elsewhere in the Tender Document, concerning the Goods offered by the above firm in reply to this Invitation for Bids.

We hereby confirm that in case, the channel partner fails to provide the necessary services as per the Tender Document referred above, M/s *[name of OEM]* shall provide standard warranty on the materials supplied against the contract. The warranty period and inclusion/exclusion of parts in the warranty shall remain the same as defined in the contract issued to our channel partner against this tender.

Yours Sincerely,
For, ……..

Authorized Signatory

ANNEXURE – 1.08

QUALIFYING CRITERIA COMPLIANCE INDEX - TECHNICAL CRITERIA				
Sl. No.	**Qualifying Criteria Description as per section 1 clause 2.00**	**Documentary Proof Description**	**Documentary Proof Enclosed on Bid Page No.**	
			From	**To**
1				
2				
3				
4				
5				

ANNEXURE – 1.09

LIST OF PURCHASE ORDERS EXECUTED & DELIVERY DETAILS IN SUPPORT OF QUALIFYING REQUIREMENTS											
Sl. No.	Item Details		PO & Execution Details					Customer Name	End User (shall be Utility/ SEB's/ PSU's) name and details	PO copy, MDCC /Delivery completion certificates/ Invoice Copies enclosed on Bid Page no.	
	Item	Model	PO No.	PO Date	PO Qty	Executed Qty	Execution Year			From	To
Total					∑	∑					

Note – Only items relevant as per qualifying requirements should be included in the list.

ANNEXURE – 1.10

LIST OF PERFORMANCE CERTIFICATES IN SUPPORT OF QUALIFYING REQUIREMENT												
S No	Item Details		PO No	Supplied/ Commissioning		Performance Certificate Issue Date	Performance Certificate Issued By End User (Utility/SEB/Govt Org.)	Contact Details of Issuing Person			Enclosed on Bid Page No.	
	Item	Model		Qty.	Date			Name	Email	Mobile	From	To
Total				∑								

Note –

1. **Only items relevant as per qualifying requirement should be included in the list.**

ANNEXURE – 1.11

SCHEDULE OF DEVIATIONS - TECHNICAL

Vendor shall refrain from taking any deviations on this TENDER. Still, in case of any deviations, all such deviations from this tender shall be set out by the Bidder, Clause by Clause in this schedule and submit the same as a part of the Technical Bid.

Unless **specifically** mentioned in this schedule, the tender shall be deemed to confirm the BYPL's specifications:

Technical Deviations:-

Sl. No.	NIT Pdf Page No.	NIT Clause No.	NIT Clause Descriptions	Details of Clarification/deviation with justifications

Note – Please enclose detailed GTP and drawings as per specification after the technical deviation sheet

Seal of the Bidder:

Signature:

Name:

ANNEXURE – 1.12

TYPE TEST REPORTS (IF APPLICABLE SEQUENCE OF TESTS SHALL BE STRICTLY IN ACCORDANCE WITH RELEVANT IS/IEC)								
Sl. No.	Test Description	Reference Standard	Reference Standard Clause No.	Name of Testing Lab	Test Report Reference Number	Date of Issue of Report	Report Enclosed on Bid Page No	
							From	To
1								
2								
3								
4								
5								
6								
7								

ANNEXURE – 1.13

SAMPLE SUBMISSION DETAILS (IF APPLICABLE AS PER SPECIFICATION)		
Sl. No.	**Description**	**Bidder's Response**
1	Samples submitted with the bid	
1	Sample Type -1	
1.1	Model Number	
1.2	Number of samples	
2	Sample Type -2	
2.1	Model Number	
2.2	Number of samples	

ANNEXURE – 1.14

QUALIFYING CRITERIA COMPLIANCE INDEX - COMMERCIAL CRITERIA				
Sl. No.	**Qualifying Criteria Description as per section 1 clause 2.00**	**Documentary Proof Description**	**Documentary Proof Enclosed on Bid Page No.**	
			From	**To**
1				
2				
3				
4				
5				

ANNEXURE – 1.15

UNDERTAKINGS
(To be submitted on Bidders Letter Head)

Date : …….

Tender No.: …….

To

Head of Department
Contracts & Material Deptt.
BSES Yamuna Power Ltd
Shaktikiran Building, Karkardooma,
Delhi 110032

Sir,

We M/s *[name of bidder]*, …… do hereby undertake that

- *[name of bidder]* has "No Litigation" pending with the BYPL or its Group/Associates Companies as on the date of bid opening.
- *[name of bidder] has* not been blacklisted/debarred by any central/state government institution/Electricity utilities as on the date of bid opening.
- *[name of bidder]* shall comply with all the statuary compliances as per the laws/rules etc. before the start of the supply/work.

Yours Sincerely,

For ……..

Authorized Signatory

ANNEXURE – 1.16

SCHEDULE OF DEVIATIONS - COMMERCIAL

Vendor shall refrain from taking any deviations on this TENDER. Still, in case of any deviations, all such deviations from this tender shall be set out by the Bidder, Clause by Clause in this schedule and submit the same as a part of the Technical Bid.

Unless **specifically** mentioned in this schedule, the tender shall be deemed to confirm the BYPL's specifications:

Commercial Deviations:-

Sl. No.	NIT Pdf Page No.	NIT Clause No.	NIT Clause Descriptions	Details of Clarification/deviation with justifications

By signing this document we hereby withdraw all the deviations whatsoever taken anywhere in this bid document and comply with all the terms and conditions, technical specifications, scope of work etc. as mentioned in the standard document except those mentioned above.

Seal of the Bidder:

Signature:

Name:

ANNEXURE – 1.17

ACCEPTANCE FORM FOR PARTICIPATION IN REVERSE AUCTION EVENT

(To be signed and stamped by the bidder)

BSES Yamuna Power Ltd (hereinafter referred to as **"BYPL"**) intends to use the reverse auction through the SAP-SRM tool as an integral part of the entire tendering process. All the bidders who are found as techno commercial qualified based on the tender requirements shall be eligible to participate in the reverse auction event.

The following terms and conditions are deemed as accepted by the bidder on participation in the bid event:

1. BYPL shall provide the user ID and password to the authorized representative of the bidder. (Authorization letter in lieu of the same be submitted along with the signed and stamped acceptance form)
2. BYPL will make every effort to make the bid process transparent. However, the award decision by BYPL would be final and binding on the bidder.
3. The bidder agrees to non-disclosure of trade information regarding the purchase, identity of BYPL, bid process, bid technology, bid documentation, bid details, etc.
4. The bidder is advised to understand the auto bid process to safeguard themselves against any possibility of non-participation in the auction event.
5. In case of bidding through internet medium, bidders are further advised to ensure availability of the entire infrastructure as required at their end to participate in the auction event. Inability to bid due to telephone line glitches, internet response issues, software or hardware hangs; power failure or any other reason shall not be the responsibility of BYPL.
6. In case of intranet medium, BYPL shall provide the infrastructure to bidders, further, BYPL has sole discretion to extend or restart the auction event in case of any glitches in infrastructure observed which has restricted the bidders from submitting the bids to ensure fair & transparent competitive bidding. In case an auction event is restarted, the best bid already available in the system shall become the start price for the new auction.
7. In case the bidder fails to participate in the auction event due to any reason whatsoever, it shall be presumed that the bidder has no further discounts to offer and the initial bid as submitted by the bidder as a part of the tender shall be considered as the bidder's final no regret offer. Any offline price bids received from a bidder in lieu of non-participation in the auction event shall be outright rejected by BYPL.
8. The bidder shall be prepared with competitive price quotes on the day of the reverse auction event.
9. The prices as quoted by the bidder during the auction event shall be inclusive of all the applicable taxes, duties and levies and shall be FOR Landed Cost basis at the BYPL site.
10. The prices submitted by a bidder during the auction event shall be binding on the bidder.
11. No requests for time extension of the auction event shall be considered by BYPL.
12. The original price bids of the bidders shall be reduced on pro-rata basis against each line item based on the final all-inclusive prices offered during the conclusion of the auction event to arrive at the contract amount.

Signature & seal of the Bidder

Name of Authorized person

ANNEXURE – 1.18

VENDOR CODE OF CONDUCT

Purchaser is committed to conducting its business in an ethical, legal and socially responsible manner. To encourage compliance with all legal requirements and ethical business practices, Purchaser has established this Vendor Code of Conduct (the "Code") for Purchaser's Vendors. For the purposes of this document, "Vendor" means any company, corporation or other entity that sells, or seeks to sell goods or services, to Purchaser, including the Vendor's employees, agents and other representatives.

Fundamental to adopting the Code is the understanding that a business, in all of its activities, must operate in full compliance with the laws, rules and regulations of the countries in which it operates. This Code encourages Vendors to go beyond legal compliance, drawing upon internationally recognized standards, in order to advance social and environmental responsibility.

I. Labour and Human Rights

Vendors must uphold the human rights of workers, and treat them with dignity and respect as understood by the international community.

. Fair Treatment - Vendors must be committed to a workplace free of harassment. Vendors shall not threaten workers with or subject them to harsh or inhumane treatment, including sexual harassment, sexual abuse, corporal punishment, mental coercion, physical coercion, verbal abuse or unreasonable restrictions on entering or exiting company provided facilities.

. Antidiscrimination - Vendors shall not discriminate against any worker based on race, colour, age, gender, sexual orientation, ethnicity, disability, religion, political affiliation, union membership, national origin, or marital status in hiring and employment practices such as applications for employment, promotions, rewards, access to training, job assignments, wages, benefits, discipline, and termination. Vendors shall not require a pregnancy test or discriminate against pregnant workers except where required by applicable laws or regulations or prudent for workplace safety. In addition, Vendors shall not require workers or potential workers to undergo medical tests that could be used in a discriminatory way except where required by applicable law or regulation or prudent for workplace safety.

. Freely Chosen Employment - Forced, bonded or indentured labour or involuntary prison labour is not to be used. All work will be voluntary, and workers should be free to leave upon reasonable notice. Workers shall not be required to hand over government-issued identification, passports or work permits as a condition of employment.

. Prevention of Under Age Labor - Child labour is strictly prohibited. Vendors shall not employ children. The minimum /age for employment or work shall be 15 years of age, the minimum age for employment in that country, or the age for completing compulsory education in that country, whichever is higher. This Code does not prohibit participation in legitimate workplace apprenticeship programs that are consistent with Article 6 of ILO Minimum Age Convention No. 138 or light work consistent with Article 7 of ILO Minimum Age Convention No. 138.

. Juvenile Labor - Vendors may employ juveniles who are older than the applicable legal minimum age for employment but are younger than 18 years of age, provided they do not perform work likely to jeopardize their health, safety, or morals, consistent with ILO Minimum Age Convention No. 138.

. Minimum Wages - Compensation paid to workers shall comply with all applicable wage laws, including those relating to minimum wages, overtime hours and legally mandated benefits. Any Disciplinary wage deductions are to conform to local law. The basis on which workers are being paid is to be clearly conveyed to them in a timely manner.

. Working Hours - Studies of good manufacturing practices clearly link worker strain to reduced productivity, increased turnover and increased injury and illness. Work weeks are not to exceed maximum set by local law. Further, a work week should not be more than 60 hours per week, including overtime, except in emergency or unusual situations. Workers should be allowed at least one day off per seven-day week.

. Freedom of Association - Open communication and direct engagement between workers and management are the most effective ways to resolve workplace and compensation issues. Vendors are to respect the rights of workers to associate freely and to communicate openly with management

regarding working conditions without fear of reprisal, intimidation or harassment. Workers' rights to join labour unions seek representation and or join worker's councils in accordance with local laws should be acknowledged.

II. Health and Safety

Vendors must recognize that in addition to minimizing the incidence of work-related injury and illness, a safe and healthy work environment enhances the quality of products and services, consistency of production and worker retention and morale. Vendors must also recognize that ongoing worker input and education are essential to identifying and solving health and safety issues in the workplace.

The health and safety standards are:

. Occupational Injury and Illness - Procedures and systems are to be in place to prevent, manage, track and report occupational injury and illness, including provisions to a) encourage worker reporting; b) classify and record injury and illness cases; c) provide necessary medical treatment; d) investigate cases and implement corrective actions to eliminate their causes; and e) facilitate return of workers to work.
. Emergency Preparedness - Emergency situations and events are to be identified and assessed, and their impact minimized by implementing emergency plans and response procedures, including emergency reporting, employee notification and evacuation procedures, worker training and drills, appropriate fire detection and suppression equipment, adequate exit facilities and recovery plans.
. Occupational Safety - Worker exposure to potential safety hazards (e.g., electrical and other energy sources, fire, vehicles, and fall hazards) is to be controlled through proper design engineering and administrative controls, preventative maintenance and safe work procedures (including lockout/ragout), and ongoing safety training. Where hazards cannot be adequately controlled by these means, workers are to be provided with appropriate, well-maintained, personal protective equipment. Workers shall not be disciplined for raising safety concerns.
. Machine Safeguarding - Production and other machinery are to be evaluated for safety hazards. Physical guards, interlocks and barriers are to be provided and properly maintained where machinery presents an injury hazard to workers.
. Industrial Hygiene - Worker exposure to chemical, biological and physical agents is to be identified, evaluated, and controlled. Engineering or administrative controls must be used to control overexposures. When hazards cannot be adequately controlled by such means, worker health is to be protected by appropriate personal protective equipment programs.
. Sanitation, Food, and Housing - Workers are to be provided with ready access to clean toilet, facilities potable water and sanitary food preparation, storage, and eating facilities. Worker dormitories provided by the Participant or a labour agent are to be maintained clean and safe, and provided by the Participant or a labour egress, hot water for bathing and showering, and adequate heat and ventilation and reasonable personal space along with reasonable entry and exit privileges.
. Physically Demanding Work - Worker exposure to the hazards of physically demanding tasks, including manual material handling and heavy or repetitive lifting, prolonged standing and highly repetitive or forceful assembly tasks is to be identified, evaluated and controlled.

III. Environmental

Vendors should recognize that environmental responsibility is integral to producing world class products In manufacturing operations, adverse effects on the environment and natural resources are to be minimized while safeguarding the health and safety of the public.

The environmental standards are:

. Product Content Restrictions - Vendors are to adhere to applicable laws and regulations regarding prohibition or restriction of specific substances including labeling laws and regulations for recycling and disposal. In addition, Vendors are to adhere to all environmental requirements specified by Purchaser.
. Chemical and Hazardous Materials -Chemical and other materials posing a hazard if released to the environment are to be identified and managed to ensure their safe handling, movement storage, recycling or reuse and disposal.

. Air Emissions - Air emissions of volatile organic chemicals, aerosols, corrosives, particulates, ozone depleting chemicals and combustion by-products generated from operations are to be characterized, monitored, controlled and treated as required prior to discharge.
. Pollution Prevention and Resource Reduction -Waste of all types, including water and energy, are to be reduced or eliminated at the source or by practices such as modifying production, maintenance and facility processes, materials substitution, conservation, recycling and re-using materials.
. Wastewater and Solid Waste - Wastewater and solid waste generated from operations industrial processes and sanitation facilities are to be monitored, controlled and treated as required prior to discharge or disposal.
. Environmental Permits and Reporting - All required environmental permits (e.g. discharge monitoring) and registrations are to be obtained, maintained and kept current and their operational and reporting requirements are to be followed.

IV. Ethics

Vendors must be committed to the highest standards of ethical conduct when dealing with workers, Vendors, and customers.
. Corruption, Extortion, or Embezzlement - Corruption, extortion, and embezzlement, in any form, are strictly prohibited. Vendors shall not engage in corruption, extortion or embezzlement in any form and violations of this prohibition may result in immediate termination as a Vendor and in legal action.
. Disclosure of Information - Vendors must disclose information regarding their business activities, structure financial situation, and performance in accordance with applicable laws and regulations and prevailing industry practices.
. No Improper Advantage - Vendors shall not offer or accept bribes or other means of obtaining undue or improper advantage.
. Fair Business, Advertising, and Competition - Vendors must uphold fair business standards in advertising, sales, and competition.
. Business Integrity - The highest standards of integrity are to be expected in all business interactions. Participants shall prohibit any and all forms of corruption, extortion and embezzlement. Monitoring and enforcement procedures shall be implemented to ensure conformance.
. Community Engagement - Vendors are encouraged to engage the community to help foster social and economic development and to contribute to the sustainability of the communities in which they operate.
. Protection of Intellectual Property - Vendors must respect intellectual property rights; safeguard customer information; and transfer of technology and know-how must be done in a manner that protects intellectual property rights.

V. Management System

Vendors shall adopt or establish a management system whose scope is related to the content of this Code. The management system shall be designed to ensure (a) compliance with applicable laws, regulations and customer requirements related to the Vendors' operations and products; (b) conformance with this Code; and (c) identification and mitigation of operational risks related to this Code. It should also facilitate continual improvement.

The management system should contain the following elements:
. Company Commitment - Corporate social and environmental responsibility statements affirming Vendor's commitment to compliance and continual improvement.
. Management Accountability and Responsibility - Clearly identified company representative[s]responsible for ensuring implementation and periodic review of the status of the management systems.
. Legal and Customer Requirements - Identification, monitoring and understanding of applicable laws, regulations and customer requirements.
. Risk Assessment and Risk Management - Process to identify the environmental, health and safety and labour practice risks associated with Vendor's operations. Determination of the relative significance for each risk and implementation of appropriate procedural and physical controls to ensure regulatory compliance to control the identified risks.
. Performance Objectives with Implementation Plan and Measures - Areas to be included in a risk assessment for health and safety are warehouse and storage facilities, plant/facilities support

equipment, laboratories and test areas, sanitation facilities (bathrooms), kitchen/cafeteria and worker housing /dormitories. Written standards, performance objectives, and targets an implementation plans including a periodic assessment of Vendor's performance against those objectives.

. Training - Programs for training managers and workers to implement Vendor's policies, procedures and improvement objectives.

. Communication - Process for communicating clear and accurate information about Vendor's performance, practices and expectations to workers, Vendors and customers.

. Worker Feedback and Participation - Ongoing processes to assess employees' understanding of and obtain feedback on practices and conditions covered by this Code and to foster continuous improvement.

. Audits and Assessments - Periodic self-evaluations to ensure conformity to legal and regulatory requirements, the content of the Code and customer contractual requirements related to social and environmental responsibility.

. Corrective Action Process - Process for timely correction of deficiencies identified by internal or external assessments, inspections, investigations and reviews.

. Documentation and Records - Creation of documents and records to ensure regulatory compliance and conformity to company requirements along with appropriate confidentiality to protect privacy.

The Code is modelled on and contains language from Recognized standards such as International Labour Organization Standards (ILO), Universal Declaration of Human Rights (UDHR), United Nations Convention against Corruption, and the Ethical Trading Initiative (ETI) were used as references in preparing this Code and may be useful sources of additional information

GENERAL CONDITIONS OF CONTRACT
(GCC-SUPPLY)

GENERAL CONDITIONS OF CONTRACT (GCC)

The General Condition of Contract shall form a part of specifications, contract document.

1.0 General Instructions

1.01 All the Bids shall be prepared and submitted in accordance with these instructions.

1.02 Bidder shall bear all costs associated with the preparation and delivery of its Bid, and the Purchaser will in no case be responsible or liable for these costs.

1.03 The Bid should be submitted by the Bidder in whose name the bid document has been issued and under no circumstances it shall be transferred/sold to the other party.

1.04 The Purchaser reserves the right to request any additional information and also reserves the right to reject the proposal of any Bidder if, in the opinion of the Purchaser, the data in support of RFQ requirement is incomplete.

1.05 The Bidder is expected to examine all instructions, forms, terms & conditions and specifications in the Bid Documents. Failure to furnish all information required in the Bid Documents or submission of a Bid not substantially responsive to the Bid Documents in every respect may result in rejection of the Bid. However, the Purchaser's decision in regard to the responsiveness and rejection of bids shall be final and binding without any obligation, financial or otherwise, on the Purchaser.

2.0 Definition of Terms

2.01 "Purchaser" shall mean BSES Yamuna Power Limited, on whose behalf this bid enquiry is issued by its authorized representative/officers.

2.02 "Bidder" shall mean the firm who quotes against this bid enquiry issued by the Purchaser. "Supplier" or "Supplier" shall mean the successful Bidder and/or Bidders whose bid has been accepted by the Purchaser and on whom the "Letter of Acceptance" is placed by the Purchaser and shall include his heirs, legal representatives, successors and permitted assigns wherever the context so admits.

2.03 "Supply" shall mean the Scope of Contract as described.

2.04 "Specification" shall mean collectively all the terms and stipulations contained in those portions of this bid document known as RFQ, Commercial Terms & Conditions, Instructions to Bidders, Technical Specifications and the Amendments, Revisions, Deletions or Additions, as may be made by the Purchaser from time to time.

2.05 "Letter of Acceptance" shall mean the official notice issued by the Purchaser notifying the Supplier that his proposal has been accepted and it shall include amendments thereto, if any, issued by the Purchaser. The "Letter of Acceptance" issued by the Purchaser shall be binding on the "Supplier" The date of Letter of Acceptance shall be taken as the effective date of the commencement of contract.

2.06 "Month" shall mean the calendar month and "Day" shall mean the calendar day.

2.07 "Codes and Standards" shall mean all the applicable codes and standards as indicated in the Specification.

2.08 "Offer Sheet" shall mean Bidder's firm offer submitted to BYPL in accordance with the specification.

2.09 "Contract" shall mean the "Letter of Acceptance/Purchase Order" issued by the Purchaser.

2.10 "Contract Price" shall mean the price referred to in the "Letter of Acceptance/Purchase Order".

2.11 "Contract Period" shall mean the period during which the "Contract" shall be executed as agreed between the Supplier and the Purchaser in the Contract inclusive of the extended contract period for reason beyond the control of the Supplier and/or Purchaser due to force majeure.

2.12 "Acceptance" shall mean and deemed to include one or more of the following as will be stipulated in the specification:

a) The written acceptance of material by the inspector at suppliers works to ship the materials.
b) Acceptance of material at Purchaser site stores after its receipt and due inspection/ testing and release of material acceptance voucher.
c) Where the scope of the contract includes supply, acceptance shall mean issue of necessary equipment / material takeover receipt after installation & commissioning and final acceptance.

3.0 Contract Documents & Priority

3.01 Contract Documents: The terms and conditions of the contract shall consist solely of these RFQ conditions and the offer sheet.

4.0 Scope of Supply -General

4.01 The "Scope of Supply" shall be on the basis of Bidder's responsibility, completely covering the obligations, responsibility and supplies provided in this Bid enquiry whether implicit or explicit.

4.02 Bidder shall have to quote for the Bill of quantities as listed in Section – IV of this RFQ.

4.03 Quantity variation and additional requirements if any shall be communicated to successful bidder during project execution.

4.04 All relevant drawings, data and instruction manuals.

5.0 Quality Assurance and Inspection

5.01 Immediately on award of contract, the bidder shall prepare detailed quality assurance plan/test procedure identifying the various stages of manufacture, quality checks performed at each stage, raw material inspection and the Customer hold points. The document shall also furnish details of method of checking, inspection and acceptance of standards/values and get the approval of Purchaser before proceeding with manufacturing. However, Purchaser shall have right to review the inspection reports, quality checks and results of suppliers in-house inspection department which are not Customer hold points and the supplier shall comply with the remarks made by purchaser or his representative on such reviews with regards to further testing, rectification or rejection, etc.

5.02 Witness and Hold points are critical steps in manufacturing, inspection and testing where the supplier is obliged to notify the Purchaser in advance so that it may be witnessed by the Purchaser. Final inspection is a mandatory hold point. The supplier is to proceed with the work past a hold point only after clearance by purchaser or a witness waiver letter from BYPL.

5.03 The performance of waiver of QA activity by Purchaser at any stage of manufacturing does not relieve the supplier of any obligation to perform in accordance with and meet all the requirements of the procurement documents and also all the codes & reference documents mentioned in the procurement document nor shall it preclude subsequent rejection by the purchaser.

5.04 On completion of manufacturing the items can only be dispatched after receipt of dispatch

Instructions issued by the Purchaser.

5.05 All in-house testing and inspection shall be done without any extra cost. The in-house inspection shall be carried out in presence of BSES/BSES authorized third-party inspection agency. Cost of Futile/abortive visit(s) shall be debited from the invoices.

5.06 Purchaser reserves the right to send any material being supplied to any recognized laboratory for testing, wherever necessary and the cost of testing shall be borne by the Bidder. In case the material is found not in order with the technical requirement/specification, the charges along with any other penalty that may be levied are to be borne by the bidder.

6.0 Inspection & Test Charges

6.01 GOODS shall be inspected by BUYER and/or third-party inspection agency nominated by BUYER. Inspection shall carry out stage-wise/final inspection as per agreed QA /QC procedure. In addition, inspection of GOODS shall be carried out at our Site/stores. SELLER shall, however, repair/replace the damaged/rejected GOODS to the satisfaction of BUYER at no extra cost.

6.02 Inspection charges are included in total order value, however, BUYER will bear third-party inspection charges. In case of a futile/abortive visit of BUYER's inspector at SELLER'S works, the cost towards the same shall be debited from the SELLER's invoices.

6.03 GOODS covered by this PURCHASE ORDER shall not be dispatched in whole or in part until SELLER has received a written Release for Shipment Notice from BUYER or their designated representative.

6.04 Inspection call shall be raised a minimum of 7 (seven) days in advance from the delivery schedule mentioned in the PO and duly filled Format issued by BYPL

7.0 Handling and Storage

7.01 Material Safety Data Sheet (MSDS), detail handling & storage instruction sheet/manual, wherever applicable, to be furnished before the commencement of supply and one copy is to be submitted in store/site with First Lot.

8.0 Packing, Packing List & Marking

8.01 **Packing:** Supplier shall pack or shall cause to be packed all Commodities in crates/boxes/drums/containers/cartons and otherwise in such a manner as shall be reasonably suitable for shipment by road or rail to BYPL, Delhi/New Delhi stores/site without undue risk of damage in transit. All the packaging materials as prescribed shall be supplied preferably with bio-degradable packing- materials.

8.02 **Packing List:** The contents of each package shall be itemized on a detailed list showing the exact weight, extreme outside dimensions (length, width & weight) of each container/box/drum/carton, Item SAP Code, PO No & date. One copy of the packing list shall be enclosed in each package delivered.

9.0 Prices/Rates/Taxes

9.01 **Price basis for supply of materials**
a) Bidder to quote their prices on Landed Cost Basis and separate price for each item for supply to BYPL Delhi/New Delhi stores inclusive of packing, forwarding, loading at manufacturer's premises, payment of GST, Freight, and any other local charges. **Octroi is presently not applicable in Delhi and however if applicable shall be reimbursed at actuals.**
b) The above supply prices shall also include unloading at BYPL Delhi/New Delhi stores/sites.
c) Transit insurance will be arranged by Bidder

10.0 Taxes & Duties

10.01 Prices for Goods are on Ex- Works basis. For the Goods covered under the GST laws, all taxes that are applicable under CGST, SGST, UGST, IGST and GST Compensation Cess shall be payable extra.

10.02 For the Goods not covered in the GST laws, the applicable ED, VAT / CST shall be payable extra at applicable rates.

10.03 GSTIN of BSES YAMUNA POWER LTD - 07AABCC8569N1Z0
CST No of BSES YAMUNA POWER LTD -07740254593
TIN NO of BSES YAMUNA POWER LTD - 07740254593
PAN NO of BSES YAMUNA POWER LTD - AABCC8569N

10.04 At the end of each month, the SELLER must submit their detail of invoices and amount thereof to the concerned officer in charge, within 07 days after the close of the respective month to which supply relates. Non-submission of the said request would be treated as good as the SELLER has no requirement for reconciliation.

11.0 Invoicing Instructions

11.01 Invoices in triplicate [1) Original for recipient, 2) Duplicate for Transporter, 3) Triplicate for supplier] shall be made out and delivered to the following address: BSES YAMUNA POWER LIMITED, SHAKTI KIRAN BUILDING, KARKARDOOMA, DELHI-110032.
MDCC will be released separately for Capex & Opex. Invoice will be submitted by the supplier as per the MDCC.

11.02 Vendor shall obtain GST registration in the State from where the supply will be carried out. Vendors supplying Goods to the Purchaser shall have a valid GST registration number and shall submit GST Tax Invoice and other documents as per SGST Act, CGST Act, IGST Act, UTGST Act, GST Compensation Cess Act and Rules made there under. Failure to submit GST Tax Invoice shall be liable for withholding SGST, CGST, IGST, UTGST, GST Compensation Cess amount charged by the vendor while releasing the payment.

11.03 Invoice will be in the name of BSES YAMUNA POWER LIMITED & address of the store/site mentioned in the MDCC. Invoice should contain all information as required under GST Invoice, Debit Note and Credit Rules. The government has notified rules of invoicing under GST along with a template of invoice(GST INV-01) covering the elements such as supplier's details, GSTIN No, HSN Codes, item details, GST tax rates, etc that need to be presented by the supplier.

11.04 Vendor to carefully examine and charge relevant CGST / SGST, UGST, IGST and GST compensation cess as applicable to the transactions.

11.05 Timely provision of invoices / Debit Notes / Credit Notes:

11.05.1 Vendor to timely provide invoice / Debit note / Credit note to enable Purchaser to claim tax benefit on or before stipulated time period. All necessary adjustment entries (Credit Notes, Purchase Returns, Debit Notes) shall be made within the timelines prescribed under the GST Laws.

11.05.2 In case of receipt of advance, the Vendor undertakes to raise the tax invoice. Purchaser, upon payment of advance, shall issue payment voucher as per applicable GST laws and rules. Four copies of the invoices need to be provided by suppliers and wherever the law requires, an Electronic Reference Number for each invoice.
Documents and devices to be carried by a person in charge of a conveyance under.

11.05.3 Any Vendors / Contractors / Service providers 'shall' mention the following minimum requirements in 'invoice' while furnishing Invoices with us:

1. Invoice / Credit Note Number and Date.
2. Address of supplier/service provider and GSTN.
3. Customer Name and Address as per GST Registration Certificate and GST registration Number.
4. 'Shipped to' and 'Billed to' addresses.
5. Place of Supply.
6. Description of Goods/Service along with unit of measurements.
7. HSN / SAC Code.
8. Taxable value (Gross & deduct Discount separately if allowed)
9. Rate and amount of Tax separately for CGST, SGST and IGST as applicable.
10. Signature of Supplier. (For e-invoices physical signature is not required)
11. Whether Reverse Charge is applicable or not.

11.06 E Way Bills/transit documents for movement of Goods:
Wherever applicable, the Vendor shall be responsible for issuing required transit documents / E Way Bills for the movement of Goods and the logistic partner/transporter shall not be liable for any loss arising due to confiscation of goods by government agencies on account of lack of proper documents or any misdeclaration. The Supplier is responsible for complying with rules applicable to the E-way bill. Any violation in provision of E-way Bill will attract penalties and seizure of Transit Material. Any Penalty and Pre-Deposit due to violation of rules/provisions shall be paid and borne by the Supplier. Also, the Supplier is responsible for releasing goods from the Authority whether CGST/SGST. Delay in supply from the contractual date due to the seizure of goods shall also attract liquidated damages.

12.0 Terms of Payment and Billing

12.01 **PRICE FOR SITC OF VRF/VRV HVAC SYSTEM :**

MS-1: 60% prorata of supply value item-wise shall be payable against R/A bills for supply of equipments and materials within 30 days against receipt & acceptance of material at site and submission of following documents duly certified by BYPL Project-in-charge, complete in all respects:

a) Signed copy of accepted Rate Contract (as applicable) & Purchase Order (for first payment)
b) PBG equivalent to 10% of PO Value (including GST) both for supply and service valid till PO validity period, as applicable
c) LR / RR / BL as applicable
d) Challan as applicable
e) Two (02) copies of the Supplier's detailed Recipient Invoice showing Commodity description, quantity, unit price, total price and basis of delivery, and is 100% of the value of the consignment claimed.
f) Two (02) copies of Supplier's transporter invoice duly receipted by BYPL Store & Original certificate issued by BYPL confirming receipt of the subject material at Store/Site and acceptance of the same as per the provisions of the contract.
g) Two (02) copies Packing List / Detailed Packing List
h) Approved Test certificates / Quality certificates, if applicable
i) Certificate of Origin, if applicable
j) Material Dispatch Clearance Certificate (MDCC)
k) Warranty / Guarantee Certificate, if applicable
l) Checklist for bill submission.

MS-2: 30% after Erection, Testing and commissioning of complete HVAC system shall be payable within 30 days against documents duly certified by BYPL Project-in-charge, complete in all respects.

MS-3: 10% after Handing over of complete HVAC system, shall be payable within 30 days against documents duly certified by BYPL Project-in-charge, complete in all respects.

12.02 Purchaser has the right to recover tax loss, interest and penalty suffered due to any non-compliance of tax laws by the Vendor. In the event, Purchaser is not able to avail of any tax credit due to any shortcoming on the part of the Vendor (which otherwise should have been available to Purchaser in the normal course), then the Vendor at his own cost and effort will get the short coming rectified. If for any reason the same is not possible, then the Vendor will make 'good' the loss suffered by Purchaser due to the tax credit it lost. In such event, any amount paid to the Vendors shall be first attributable to the tax (GST) charged in the invoice and the balance shall be considered towards the 'value' of supply of goods/ services.

12.03 Purchaser shall deduct "Tax Deducted at Source" wherever applicable and at the rate prescribed under the GST Laws or any other Indian law and remit the same to the Government. Necessary TDS certificates as per law shall be issued by the purchase to the vendor.

12.04 Any liability arising out of dispute on the tax rate, classification under HSN, calculation and payment of tax to the Government will be to the Vendor's account.

12.05 Where the supply of Goods is liable to GST under reverse charge mechanism, then the supplier should clearly mention the category under which it has been registered and also that "the liability of payment of GST is on the Recipient of Supply".

13.0 Tax Indemnity Clause

13.01 Vendor (along with its affiliates in India or overseas including any agent/ third party contractor or any other person appointed by such affiliates for this agreement) agrees that it will be solely responsible for performing all compliances and making payments of all taxes (direct tax or indirect tax including but not limited to income-tax, transfer pricing, value added tax, SGST, CGST, IGST, UTGST, GST Compensation Cess custom duty, excise duty, Research and Development Cess, etc.), cesses, interest, penalties or any other tax/ duty/ amount/ charge/ liability arising either out of laws/ regulations applicable in India and overseas or because of a demand/ recovery initiated by any revenue authority under laws/ regulations applicable in India or overseas.

13.02 In case any tax liability (including but not limited to income tax, transfer pricing, value added tax, SGST, CGST, IGST, UTGST, GST Compensation Cess, custom duty, excise duty, Research and Development Cess, etc.), cesses, interest, penalties or any other tax/ duty/ amount/ charge/ liability becomes payable by Purchaser due to failure of the Vendor, or any of its affiliates in India or overseas including any agent/ third party contractor or any other person appointed by such affiliates for this agreement, to comply with the relevant laws/ regulations applicable in India or overseas, Vendor undertakes to indemnify Purchaser for an amount equal to amount payable by Purchaser.

13.03 Further, Vendor undertakes to keep Purchaser indemnified at all times against and from all other actions, proceedings, claims, loss, damage, costs and expenses which may be brought against Purchaser or suffered or incurred by Purchaser and which shall have arisen either directly or indirectly out of or in connection with failure of The Vendor, or any of its affiliates in India or overseas including any agent/ third party contractor or any other person appointed by such affiliates for this agreement, to comply with relevant obligations/ compliance under any law/ regulations applicable in India and overseas.

13.04 The parties agree to follow the following process in case any communication of demand, arising out of non-compliance by Vendor (along with its affiliates in India or overseas including any agent/ third party contractor or any other person appointed by such affiliates for this agreement), is received by Purchaser:

13.04.1 On Purchaser receiving any communication from a competent authority demanding tax liability (including but not limited to income tax, transfer pricing, value added tax, SGST, CGST, IGST, UTGST, GST Compensation Cess custom duty, excise duty, Research and Development Cess, etc.), cesses, interest, penalties or any other tax/ duty/ amount/ charge/ liability, Purchaser

shall, within 5 common working days from the date of receipt of such communication (save where the period to respond to the relevant authority is less than five days, in which case, as soon as reasonably possible) inform Vendor in writing of such communication.

13.04.2 Pursuant to receiving communication from Purchaser, Vendor shall suggest to accept the communication and pay the demand amount to the competent authority. In such an event, Vendor shall reimburse such amount paid to Purchaser within 5 working days from the date of payment by Purchaser to the competent authority.

13.04.3 If Vendor advises in writing and Purchaser agrees to dispute the demand, then Purchaser shall dispute the matter with competent authority as per due process prescribed under the regulations and Purchaser shall not pay the Tax Demand. In such scenario, cost of litigation including but not limited to Counsel cost, filing fees, other related charges, should be reimbursed by Vendor to Purchaser. Additionally, If any coercive steps of recovery are initiated by the department, then Purchaser would pay such amount (including by way of adjustment of refunds due to it) and the same would be reimbursed by Vendor within 5 working days from date of such recovery from Purchaser. Purchaser will take all necessary steps to avoid such recovery measures.

13.04.4 On determination of the demand through an Order issued by a Tribunal or any other similar Authority, by whatever name called, under any law applicable in India or overseas, if the demand or any part thereof becomes payable and is paid by Purchaser, then Vendor undertakes to reimburse such amount to Purchaser within 10 days from the date of payment. Alternatively, if on determination of the demand through an Order, no amount is payable by Purchaser then any refund arising to Purchaser due to such an Order shall be passed on to Vendor within 10 days from the date of receipt of refund.

14.0 The Micro, Small and Medium Enterprises (MSME)

14.01 If the SELLERS establishment is covered under the purview of The Micro, Small and Medium Enterprises Development Act, 2006 and its amendments, he shall declare so within the bid of its status failing which it will be presumed that it is a non-MSME unit. Also, submit a **copy of Udyog Aadhaar (UA) & Udyam Registration Number.**

15.0 Price Validity

15.01 All bids submitted shall remain valid, firm and subject to unconditional acceptance by BYPL Delhi for 120 days from the due date of submission. For awarded suppliers, the prices shall remain valid till contract completion.

16.0 Performance Guarantee

16.01 The successful bidder shall furnish the Performance Bank Guarantee within fifteen (15) days from the Purchase Order Date for an amount of 10% (Ten percent) of the Total Contract value (both for Supply and Service). The Performance Bond shall be valid for a period of Sixty months (60) from the date of the commissioning or Sixty Six months (66) from the date of receipt of material (last consignment) at site/stores whichever is earlier plus 3 months towards claim period. Upon receipt of the PBG by BYPL against RC, the EMD shall be released.

16.02 Bank guarantee shall be drawn in favour of BSES Yamuna Power Ltd as applicable. The performance Bank guarantee shall be in the format specified by BYPL.

17.0 Forfeiture

17.01 Each Performance Bond established under Clause 10.0 shall contain a statement that it shall be automatically and unconditionally forfeited without recourse and payable against the presentation by BYPL of this Performance Bond, to the relevant bank referred to above,

together with a simple statement that supplier has failed to comply with any term or condition outlined in the Contract.

17.02 Each Performance BG established under will be automatically and unconditionally forfeited without recourse if BYPL in its sole discretion determines that supplier has failed to comply with any term or condition outlined in the contract.

18.0 Release

18.01 All Performance Bonds will be released without interest within seven (7) days from the last date up to which the Performance Bond has to be kept valid (as defined in Clause 16.0) except for the case outlined in Clause 22.0.

19.0 Defects Liability Period/Guarantee/Warranty

5 years comprehensive warranty from successful handing over and taking over and operational run of VRF/VRV HVAC system. Comprehensive warranty should cover repair and replacement of all the defective items and its services during the entire period to make the system operational at desired parameters.

20.0 Return, Replacement or Substitution

20.01 BYPL shall give Supplier notice of any defective Commodity promptly after becoming aware thereof. BYPL may at its discretion elect to return defective Commodities to Supplier for replacement, free of charge to BYPL or may reject such Commodities and purchase the same or similar Commodities from any third party. In the latter case, BYPL shall furnish proof to Supplier of the cost of such substitute purchase. In either case, all costs of any replacement, substitution, shipping, labour and other related expenses incurred in connection with the return and replacement or for the substitute purchase of a Commodity hereunder should be for the account of Supplier. BYPL may set off such costs against any amounts payable by BYPL to the Supplier. Supplier shall reimburse BYPL for the amount, if any, by which the price of a substitute Commodity exceeds the price for such Commodity as quoted in the Bid. BUYER at its sole discretion shall have the opinion to dispose of the material or GOODS so rejected and not taken back within forty-five days from the date of intimation of rejection.

21.0 Effective Date of Commencement of Contract

21.01 The date of the issuance of the Letter of Acceptance/Purchase Order shall be treated as the effective date of the commencement of Contract.

22.0 Time – The Essence Of Contract

22.01 The time and the date of completion of the "Supply" as stipulated in the Letter of Acceptance / Purchase order issued to the Supplier shall be deemed to be the essence of the "Contract". The Supply has to be completed not later than the aforesaid Schedule and date of completion of supply.

23.0 The Laws and Jurisdiction of Contract:

23.01 The laws applicable to this Contract shall be the Laws in force in India.

23.02 All disputes arising in connection with the present Contract shall be settled amicably by mutual consultation failing which shall be finally settled as per the rules of Arbitration and Conciliation Act, 1996 at the discretion of Purchaser. The venue of arbitration shall be Delhi, India

24.0 Events of Default

24.01 Events of Default. Each of the following events or occurrences shall constitute an event of default ("Event of Default") under the Contract:

(a) Supplier fails or refuses to pay any amounts due under the Contract;

(b) Supplier fails or refuses to deliver Commodities conforming to this RFQ/specifications, or fails to deliver Commodities within the period specified in P.O. or any extension thereof

(c) Supplier becomes insolvent or unable to pay its debts when due, or commits any act of bankruptcy, such as filing any petition in any bankruptcy, winding-up or reorganization proceeding, or acknowledges in writing its insolvency or inability to pay its debts; or the Supplier's creditors file any petition relating to bankruptcy of Supplier;

(d) Supplier otherwise fails or refuses to perform or observe any term or condition of the Contract and such failure is not remediable or, if remediable, continues for a period of 30 days after receipt by the Supplier of notice of such failure from BYPL.

25.0 Consequences of Default.

(a) If an Event of Default shall occur and be continuing, BYPL may forthwith terminate the Contract by written notice.

(b) In the event of an Event of Default, BYPL may, without prejudice to any other right granted to it by law, or the Contract, take any or all of the following actions;

(i) present for payment to the relevant bank the Performance Bond;

(ii) purchase the same or similar Commodities from any third party; and/or

(iii) recover any losses and/or additional expenses BYPL may incur as a result of Supplier's default.

26.0 Penalty for Delay

26.01 If supply of items/equipments is delayed beyond the supply schedule as stipulated in the purchase order /work order then the Supplier shall be liable to pay to the Purchaser as penalty for delay, a sum of 1% (one percent) of the basic (ex-works) price for every week delay of undelivered units or part thereof for individual milestone deliveries.

26.02 The total amount of penalty for delay under the contract will be subject to a maximum of ten percent (10%) of the basic (ex-works) price of total undelivered units for both supply and service.

26.03 The Purchaser may, without prejudice to any method of recovery, deduct the amount for such damages from any amount due or which may become due to the Supplier or from the Performance Bond or file a claim against the supplier.

26.4 If the Penalty is levied as per the Order terms & conditions; BYPL will raise the Invoice for the penalty amount along with applicable GST rates. Accordingly, after setting off the penalty Invoice amount, net payment shall be made.

27.0 Variation in Taxes, Duties & Levies

27.1 The total order value shall be adjusted on account of any variations in Statutory Levies imposed by Competent Authorities by way of fresh notification(s) within the stipulated delivery period only. In case of reduction in taxes, duties and levies, the benefits of the same shall be passed on to BUYER.

27.2 No other Taxes, Duties or levies other than those specified above will be payable by BUYER except in case of new Levies, Taxes or duties imposed by the Competent Authorities by way of fresh notification(s) after the issue of PURCHASE ORDER but within the stipulated delivery period.

27.3 Notwithstanding what has been stated above, changes in Taxes, Duties & Levies shall apply only to that portion of PURCHASE ORDER not executed on the date of notification by the Competent Authority. Further, changes in Taxes, Duties & Levies after the due date of Delivery shall not affect PURCHASE ORDER Terms and Value.

27.4 PURCHASE ORDER value shall not be subject to any variation on account of variation in Exchange rate(s).

28.0 Taxes & Duties on raw materials & bought out components

28.01 Taxes & Duties on raw materials & bought-out components are included in Order Value and are not subject to any escalation or variation for any reason whatsoever.

28.02 Taxes & Duties on raw materials & bought-out components procured indigenously are included in Order Value and are not subject to any escalation or variation for any reason whatsoever.

29.0 Force Majeure

29.01 General

An "Event of Force Majeure" shall mean any event or circumstance not within the reasonable control directly or indirectly, of the Party affected, but only if and to the extent that:

(i) Such event or circumstance materially and adversely affects the ability of the affected Party to perform its obligations under this Contract, and the affected Party has taken all reasonable precautions, due care and reasonable alternative measures to prevent or avoid the effect of such event on the affected party's ability to perform its obligations under this Contract and to mitigate the consequences thereof.

(ii) For the avoidance of doubt, if such event or circumstance would not have materially and adversely affected the performance of the affected party had such affected party followed good industry practice, such event or circumstance shall not constitute force majeure.

(iii) Such event is not the direct or indirect result of the failure of such Party to perform any of its obligations under this Contract.

(iv) Such Party has given the other Party prompt notice describing such events, the effect thereof and the actions being taken to comply with the above clause.

29.02 Specific Events of Force Majeure subject to the provisions of above clause, Events of Force Majeure shall include only the following to the extent that they or their consequences satisfy the above requirements :

(i) The following events and circumstances :

a) Effect of any natural element or other acts of God, including but not limited to storm, flood, earthquake, lightning, cyclone, landslides or other natural disasters.

b) Explosions or fires

(ii) War declared by the Government of India.

(iii) Dangers of navigation, perils of the sea.

Note: Causes like power breakdowns/strikes, accidents etc do not fall under Force Majeure.

29.03 Notice of Events of Force Majeure If a force majeure event prevents a party from performing any obligations under the Contract in part or in full, that party shall:

i) Immediately notify the other party in writing of the force majeure events within 7(seven) working days of the occurrence of the force majeure event

ii) Be entitled to suspend performance of the obligation under the Contract which is affected by force majeure event for the duration of the force majeure event.

iii) Use all reasonable efforts to resume full performance of the obligation as soon as practicable

iv) Keep the other party informed of all such efforts to resume full performance of the obligation on a regular basis.
v) Provide prompt notice of the resumption of full performance or obligation to the other party.

29.04 Mitigation of Events of Force Majeure Each Party shall:
(i) Make all reasonable efforts to prevent and reduce to a minimum and mitigate the effect of any delay occasioned by an Event of Force Majeure including recourse to alternate methods of satisfying its obligations under the Contract;
(ii) Use its best efforts to ensure resumption of normal performance after the termination of any Event of Force Majeure and shall perform its obligations to the maximum extent practicable as agreed between the Parties; and
(iii) Keep the other Party informed at regular intervals of the circumstances concerning the event of Force Majeure, with best estimates as to its likely continuation and what measures or contingency planning it is taking to mitigate and or terminate the Event of Force Majeure.

29.05 Burden of Proof In the event that the Parties are unable in good faith to agree that a Force Majeure event has occurred to an affected party, the Parties shall resolve their dispute in accordance with the provisions of this Agreement. The burden of proof as to whether or not a force majeure event has occurred shall be upon the party claiming that the force majeure event has occurred and that it is the affected party.

29.06 Termination for Certain Events of Force Majeure. If any obligation of any Party under the Contract is or is reasonably expected to be delayed or prevented by a Force Majeure event for a continuous period of more than 3 months, the Parties shall promptly discuss in good faith how to proceed with a view to reaching a solution on mutually agreed basis. If a solution on mutually agreed basis cannot be arrived at within a period of 30 days after the expiry of the period of three months, the Contract shall be terminated after the said period of 30 days and neither Party shall be liable to the other for any consequences arising on account of such termination.
The Purchaser may terminate the contract after giving 7 (seven) days' notice if any of the following occurs:
i. Bidder fails to complete the execution of works within the approved schedule of works, terms and conditions.
ii. In case the Bidder commits any Act of Insolvency, or is adjudged insolvent
iii. Has abandoned the contract
iv. Has failed to commence work or has suspended the progress of works
v. Has failed to proceed with the works with due diligence and failed to make such due progress

29.07 Limitation of Force Majeure event. The Supplier shall not be relieved of any obligation under the Contract solely because the cost of performance is increased, whether as a consequence of adverse economic consequences or otherwise.

29.08 Extension of Contract Period due to Force Majeure event The Contract period may be extended by mutual agreement of Parties by way of an adjustment on account of any period during which an obligation of either Party is suspended due to a Force Majeure event.

29.09 Effect of Events of Force Majeure. Except as otherwise provided herein or may further be agreed between the Parties, either Party shall be excused from performance and neither Party shall be construed to be in default in respect of any obligations hereunder, for so long as the failure to perform such obligations shall be due to an event of Force Majeure."

29.10 Severability
If any provision of this Agreement is or becomes invalid or unenforceable by the courts of any jurisdiction to which it is subject, such invalidity or unenforceability shall not prejudice the remaining provisions of this Agreement, which shall continue in full force and effect.

30.0 Transfer and Sub-Letting

30.01 The Supplier shall not sublet, transfer, assign or otherwise part with the Contract or any part thereof, either directly or indirectly, without prior written permission of the Purchaser.

31.0 Recoveries

31.01 Whenever under this contract any money is recoverable from and payable by the bidder, the purchaser shall be entitled to recover such sum by appropriating in part or in whole by detecting any sum due to which any time thereafter may become due from the supplier in this or any other contract. Should the sum be not sufficient to cover the full amount recoverable the bidder shall pay to the purchaser on demand the remaining balance.

32.0 Waiver

32.01 Failure to enforce any condition herein contained shall not operate as a waiver of the condition itself or any subsequent breach thereof.

33.0 Indemnification

33.01 Notwithstanding contrary to anything contained in this RFQ, Supplier shall at his costs and risks make good any loss or damage to the property of the Purchaser and/or the other Supplier engaged by the Purchaser and/or the employees of the Purchaser and/or employees of the other Supplier engaged by the Purchaser whatsoever arising out of the negligence of the Supplier while performing the obligations under this contract.

34.00 Termination for convenience of Purchaser

34.1 Purchaser at its sole discretion may terminate the contract by giving 30 days prior notice in writing or through email to the Supplier. Purchaser shall pay the Supplier for all the supplies/ services rendered till the actual date of contract termination against submission of invoice by the Supplier to that effect.

34.2 Payment of such compensation is the sole and exclusive remedy of the supplier for termination of this Agreement by Purchaser hereunder and the supplier shall not be entitled to, and hereby waives,
claims for lost profits and all other damages and expenses.

34.3 Supplier hereby agrees that substantiation for settlement of any claims submitted by supplier shall be complete and in sufficient detail to allow Purchaser's evaluation. Terminate all sub-contracts except those that have been/ to be assigned to the Purchaser all rights, titles and benefits of the Suppliers/Vendor as the case may be.

35.00 Documentation

35.01 The Bidder shall procure all equipment from BYPL-approved sources as per the attached specifications. The Bidders shall submit copies of Material/Type Test Certificates, O&M Manuals, and Approved & As-built drawings, related to various equipment (as applicable). The Bidder shall ensure strict compliance with the specifications and Field Quality Procedures issued by BYPL.

36.0 Transit Insurance

36.01 Transit Insurance shall be arranged by the Bidder.

36.02 DAMAGE / LOSS OF CARGO IN TRANSIT: The vendor shall be solely responsible for coordinating with the concerned insurance company for procuring insurance for material and/or Goods, processing claims lodgment and settlement. Notwithstanding the insurance cover, in case of loss/damage to material and/or Goods, in any manner and for any cause whatsoever, Vendor shall cause the damaged cargo to be replaced and delivered to the Purchaser with new

material and/or Goods within 30 days of such loss/damage. The Vendor shall be solely responsible for all expenses in relation to the replacement and delivery in such circumstances.

37.0 Limitation of Liability

37.01 Except for willful misconduct or gross negligence, neither Party shall be liable to the other Party for loss of use of any Works, loss of profit, loss of any contract or any other indirect or consequential loss or damage which may be suffered by the other Party in connection with the Contract. The total liability of the Supplier to the Purchaser under the Contract shall not exceed the Contract Value. Except that this Clause shall not limit the liability of the Supplier:
(a) In cases of fraud, willful misconduct or illegal or unlawful acts, or
(b) In cases of acts or omissions of the Supplier that are contrary to the most elementary rules of diligence that a conscientious Supplier would have followed in similar circumstances.

38.0 Liability of Suppliers

38.1 Subject to the due discharge of its obligations under the Contract and except in case of gross negligence or willful misconduct on the part of the Supplier or on the part of any person acting on behalf of the Supplier, with respect to any loss or damage caused by the Supplier to the Purchaser's property or the Site, the Supplier shall not be liable to the Purchaser for the following:
(a) For any indirect or consequential loss or damage; and
(b) For any direct loss or damage that exceeds:
(i) The total payments made and expected to be made to the Supplier under the Contract including reimbursements, if any; or
(ii) The insurance claim proceeds that the Supplier may be entitled to receive from any insurance purchased by the Supplier to cover such a liability, whichever is higher.

38.2 This limitation of liability shall not affect the supplier's liability, if any, for damage to third-party property or injury or death of a person due to negligence of the Contractor or any Person or firm acting on behalf of the supplier in executing the order.

38.3 Notwithstanding anything contained in the Contract, the supplier shall not be liable for any gross negligence or willful misconduct on the part of the Purchaser or any of its affiliates, any vendor, or any party, other than Supplier and/or, its directors, officers, agents or representatives or its affiliates, or Sub-supplier, or the vendor or any third party engaged by it.

38.4 Notwithstanding anything contained in the Contract, including but not limited to approval by the Purchaser of any drawings, documents, vendor list, supply of information or data or the participation of the Purchaser in any meeting and/or discussion or otherwise, shall not absolve the Supplier from any of its liabilities or responsibilities arising in relation to or under the Contract.

39.0 Intellectual Property Rights and Royalties

39.1 The Supplier shall indemnify the Purchaser and the Purchaser's Representative from and against all claims and proceedings on account of infringement (or alleged infringement) of any patent rights, registered designs, copyright, design, trademark, trade name, know-how or other intellectual property rights (hereinafter collectively referred to as "**Intellectual Property Rights**") in respect of the Works, Supplier's Equipment, machines, Works method, Plant, Materials, or anything whatsoever required for the execution of the Works and from and against all claims, demands, proceedings, damages, costs, charges and expenses whatsoever in respect thereof or in relation thereto. In the event of an infringement of any Intellectual Property Rights of any third party as a result of the execution of the Works (or any part thereof) by the Supplier, the Supplier shall rectify, modify or replace, at its own cost, the Works, Plant or Materials or anything whatsoever required for the Works so that infringement ceases to exist or, in the alternative, the Supplier shall procure necessary rights/ licenses from the affected third party so that there is no infringement of Intellectual Property Rights.

39.2 The Supplier shall be promptly notified of any claim made against the Purchaser. The Supplier shall, at its cost, conduct negotiations for the settlement of such claim, and any litigation or

arbitration that may arise from it. The Purchaser or the Purchaser's Representative shall not make any admission that might be prejudicial to the Supplier unless the Supplier has failed to take over the conduct of the negotiations, litigation or arbitration within a reasonable time after having been so requested. In the event of the Supplier failing to act at the Purchaser's Representative's notice, the Purchaser shall be at full liberty to deduct any such amount of pending claim from any amount due to the Supplier under the Contract or any other contract and the balance portion of claim shall be treated as debt due from the Supplier.

39.3 All Intellectual Property Rights in respect of any Plant, Materials, Drawings and Designs, plans, documents, specifications, data, materials, know-how, charts, information, etc., provided to the Supplier by the Purchaser pursuant to this Contract for the execution of the Works, belongs to and shall continue to belong to the Purchaser and the Supplier shall not have any rights in the same other than the limited right for its use for the purpose of execution of the Works.

39.4 Intellectual Property Rights in respect of any Plant, Materials, Drawings and Designs, plans, calculations, drawings, documents, know-how and information relating to the Works which are proprietary to the Supplier and/ or its third-party licensors ("**Supplier's IPR**") shall continue to vest with the Supplier and/ or its third-party licensors and the Supplier shall grant and/ or procure from its third party licensors, at its own cost, a worldwide, perpetual, royalty-free, non-exclusive license (along with the right to sub-license) to use and reproduce such Supplier's IPR for the use, operation, maintenance and repair of the Works.

39.5 If any patent, trademark, trade name, registered design or software is developed by the Supplier or its Sub Supplier specifically for the execution of the Works, then all Intellectual Property Rights in respect of such design, trademark, trade name or software shall be the absolute property of the Purchaser and shall not be utilized or retained by the Supplier (or its Sub Suppliers) for any purpose other than with the prior written consent of the Purchaser.

39.6 If the Supplier uses proprietary software (whether customized or off the shelf) for the purpose of storing or utilizing records in relation to the Works, the Supplier shall obtain at its own expense, the grant of a worldwide, royalty-free, perpetual licence or sublicence (including the right to sublicense) to use such software, in favour of the Purchaser provided that the use of such software under the licence or the sublicense may be restricted to use any such software only for the design, construction, reconstruction, manufacture, installation, completion, reinstatement, extension, repair and operation of the Works or any part thereof.

39.7 If any software is used by the Supplier for the execution of the Works over which the Supplier or a third party holds pre-existing title or other rights, the Supplier shall obtain for the Purchaser, a worldwide, royalty-free, perpetual license for the right to use and apply that software (together with any modifications, improvements and developments thereof).

40.0 Acceptance

40.01 Vendor confirms to have gone through the Policy of BYPL on legal and ethical code required to be followed by vendors encapsulated in the "Vendor Code of Conduct" displayed on the official website of BYPL (www.bsesdelhi.com) also, which shall be treated as a part of the contract/PO/WO.
The vendor undertakes that he shall adhere to the Vendor Code of Conduct and also agrees that any violation of the Vendor Code of Conduct shall be treated as breach of the contract/PO/WO.
In the event of any such breach, irrespective of whether it causes any loss/damage, Purchaser (BYPL) shall have the right to recover loss/damage from Vendor.
The Contractor/Vendor hereby indemnifies and agrees to keep indemnified the Purchaser (BYPL) against any claim/litigation arising out of any violation of Vendor Code of Conduct by the Contractor/Vendor or its officers, agents & representatives etc.

40.02 Acceptance of the CONTRACT implies and includes acceptance of all terms and conditions enumerated in the CONTRACT in the technical specification and drawings made available to Contractor consisting of general conditions, detailed scope of work, detailed technical specification, detailed equipment drawing and complete scope of work.

40.03 Contractor and Company contractual obligations are strictly limited to the terms set out in the CONTRACT. No amendments to the concluded CONTRACT shall be binding unless agreed to in writing for such amendment by both parties.

40.04 We expect your services and supplies to be aligned to our Vision, Mission and Values. Please refer to the following link to know about our Vision, Mission and Values; https://www.bsesdelhi.com/web/bypl/about-bses.

QUANTITY AND DELIVERY REQUIREMENTS

Sl. No.	SAP Code	Item Description	Total Qty. (Nos)	Tentative Delivery & Completion Schedule	Destination
PART-A : PRICE FOR SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF VRF/VRV/HVAC SYSTEM					
1.		SECTION 'A' - VRV SYSTEM FOR COMFORT AIR-CONDITIONING	As per Annexure-A	SITC work within 04 months from the date of LOI/Purchase Order/Work Order.	BYPL Stores/Site/ Offices
2.		SECTION 'B' - DX TFA UNIT FOR FRESH AIR SUPPLY			
3.		SECTION 'C' - VRV SYSTEM FOR BACK-UP AIR CONDITIONING			
4.		SECTION 'D' - UNDERDECK INSULATION			
5.		SECTION 'E' - INDOOR AIR PURIFICATION ARRANGEMENT			
6.		SECTION 'F' - DISMANTLING OF EXISTING INSTALLATION & TRANSPORTATION OF DISMANTLED ITEMS AT BYPL STORAGE YARD			BYPL Scrap Stores/Other Stores

Note : The detailed BOQ shall be as per Annexure-A.

X II

ANNEXURE – 2.01

FORMAT OF PERFORMANCE BANK GUARANTEE
(To be executed on a Non-Judicial Stamp Paper of appropriate value)

This Guarantee made at _____ this [___] day of [_____] 20XX

1. WHEREAS M/s BSES Yamuna Power Limited, a Company incorporated under the provisions of Companies Act, 1956 having its Registered Office at Shaktikiran Building, Karkardooma, Delhi 110032, India hereinafter referred to as the " Owner ", (which expression shall unless repugnant to the context or meaning thereof include its successors, administrators, executors and assigns).

2. AND WHEREAS the Owner has entered into a contract for _____(Please specify the nature of contract here) vide Contract No. _____dated _____(hereinafter referred to as the "Contract") with M/s._____, (hereinafter referred to as "the Supplier", which expression shall unless repugnant to the context or meaning thereof be deemed to mean and include each of their respective successors and assigns) for providing services on the terms and conditions as more particularly detailed therein.

3. AND WHEREAS as per clause ____of Conditions of Contract, the Suppliers are obliged to provide to the Owners an unconditional bank guarantee for an amount equivalent to ten percent (10%) of the total Contract Value for the timely completion and faithful and successful execution of the Contract from **[_____]** *pl. specify the name of Bank)* having its head/registered office at **[_____]** through its branch in _____*(pl. specify the name of Branch through which B.G is issued)* hereinafter referred to as "the Bank", (which expression shall unless it be repugnant to the context or meaning thereof be deemed to include its successors and permitted assigns).

4. NOW THEREFORE, in consideration inter alia of the Owner granting the Suppliers the Contract, the Bank hereby unconditionally and irrevocably guarantees and undertakes, on a written demand, to immediately pay to the Owner any amount so demanded (by way of one or more claims) not exceeding in the aggregate [Rs.].....(*in words)* without any demur, reservation, contest or protest and/or without reference to the Supplier and without the Owner needing to provide or show to the Bank, grounds or reasons or give any justification for such demand for the sum/s demanded.

5. The decision of the Owner to invoke this Guarantee and as to whether the Supplier has not performed its obligations under the Contract shall be binding on the Bank. The Bank

acknowledges that any such demand by the Owner of the amounts payable by the Bank to the Owner shall be final, binding and conclusive evidence in respect of the amounts payable by the Supplier to the Owner. Any such demand made by the Owner on the Bank shall be conclusive and binding, notwithstanding any difference between the Owner and the Supplier or any dispute raised, invoked, threatened or pending before any court, tribunal, arbitrator or any other authority.

6. The Bank also agrees that the Owner at its option shall be entitled to enforce this Guarantee against the Bank as a principal debtor without proceeding against the Suppliers notwithstanding any other security or other guarantee that the Owner may have in relation to the Supplier's liabilities.

7. The Bank hereby waives the necessity for the Owner first demanding the aforesaid amounts or any part thereof from the Suppliers before making payment to the Owner and further also waives any right the Bank may have of first requiring the Owner to use its legal remedies against the Suppliers, before presenting any written demand to the Bank for payment under this Guarantee.

8. The Bank's obligations under this Guarantee shall not be reduced by reason of any partial performance of the Contract. The Bank's obligations shall not be reduced by any failure by the Owner to timely pay or perform any of its obligations under the Contract.

9. The Bank further unconditionally and unequivocally agrees with the Owner that the Owner shall be at liberty, without the Bank's consent and without affecting in any manner its rights and the Bank's obligation under this Guarantee, from time to time, to:

   (i) vary and/or modify any of the terms and conditions of the Contract;

   (ii) Forebear or enforce any of the rights exercisable by the Owner against the Suppliers under the terms and conditions of the Contract; or

   (iii) Extend and/or postpone the time for performance of the obligations of the Suppliers under the Contract;

   and the Bank shall not be relieved from its liability by reason of any such act or omission on the part of the Owner or any indulgence shown by the Owner to the Suppliers or any other reason whatsoever which under the law relating to sureties would, but for this provision, have the effect of relieving the Bank of its obligations under this Guarantee.

10. This Guarantee shall be a continuing bank guarantee and shall not be discharged by any change in the constitution or composition of the Suppliers, and this Guarantee shall not be affected or

discharged by the liquidation, winding-up, bankruptcy, reorganization, dissolution or insolvency of the Suppliers or any of them or any other circumstances whatsoever.

11. This Guarantee shall be in addition to and not in substitution or in derogation of any other security held by the Owner to secure the performance of the obligations of the Suppliers under the Contract.

12. NOTWITHSTANDING anything herein above contained, the liability of the BANK under this Guarantee shall be restricted to _____*(insert an amount equal to ten percent (10%) of the Contract Value)* and this Guarantee shall be valid and enforceable and expire on _____*(pl. specify date)* or unless a suit or action to enforce a claim under this Guarantee is filed against the Bank on or before the date of expiry.

13. On termination of this Guarantee, all rights under the said Guarantee shall be forfeited and the Bank shall be relieved and discharged from all liabilities hereunder.

14. The Bank undertakes not to revoke this Guarantee during its validity except with the prior written consent of the Owner and agrees that any change in the constitution of the Bank or the Suppliers shall not discharge our liability hereunder.

15. This Guarantee shall be governed by the laws of India. Any suit, action, or other proceeding arising out of, connected with, or related to this Guarantee or the subject matter hereof shall be subject to the exclusive jurisdiction of the courts of **Delhi,** India.

Dated this ……. day of …….. …20XX at …….

(Signature)

.....

(Name)

.....

(Designation with Bank Stamp)
Attorney as per
Power of Attorney No.....

Date.....

ANNEXURE – 2.02

BYPL BANK DETAIL WITH IFSC CODE:

1. Name of the Bank:	Axis Bank Limited
2. Branch Name & Full Address:	C-58, Basement & Ground Floor, Preet Vihar, Main Vikas Marg, New Delhi 110092
3. Branch Code:	055
4. Bank Account No:	911030003596085
5. IFSC Code:	UTIB0000055
6. Swift Code:	AXISINBB055

ANNEXURE – 2.03

FORMAT OF WARRANTY/GUARANTEE CERTIFICATE

BSES YAMUNA POWER LIMITED Shaktikiran Building, Karkardooma, Delhi -110032.

Ref. Purchase Order No. :

Dear Sir,

We hereby confirm that the.....dispatched to BSES YAMUNA POWER LTD vide invoice no.....

DT.....is exactly of the same nature and description as per above mentioned Purchase Order.

We further confirm that we will replace/repair our.....free of cost if any manufacturing defect during.....months from the date of dispatch of material or.....months from the date of commissioning whichever is earlier.

Vendor Name & Signature

ANNEXURE – 2.04

UNDERTAKING GST

The Vendor shall give an undertaking in the following words on each invoice in the absence of which tax payment as on the Vendor's invoice may be withheld.

"The tax component as mentioned in the invoice shall be deposited with the GST Department as per law by way of actual payment or by way of legal set off as per law. The turnover billed shall be duly declared in my GST returns a copy of which shall be filed with the Purchaser. Should the input tax credit to the Purchaser be denied by way of any lapse on the part of the Vendor, the same shall be paid on demand and in any case the Purchaser is authorized to deduct the tax equivalent amount from the amount payable to the Vendor"

ANNEXURE – 2.05

SUMMARY OF COMMERCIAL TERMS AND CONDITIONS

SL NO.	PARTICULARS	CLAUSE AS PER TENDER	BIDDER'S CONFIRMATION
1.	Price Validity	120 days from the date of Bid submission.	
2.	Price basis	a) Firm, FOR Delhi stores/ sites/ offices basis. Prices shall be inclusive of all taxes, freight upto Delhi stores/ sites/ offices. b) Unloading at stores/ sites/ offices shall be in vendor's scope. c) Transit insurance in Bidder scope.	
3.	Payment terms	For Supply, Installation, Testing and Commissioning of VRF / VRV HVAC System:	
		MS-1: 60% prorata of supply value item-wise shall be payable against R/A bills for supply of equipments and materials within 30 days against receipt & acceptance of material at site and submission of documents duly certified by BYPL Project-in-charge, complete in all respects:	
		MS-2: 30% after Erection, Testing and commissioning of complete HVAC system shall be payable within 30 days against documents duly certified by BYPL Project-in-charge, complete in all respects.	
		MS-3: 10% after Handing over of complete HVAC system shall be payable within 30 days against documents duly certified by BYPL Project-in-charge, complete in all respects.	
4.	Quantity Variation	The purchaser reserves the rights to vary the quantity by (+/-) 30% of the tender quantity.	
5.	Delivery and completion Schedule	SITC work shall be completed within 4 months from the date of LOI/Purchase Order/Work Order.	
6.	Defect Liability Period	5 years comprehensive warranty from successful handing over and taking over and operational run of VRF/VRV HVAC system. Comprehensive warranty should cover repair and replacement of all the defective items and its services during the entire period to make the system operational at desired parameters.	
7.	Penalty for delay	1% per week of delay of undelivered units part thereof subject to maximum of 10% of total PO (ex works) value of undelivered units both for supply and service.	
8.	Performance Bank Guarantee	The successful bidder shall furnish the Contract Performance Bank Guarantee within fifteen (15) days from the Purchase Order Date for an amount of 10% (Ten percent) of the Total Contract value (both for Supply and Service). The Performance Bond shall be valid for a period of Sixty months (60) from the date of the commissioning or Sixty Six months (66) from the date of receipt of material (last consignment) at site/stores whichever is earlier plus 3 months towards claim period.	
9.	Reverse Auction	In a bid to make our entire procurement process more fair and transparent, BYPL intends to use the reverse auctions through SAP-SRM tool as an integral part of the entire tendering process. All the bidders who are found as techno commercial qualified based on the tender requirements shall be eligible to participate in the reverse auction event.	

Seal of the Bidder:

Signature:

Name:

VOLUME – II

PRICE BID FORMAT

ALL PRICES IN INR (₹)

Sl. No.	DESCRIPTION OF GOODS	HSN CODE (8 Digit Mandatory)	UoM	QTY **(A)**	UNIT BASIC PRICE INCL FREIGHT (₹) **(B)**	UNIT GST & CESS AS APPLICABLE (CGST & SGST/UTGST or IGST) (₹) **(C)**		UNIT LANDED RATE (All Inclusive) (₹) **(D=B+C)**	TOTAL LANDED VALUE (₹) **(E=DXA)**
						%	AMT		
PRICE FOR SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF VRF/VRV/HVAC SYSTEM									
1.	SECTION 'A' – VRV SYSTEM FOR COMFORT AIR-CONDITIONING		LOT						
2.	SECTION 'B' – DX TFA UNIT FOR FRESH AIR SUPPLY		LOT						
3.	SECTION 'C' – VRV SYSTEM FOR BACK-UP AIR CONDITIONING		LOT						
4.	SECTION 'D' – UNDERDECK INSULATION		LOT						
5.	SECTION 'E' – INDOOR AIR PURIFICATION ARRANGEMENT		LOT						
6.	SECTION 'F' - DISMANTLING OF EXISTING INSTALLATION & TRANSPORTATION OF DISMANTLED ITEMS AT BYPL STORAGE YARD		LOT						
							Total Amount (A)		
Amount in words : Rupees									

NOTE:

1) Cost of all tests as per technical specification is to be included. No separate charges will be paid.

2**) For Price bid,** Price shall be detailed as per Annexure-B of Price format.

3) For Unpriced Bid, the Un-priced bid should be marked as "Quoted" and to be submitted for Part B.

Vendor to do the site visit to review the Existing Installation.

We declare that the following are our quoted prices in INR for the entire package.

Date: Bidders Name:

Place: Bidders Address:

Signature: ..... Designation: .....

Printed Name: ..... Common Seal: .....

VOLUME – III

TECHNICAL SPECIFICATIONS

The technical specification for Supply, Installation, Commissioning and Testing of VRF/VRV HVAC system shall be as per the below attached document

BSES Yamuna Power Limited

AT

SHAKTI KIRAN BUILDING KARKARDOOMA, DELHI

SPECIFICATIONS

FOR

SITC OF HVAC WORK

CONTENTS

1. TENDER NUMBER _____

2. DATE OF ISSUE _____

3. TENDER ISSUED TO _____

_____

_____

INTRODUCTION TO PROJECT

1. **General**

This document pertains to supply, installation, testing and commissioning of HVAC system and intended to be read in conjunction with the relevant IS codes and IS Specifications (latest).

2. **Details of Site**

The site is situated at Shakti Kiran Building, Karkardooma, Delhi.

3. **Contractor's Scope of Work**

The scope of work proposed under this contract includes supply, installation, testing and commissioning of the complete HVAC system including air-conditioning works & mechanical ventilation system as elaborated in design drawings, detailed specifications and bill of quantities.

The scope shall cover Supply and Installation of all necessary equipment including Variable Refrigerant Volume/Flow (VRV/VRF) system comprising of Outdoor & Indoor Units, Double skin AHUs/ TFA Units, DX Condensing units, Split units, Axial Fans, Copper Refrigerant Piping, Condensate Drain Piping, Inline Fans and Propeller Fans etc.

.

Scope of work also includes supply and installation of site fabricated GSS ductwork, grilles/diffusers and insulation as required.

Routine testing, pressure testing of fabricated components, balancing and commissioning of the entire HVAC system and performance testing as per system requirement shall also be covered in the scope.

The Contractor shall be responsible to complete the entire work under scope in all respect in line with the contract documents and with the directions of and to the satisfaction of the Architects and Owners.

The Contractor shall furnish all labour, materials and equipment (except those to be supplied by the Owners, if any) as listed under bill of quantities and specified otherwise, transportation and incidental necessary for supply, installation, testing and commissioning of complete Mechanical Ventilation system.

The scope shall also cover supply and installation of materials, equipment, appliances and incidental work not specifically mentioned herein or noted on the drawings or documents as being furnished or installed, but which are necessary and customary to make a complete installation. Supply of such material/equipment and execution shall be carried out in accordance with the latest IS codes and IS specifications. In the event of non availability of relevant IS codes/specifications, good engineering practices shall be adopted

4.0 **Items to be provided by other agencies (Exclusions):**

The following activities associated with the said contract shall be carried out by other agencies under direct supervision of the AC contractor:

4.1 **Civil Works:**

All associated civil works listed below shall be carried out by civil /interior contractor:

a. Foundation for ODUs & Air Handling units including PCC/RCC blocks if required.

b. False ceiling work if required.

c. Providing aluminum channel through in the false ceiling for fixing of diffusers and frame work in walls for fixing of grilles.

d. Providing opening in walls/slabs for crossing of ducts/piping and making them good & finished.

4.2 **Plumbing Works:**

All associated plumbing works listed below shall be carried out by plumbing contractor.

a. Providing floor trap for termination of condensate drain piping associated with ductable & non ductable indoor units to be carried out by the AC contractor.

4.3 **Electrical Works:**

All associated electrical works listed below shall be carried out by electrical contractor:

a. Providing 415 $\pm$ 10 % volts, 50 Hz, 3 phase stabilised power supply at control panel of TFA unit, VRV ODU unit and split unit with scroll compressor in the form of power cabling and necessary earthing.

b. Providing 220 $\pm$ 6 % volts, 50 Hz, 1 phase power point near each VRV IDU and Hi-wall type split units with rotary compressor, propeller fan and inline fans as shown in the design drawings.

****

TECHNICAL CLAUSES

1. **Design Drawings**

The drawings prepared by the Consultants are indicative only of the general arrangement of the entire installation. The Contractor shall follow these drawings and specifications in preparation of his shop drawings and subsequent installation. He shall check the drawings of other trades to verify space for his installation. The Contractor shall examine all relevant architectural, structural, plumbing, electrical and other services layout drawings before preparing the shop drawings for this installation, and report to the Architects/Consultants any discrepancy and obtain clarifications. Any changes found necessary for co-ordination and installation of this work with other services and trades shall be made with prior approval of the Architects/Consultants and Owner without any additional cost to the Owner.

2. **Site visit & Shop Drawings**

The contractor shall visit the site and shall satisfy himself as to condition under which work is to be performed. No claim for consequences of ignorance at the later date shall be entertained. He should also check and ascertain the location of existing structure or equipment or any other situation which may effect the work.

The contractor shall submit five sets of shop drawings for air distribution system layout, Electrical panels & Equipment Layout drawings for approval of the Owners/Architects. Contractor shall also submit technical submittals for all major items including VRV Units, split units, ventilation fans, inline fans, piping & Valves, Ducting & GS sheet, grilles, diffusers, fire dampers, insulation material, electrical components etc. for the approval of the Owners/Architects.

Five sets of detailed shop drawings of all equipment and materials including ducting, piping, ventilation system, electrical work associated with the HVAC system required to complete the project as per specifications and as required by the Architect/ Consultant. These drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all equipment, also the details of all related items of work by other Contractors. Each item of equipment proposed shall be a standard catalogue product of an established manufacturer as per specifications.

If the Architect/Consultants makes any amendment in the above drawings, the contractor shall supply two fresh sets of drawings with the amendments duly incorporated, along with the drawings on which corrections were made. After final approval has been obtained from the Architect/Consultant, the Contractor shall submit a further six sets of shop drawings for the exclusive use of and retention by the Architect/Consultant. No material or equipment may be delivered or installed at the job site until the contractor has in his possession, the approved shop drawings for the particular material or equipment.

The shop drawings shall be submitted for approval sufficiently in advance of planned delivery and installation of any material to allow Architects/ Consultants ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved CPM charts.

Samples, drawings, specifications, catalogues, pamphlets and other documents submitted for approval shall be in quadruplicate, each item in each set shall be properly labeled,

indicating the specific service for which material or equipment is to be used, giving reference to the governing section and clause number of Specifications clearly identifying in ink the items and the operating characteristics. Data of a general nature shall not be accepted.

Approval rendered on shop drawings shall not be considered as a guarantee of measurements of building conditions. Where drawings are approved, said approval does not mean that drawings have been checked in detail nor does it any way relieve the Contractor from his responsibility or necessity of furnishing material or performing work as required by the contract.

Where the Contractor proposes to use an item of equipment other than that specified or detailed on the drawings which requires any redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical, electrical or architectural layout, all such redesign and all new drawings and detailing required thereof, shall be prepared by the Contractor at his own cost and approved by the Architect/Consultant.

Where the work of the Contractor has to be installed in close proximity to, or will interfere with work of other trades, he shall assist in working out space conditions to make satisfactory adjustments. If so directed by the Architect/Consultant, the Contractor shall prepare composite working drawings and sections at a suitable scale not less than 1:50, clearly showing how his work is to be installed in relation to the work of other trades. If the Contractor installs his work before coordinating with other trades, or so as to cause any interference with work of other trades, he shall make all the necessary changes without extra cost to the Owner.

Within two weeks of approval of all the relevant shop drawings, the Contractor shall submit to the Architect/Consultant four copies of comprehensive itemized price list of recommended imported and local spare parts and tools covering all equipment and materials in this contract. The Owner shall make arrangements to procure these spare parts and tools.

3. Material & Workmanship

All material used in work shall be of the best quality, obtainable and of approved list of manufacturers and shall conform to latest Indian Standard specifications unless otherwise stated.

4. Erection and Supervision

The Contractor shall depute engineers from time to time of commencement of installation work to inspect all relevant foundation/fabrication and other necessary facilities to make improved action if felt necessary. However, a qualified experienced engineer to be deputed at site beginning from commencement of HVAC activities at site & till handing over of the project.

5. Testing and Commissioning

On completion, the installation shall be tested for conformity with the stipulated performance specifications. Any defect, shortcoming detected in the system/material/workmanship shall be rectified by the Contractor to the entire satisfaction of the Consultants without any extra cost to the Owner. The installation shall be tested again after the removal of the defects and shall be commissioned only after approval by

competent inspecting authority or the Consultants and the Owner. All tests shall be carried out in the presence of the Consultants and Owner's representative.

Testing and commissioning shall include furnishing all labour, materials, instruments etc. and incidentals necessary for complete testing of each component as per the specifications and manufacturer's recommendations.

Maintenance Services for the complete HVAC installation shall be provided during the defects liability period of one year.

The initial tests shall include but not be limited to the following:

i. To operate & check the proper functioning of all electrically operated components like compressor motor, pumps, blowers, fans and other electrical motors etc.

ii. To test and check the switchgears etc. and other safety & control devices ensuring proper functioning.

iii. To check and balance the water flow in the water circuits so that flow rate through various equipments is as per design.

iv. To check for leaks in the system & perform pressure testing.

v. To check alignment of motors, Belts and other dynamic equipments.

vi. To check all control settings to ensure smooth & proper functioning of the system.

6. **Samples & Technical Submittals**

Samples, make or brand of all the materials must be got approved by the Architect/ Consultants/Owner in writing before they are brought to the site. Nothing extra shall be paid for presenting samples of any item as desired by Owner/Architect/Consultants.

Technical submittals of all the major items or as desired by the Architects/Consultants incorporating complete technical details in line with the tender specifications & catalogue prior to procurement of equipment/material shall be submitted for the approval.

7. Contradiction between BOQ, Specifications and Drawings :

In the event of conflicts between BOQ, Specifications and Drawings, the BOQ shall take precedence over the specifications and drawings. Keeping the general intent of the scope of work under said contract, the Architects/Consultants would interpret the requirements of the design intent & contract and their decision shall be final and acceptable to all concerns including the contractors.

8. Owner reserve the right to relax or modify any condition listed in conditions of the contract in overall interest of the work. .

9. All tools, plant and machinery provided by the contractor shall, when brought to the site, be deemed to be exclusively intended for construction and completion of this work and the

contractor shall not remove the same or any part thereof without the consent of the Architect / Owner.

10. The rates quoted by the contractor shall be all inclusive keeping in mind the specifications, additional and special conditions in view and nothing extra shall be payable whatsoever.

11. Unless otherwise provided in the schedule of quantities the rates tendered by the contractor shall be all inclusive and shall apply to all heights, lifts, leads and depths of the building. Nothing extra shall be payable to him on this account.

12**.** The equipments erected, commissioned at site should be suitable for maximum temperature of 50 degree C.

13. The electrical installation shall be carried out in accordance with Indian electricity rules, relevant Indian standard such as IS 732, IS 3043 and the requirements stipulated by local statutory body such as electrical inspectors for such installations. It is to be clearly understood that the final responsibility for sufficiency, adequacy, and conformity to the performance of the HVAC system shall be with the Contractor.

14. The equipment and materials to be supplied shall conform to the requirements of the relevant IS standards.

15. The work shall be executed strictly as per the specifications drawn and "Approved for Construction Shop Drawings" and to the entire satisfaction of the Owners/Architects.

16. Completion Drawings & Documents -After completion of the work, the contractor shall furnish four sets of completion documents complete with "As Built Drawings".

17. The contractor shall ensure good conduct of the workman at the site of work.

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SYSTEM DESIGN IN BRIEF

1.0 **Introduction :**

BSES is planning to replace their existing HVAC installation.

5.0 **Basis of Design**:

The various design parameters pertaining to air-conditioning system are being given hereunder:

a. Orientation:

Orientation of the building is as noted during site visit. Entrance of the building faces North-west Side.

b. Outside design conditions:

The outside design conditions for **NEW DELHI** are given hereunder:

Season	Dry Bulb Temperature	Wet Bulb Temperature
Summer	120.2º F (49º C) db	75º F (23.9º C) wb
Monsoon	95º F (35º C) db	83º F (28.3º C) wb
Winter	53.6º F (12º C) db	41º F (5º C) wb

c. Inside design conditions:

Summer & Monsoon:

i. **For Office Spaces**

Temperature : 73.4± 2ºF (23±1ºC)
Relative Humidity : Not to exceed 65% during monsoon

d. External Building Fabric detail:

The following details as regard to heat gain from external building fabric have been considered which are subject to further confirmation from Developers:

i. **For Single Glass:**

Solar Factor: 0.56
Overall Heat Transfer Co-efficient ("U" Value): 1.13 BTUs/Hr Sft F (6.42 Watt/SqM K)

ii. **For Walls** (230mm Brick Wall):

Overall Heat Transfer Co-efficient ("U" Value): 0.32 BTUs/Hr Sft F (1.82 Watt/SqM K)

iii. **For Roof Exposed to Sun (with 19mm thick Nitrile Rubber insulation with class 'O' fire retardant properties in form of underdeck insulation)**:

Overall Heat Transfer Co-efficient ("U" Value): 0.16 BTUs/Hr Sft F (0.91 Watt/SqM K).

e. Fresh air replenishment:

Generally, as per ASHRAE Standard 62.1 – 2022 recommendations + 30% Extra as LEED recommendations

i. For Office Spaces – (5Cfm/Person + 0.06Cfm/Sq. Ft) x 1.3

g. Relevant International Codes and Standards:

Apart from the specific equipment standards and specifications, the following broad certifying agency/standards will be considered while designing the system:

i. ASHRAE-American Society for Heating, Refrigerating and Air-conditioning Engineers

ii. ISHRAE-Indian Society for Heating, Refrigerating and Air-conditioning Engineers

iii. National Building Code of India (NBC) 2016

iv. SMACNA – Sheet Metal and Air Conditioning Contractors National Association.

v. UL - Underwriter's Laboratory, USA.

6.0 Heat Loads with Existing & Proposed Equipment Selection

Based on the interior plans and design data mentioned below, the heat loads for the various spaces to be air-conditioned have been worked out and heat load results along with equipment selection are given hereunder:

Space	Area (Sq. ft.)	Height (Ft.)	Occupancy	Lighting Load (W/ Sq. ft.)	Equipment Load (KW)	Fresh Air (Cfm)	TR (S)	TR (M)	Heating (KW)	Dehumidified Air Quantity (Cfm)	Equipment Selection (Existing)	Equipment Selection (Working)	Equipment Selection (Standby)
	Ground Floor												
	Connecting Passage Areas												
Reception & Corridor Area	1070	10.9	8	0.8	0.20	135	4.7	3.6	-3.4	2395	1x8.5TR Ductable type Indoor unit	1x8.0TR/2966 VRF based Ductable type indoor units	--
Security Room	50	10.9	2	0.8	0.15	17	0.3	0.3	-0.1	108	1x1.5TR Hi wall type split unit		--
O.S. Room	70	10.9	2	0.8	0.15	18	0.5	0.4	-0.4	248	Not Known		--
Carnation Room	115	10.9	8	0.8	0.50	61	2.4	2.0	-0.8	1201	window AC installed, capacity not known	1x2.0TR/706Cfm VRF Based Hi-wall type IDU	--
Total (Connecting Passage	**1305**					**232**	**7.9**	**6.3**	**-4.7**	**3952**		**Total VRF IDUs : 10TR Proposed**	--

Space	Area (Sq. ft.)	Height (Ft.)	Occupancy	Lighting Load (W/ Sq. ft.)	Equipment Load (KW)	Fresh Air (Cfm)	TR (S)	TR (M)	Heating (KW)	Dehumidified Air Quantity (Cfm)	Equipment Selection (Existing)	Equipment Selection (Working)	Equipment Selection (Standby)
Areas)												**VRF ODUs : 10HP**	
	Block- A												
Admin Staff	95	9.4	10	0.8	0.5	40	0.9	0.9	-0.2	422	DX Split Hi wall type IDU, capacity not known	1x1.3TR/406Cfm VRF Based Hi-wall type IDU	--
Cabin NE-Glazing	175	9.4	5	0.8	0.50	46	1.0	1.0	-0.2	456	DX Split Hi wall type IDU, capacity not known	1x2.0TR/706Cfm VRF Based Hi-wall type IDU	--
Conference Room SW-Glazing	755	9.4	35	0.8	1.50	286	5.7	6.1	-1.0	2416	2x4TR Cassette type Split units	2x4TR/1236Cfm Round flow cassette type IDUs	--
Cabin SW-Glazing	85	9.4	3	0.8	0.20	26	1.0	1.0	-0.3	514	DX Split Hi wall type IDU, capacity not known	1x2.0TR/706Cfm VRF Based Hi-wall type IDU	--
Internal Cabin	85	9.4	3	0.8	0.20	26	0.3	0.4	0.1	109	DX Split Hi wall type IDU, capacity not known	1x1.0TR/367Cfm VRF Based Hi-wall type IDU	--
Staff Room (Block- A & B)	140	9.4	4	0.8	0.25	37	1.2	1.2	-0.3	564	DX Split Hi wall type IDU, capacity not known	1x2.0TR/706Cfm VRF Based Hi-wall type IDU	--
Fresh air arrangement												1x750Cfm/6.4 TR DX TFA unit with 8HP VRV outdoor unit	
Total- Block- A	**1335**					**461**	**10.1**	**10.6**	**-1.9**	**4481**		**Total VRF IDUs : 23.2TR Proposed VRF ODUs : 24HP (12HP+12HP) VRF Outdoor unit**	
	Block- C												
Coffee Shop & Waiting Area	645	9.4	15	0.8	0.20	148	3.5	3.6	-1.1	1579	1x5.5TR Ductable type split unit	1x8TR/2966Cfm VRF based Ducatable type indoor unit & 1x2TR Wall Mounted type VRF IDU connected to	--
Meeting Room	170	9.4	12	0.8	0.75	91	2.8	2.7	-0.7	1358	1x1.5TR Hi wall type split unit & also fed from Coffee shop		--

Space	Area (Sq. ft.)	Height (Ft.)	Occupancy	Lighting Load (W/ Sq. ft.)	Equipment Load (KW)	Fresh Air (Cfm)	TR (S)	TR (M)	Heating (KW)	Dehumidified Air Quantity (Cfm)	Equipment Selection (Existing)	Equipment Selection (Working)	Equipment Selection (Standby)
											Ductable unit	12HP outdoor unit	
Green Room	355	12.9	5	0.8	0.20	59	0.9	0.9	-0.6	371	1x11TR & 5.5TR Ductable type split units	1x4500Cfm/ 16TR VRF Based Ceiling Suspended Air Handling unit Connected with 20HP Outdoor unit	--
Auditorium	1530	12.9	140	0.8	2.00	1142	12.5	15.7	-0.2	3619			--
Total-Block-C	**2700**					**1440**	**19.7**	**23.0**	**-2.6**	**6927**			
Fresh air arrangement												1x1500Cfm/9.6TR DX TFA unit with 12HP Outdoor unit	
Total-G. F	**5340**					**2133**	**37.7**	**39.9**	**-9.2**	**15360**			
	1st Floor												
	Connecting Passage Areas												
Reception & Corridor Area	850	9.5	5	0.8	0.10	99	3.6	2.8	-2.6	1840	1x3.0TR Cassette type split unit	1x6.4TR/2542 Cfm VRF based Ductable type indoor unit	--
Security Room	50	9.5	2	0.8	0.10	17	0.3	0.3	-0.1	95	Not Known		--
Meeting Room adj Lift	110	9.5	10	0.8	0.50	74	2.1	1.9	-0.6	981	window AC installed, capacity not known	1x2.0TR/706Cfm VRF Based Hi-wall type IDU	--
HOD's Dining Hall	145	9.5	10	0.8	0.10	101	1.0	1.3	-0.3	295	DX Split Hi wall type IDU, capacity not known	1x1.3TR/406Cfm VRF Based Hi-wall type IDU	--
Total (Connecting Passage Areas)	**1155**					**290**	**6.9**	**6.3**	**-3.6**	**3210**		**Total VRF IDUs : 9.7TR Proposed VRF ODU : 10HP VRF Outdoor unit**	
	Block- A												
HOD Cabin-1 NE-Glazing	100	9.4	3	0.8	0.15	27	0.7	0.6	-0.3	323	2x11TR & 1x5.5TR Ductable type indoor units	8x4.6TR/1412 Cfm VRF based Ductable type indoor units	4x4.6TR/1412 Cfm VRF based Ductable type indoor units
HOD Cabin-2 & 3 NE-Glazing (Typical to above 2-Nos.)	200					55	1.4	1.2	-0.7	646			
Meeting Room-10 Pax NW-	175	9.4	12	0.8	0.75	92	2.3	2.1	-0.6	1064			

Space	Area (Sq. ft.)	Height (Ft.)	Occupancy	Lighting Load (W/ Sq. ft.)	Equipment Load (KW)	Fresh Air (Cfm)	TR (S)	TR (M)	Heating (KW)	Dehumidified Air Quantity (Cfm)	Equipment Selection (Existing)	Equipment Selection (Working)	Equipment Selection (Standby)
Glazing													
HOD Cabin-4 NW-Glazing	110	9.4	3	0.8	0.15	28	0.6	0.6	-0.2	283			
HOD Cabin-5 SW-Glazing	110	9.4	3	0.8	0.15	28	1.7	1.4	-0.8	927			
Workstation Area	1030	12.9	22	0.8	2.00	223	4.9	5.3	-0.5	2222			
Sub Total-I	**1725**					**453**	**11.7**	**11.2**	**-3.1**	**5465**			
	Block- B												
Internal HOD Cabin-1	100	9.4	3	0.8	0.15	27	0.3	0.4	0.1	97			
HOD Cabin-2 adj. to Pantry	100	9.4	3	0.8	0.15	27	0.4	0.4	-0.1	132			
HOD Cabin-2 NE-Glazing	100	9.4	3	0.8	0.15	27	0.7	0.6	-0.4	338			
Meeting Room-10 Pax SE-Glazing	175	9.4	12	0.8	0.75	92	2.0	1.9	-0.6	879			
HOD Cabin-4 SE-Wall	110	9.4	3	0.8	0.15	28	0.5	0.5	-0.2	229			
HOD Cabin-5 SW-Glazing	110	9.4	3	0.8	0.15	28	1.4	1.2	-0.8	727			
Workstation Area	1030	9.4	22	0.8	2.00	223	4.9	5.3	-0.5	2222			
Passage Area (Block- A & B)	325	9.4	2	0.8	0.00	38	0.8	0.8	-0.3	354			
Sub Total-II	**2050**					**491**	**11.0**	**11.1**	**-2.8**	**4979**			
Fresh air arrangement												1x1000Cfm/8 TR DX TFA unit with 10HP VRV outdoor unit	
Total (Block-A & B)	**3775**					**944**	**22.7**	**22.4**	**-5.9**	**10443**		**Total VRF IDUs : 36.8TR Proposed VRF ODUs :**	**Total VRF IDUs : 18.4TR Proposed VRF ODUs : 18HP**

Space	Area (Sq. ft.)	Height (Ft.)	Occupancy	Lighting Load (W/ Sq. ft.)	Equipment Load (KW)	Fresh Air (Cfm)	TR (S)	TR (M)	Heating (KW)	Dehumidified Air Quantity (Cfm)	Equipment Selection (Existing)	Equipment Selection (Working)	Equipment Selection (Standby)
												36HP (2x18HP modules) + 10HP	
	Block- C												
Cabin-1	115	9.4	3	0.8	0.15	28	1.1	1.1	-0.4	574	2x11TR Ductable type indoor unit	4x4.6TR/1412 Cfm VRF based Ductable type indoor unit	2x4.6TR/1412 Cfm VRF based Ductable type indoor unit
Cabin-2 (Typical to above)	115					28	1.1	1.1	-0.4	574			
Sub Total-I	**230**					**57**	**2.3**	**2.2**	**-0.9**	**1148**			
	Block- D												
Internal Cabin adj. to Electrical Room	115	9.4	3	0.8	0.15	28	0.4	0.5	-0.2	161			
Waiting Area	330	9.4	5	0.8	0.00	58	1.0	1.1	-0.7	434			
P.A Room	70	9.4	2	0.8	0.20	18	0.8	0.8	-0.4	416			
Meeting Room-10 Pax	270	9.4	12	0.8	0.75	99	1.5	1.7	0.0	573			
Reception (Block-C & D)	545	12.9	5	0.8	0.15	75	1.3	1.5	-0.4	579			
Workstation Area (Block-C & D)	435	9.4	15	0.8	1.70	131	3.1	2.9	-1.0	1386			
CEO Cabin	480	9.4	5	0.8	0.25	70	2.4	1.8	-1.7	1212	1x3.0TR 4-way Cassette type unit		
Board Room NE-Glazing (Block- C)	675	9.4	40	0.8	1.75	313	5.1	5.5	-1.6	1963	2x4.0TR Round Cassette type split units	2x3.2TR/1024 Cfm Cassette type VRF IDUs	--
Cafeteria (Block- C)	330	9.4	14	0.8	0.50	164	3.0	2.9	-1.0	1226	1x4.0TR Round Cassette type split unit	1x4TR/1236Cfm Cassette type VRF IDUs	--
Sub Total-II	**3250**					**958**	**18.6**	**18.5**	**-6.9**	**7951**		**For Board Room & Cafeteria VRF ODU: 12HP**	
Fresh air arrangement												1x1000Cfm/8 TR DX TFA unit with 10HP VRF outdoor unit	

Space	Area (Sq. ft.)	Height (Ft.)	Occupancy	Lighting Load (W/ Sq. ft.)	Equipment Load (KW)	Fresh Air (Cfm)	TR (S)	TR (M)	Heating (KW)	Dehumidified Air Quantity (Cfm)	Equipment Selection (Existing)	Equipment Selection (Working)	Equipment Selection (Standby)
Total (Block-C & D)	**3480**					**1015**	**22.0**	**21.4**	**-8.5**	**9753**		**Total VRF IDUs : 18.4TR Proposed VRF ODUs : 20HP (2x10HP Modules) + 10HP**	**Total VRF IDUs : 9.2TR Proposed VRF ODUs : 10HP**
Total-1st F	**8410**					**2249**	**50.6**	**49.3**	**-17.3**	**22753**			
	2nd Floor												
	Connecting Passage Areas												
Waiting & Corridor Area	1070	9.5	5	0.8	0.10	116	3.8	3.0	-2.6	1952	Not Known	1x6.4TR/2542 Cfm VRF based Ductable type indoor unit	--
Meeting Room adj Lift	110	9.5	9	0.8	0.75	66	2.1	1.8	-0.5	1002	window AC installed, capacity not known	1x2.0TR/706Cfm VRF Based Hi-wall type IDU	--
Library	290	9.5	22	0.8	0.15	166	2.2	2.5	-0.4	721	2x1.5TR Hi-wall type split units	1x1.3TR/636Cfm & 1x1.0TR/600Cfm VRF Based Cassette type IDUs	--
Restaurant	155	9.5	18	0.8	0.15	163	1.8	2.3	-0.2	488	Not Known	1x2.0TR/706Cfm VRF Based Hi-wall type IDU	--
Total (Connecting Passage Areas)	**1625**					**510**	**9.9**	**9.7**	**-3.7**	**4164**		**Total VRF IDUs : 12.7TR Proposed VRF ODUs : 14HP VRF Outdoor unit**	
	Block- A												
Cabin	100	9.4	3	0.8	0.15	27	0.7	0.6	-0.3	323	2x11TR & 1x8.5TR Ductable type DX split units	8x4TR/1236Cfm VRF based Ductable type indoor units	4x4TR/1236Cfm VRF based Ductable type indoor units
Staff	210	9.4	6	0.8	0.50	52	1.9	1.5	-0.9	956			
Internal WS Area	845	9.4	20	0.8	1.80	195	3.1	3.5	0.2	1239			
Part WS Area-SW Side	460	12.9	7	0.8	0.50	79	4.2	3.7	-1.8	2217			
Sub Total-I	**1615**					**353**	**9.9**	**9.3**	**-2.9**	**4735**			
	Block- B												
Cabin-1	100	9.4	3	0.8	0.15	27	0.3	0.4	0.1	97			
Cabin-2	100	9.4	3	0.8	0.15	27	0.4	0.4	-0.1	150			

Space	Area (Sq. ft.)	Height (Ft.)	Occupancy	Lighting Load (W/ Sq. ft.)	Equipment Load (KW)	Fresh Air (Cfm)	TR (S)	TR (M)	Heating (KW)	Dehumidified Air Quantity (Cfm)	Equipment Selection (Existing)	Equipment Selection (Working)	Equipment Selection (Standby)
Staff	215	9.4	6	0.8	0.50	53	1.8	1.4	-1.0	895			
Internal WS Area	775	9.4	20	0.8	1.80	189	2.8	3.2	0.2	1091			
Part WS Area-SW Side	420	9.4	7	0.8	0.50	76	3.7	3.3	-1.7	1931			
Sub Total-II	**1610**					**372**	**9.0**	**8.8**	**-2.6**	**4163**			
Meeting Room-8pax (Block- A & B)	275	9.4	9	0.8	0.75	79	1.3	1.5	0.02	523			
Sub Total-III	**275**					**79**	**1.3**	**1.5**	**0.0**	**523**			
Fresh air arrangement												1x1000Cfm/8 TR DX TFA unit with 10HP VRV outdoor unit	
Total (Block-A & B)	**3500**					**803**	**20.2**	**19.6**	**-5.4**	**9421**		**Total VRF IDUs : 32TR Proposed VRF ODUs : 32HP (2x16HP modules) + 10HP**	**Total VRF IDUs : 16TR Proposed VRF ODUs : 16HP**
	Block- C												
Cabin-1	100	9.4	3	0.8	0.15	27	1.0	1.0	-0.3	487	2x11TR & 1x8.5TR Ductable type DX split units	8x4TR/1236Cfm VRF based Ductable type indoor units	4x4TR/1236Cfm VRF based Ductable type indoor units
Cabin-2 (Typical to above)	100					27	1.0	1.0	-0.3	487			
Staff	205	9.4	6	0.8	0.50	52	2.6	2.4	-1.0	1393			
Internal WS Area	870	9.4	20	0.8	1.80	197	3.2	3.5	0.2	1276			
Part WS Area-NE Side	455	9.4	7	0.8	0.66	78	3.2	2.4	-1.8	1654			
Sub Total-I	**1730**					**381**	**11.0**	**10.2**	**-3.4**	**5298**			
	Block- D												
Cabin-1	100	9.4	3	0.8	0.15	27	0.3	0.4	0.1	102			
Cabin-2 (Typical to above)	100					27	0.3	0.4	0.1	102			
Staff	205	9.4	6	0.8	0.50	52	2.2	2.0	-0.9	1144			
Internal	775	9.4	20	0.8	1.80	189	3.0	3.3	0.1	1162			

Space	Area (Sq. ft.)	Height (Ft.)	Occupancy	Lighting Load (W/ Sq. ft.)	Equipment Load (KW)	Fresh Air (Cfm)	TR (S)	TR (M)	Heating (KW)	Dehumidified Air Quantity (Cfm)	Equipment Selection (Existing)	Equipment Selection (Working)	Equipment Selection (Standby)
WS Area													
Part WS Area-NE Side	415	9.4	7	0.8	0.66	75	2.3	1.9	-1.3	1146			
Sub Total-II	**1595**					**371**	**8.1**	**8.0**	**-2.0**	**3655**			
Meeting Room-8pax (Block-C & D)	275	12.9	8	0.8	0.75	77	1.2	1.3	0.00	458			
Sub Total-III	**275**					**77**	**1.2**	**1.3**	**0.0**	**458**			
Fresh air arrangement												1x1000Cfm/8 TR DX TFA unit with 10HP VRV outdoor unit	
Total (Block-C & D)	**3600**					**829**	**20.3**	**19.5**	**-5.4**	**9411**		**Total VRF IDUs : 32TR Proposed VRF ODUs : 32HP (2x16HP modules) + 10HP**	**Total VRF IDUs : 16TR Proposed VRF ODUs : 16HP**
Total-2nd F	**8725**					**2142**	**50.4**	**48.8**	**-14.5**	**22996**			
	3rd Floor (with underdeck insulation)												
	Connecting Passage Areas												
Corridor Area	1000	9.5	5	0.8	0.00	111	4.8	3.6	-3.3	2533	Not known	1x6.4TR/2542 Cfm VRF based Ductable type indoor units	--
Meeting Room adj Lift	145	9.5	12	0.8	0.20	116	1.3	1.6	-0.4	437	1x1.5TR Hi-wall type split units	1x2.0TR/706Cfm VRF Based Hi-wall type IDU	--
Restaurant	110	9.5	8	0.8	0.50	61	2.0	1.7	-0.7	982	window AC installed, capacity not known	1x2.0TR/706Cfm VRF Based Hi-wall type IDU	--
Total (Connecting Passage Areas)	**1255**					**287**	**8.1**	**6.9**	**-4.3**	**3952**		**Total VRF IDUs : 10.4TR Proposed VRF ODUs : 12HP VRF Outdoor unit**	
	Block- A												
Cabin-1 NE-Glazing	90	9.5	3	0.8	0.15	27	0.8	0.7	-0.4	389	6x6.4TR VRV based Ductable type	4x4.6TR/1412 Cfm & 4x4.0TR/1236	2x4.6TR/1412 Cfm & 2x4.0TR/1236

Space	Area (Sq. ft.)	Height (Ft.)	Occupancy	Lighting Load (W/ Sq. ft.)	Equipment Load (KW)	Fresh Air (Cfm)	TR (S)	TR (M)	Heating (KW)	Dehumidified Air Quantity (Cfm)	Equipment Selection (Existing)	Equipment Selection (Working)	Equipment Selection (Standby)
Cabin-2 (Typical to above)	90					27	0.8	0.7	-0.4	389	units	Cfm VRV based Ductable type IDUs	Cfm VRV based Ductable type IDUs
Cabin-3 NW-Glazing	90	9.5	3	0.8	0.15	27	1.4	1.0	-0.8	737			
	Block- B												
Cabin-1 adj. to Toilet	90	9.5	3	0.8	0.15	27	0.5	0.5	-0.2	200			
Cabin-2 (Typical to above)	90					27	0.5	0.5	-0.2	200			
Cabin-3 NE Glazing	90	9.5	3	0.8	0.15	27	0.8	0.7	-0.4	386			
Cabin-4 SE Side	90	9.5	3	0.8	0.15	27	1.1	0.8	-0.8	578			
Sub Total-I (Block- A & B)	**630**					**186**	**5.9**	**4.8**	**-3.3**	**2879**			
Internal Workstation Area (Block- A)	905	9.5	20	0.8	2.30	201	4.5	4.4	-0.4	2016			
Part WS Area-SW Glazing (Block- A)	460	9.5	10	0.8	0.60	101	5.2	4.6	-2.3	2737			
Internal WS Area (Block- B)	930	9.5	20	0.8	2.30	203	4.2	4.2	-0.4	1852			
Part WS Area-SW Side (Block- B)	415	9.5	10	0.8	0.60	97	4.5	4.1	-2.1	2363			
Meeting Room-8 Pax (Block- A & B)	275	9.5	10	0.8	0.75	86	2.4	2.4	-0.5	1123			
Sub Total-II	**2985**					**688**	**20.8**	**19.7**	**-5.7**	**10092**			
Fresh air arrangement												1x1000Cfm/8 TR DX TFA unit with 10HP VRV outdoor unit	
Total (Block- A & B)	**3615**					**873**	**26.7**	**24.5**	**-9.0**	**12971**	**3x14HP VRV ODUs**	**Total VRF IDUs: 34.4TR Proposed VRF ODUs : 36HP (2x18HP**	**Total VRF IDUs: 17.2TR Proposed VRF ODUs : 18HP VRF Outdoor unit**

Space	Area (Sq. ft.)	Height (Ft.)	Occupancy	Lighting Load (W/ Sq. ft.)	Equipment Load (KW)	Fresh Air (Cfm)	TR (S)	TR (M)	Heating (KW)	Dehumidified Air Quantity (Cfm)	Equipment Selection (Existing)	Equipment Selection (Working)	Equipment Selection (Standby)
												Modules) + 10HP VRF Outdoor unit	
	Block- C												
Cabin-1 SW-Glazing	90	9.5	3	0.8	0.15	27	1.1	1.0	-0.4	549	4x6.4TR VRV based Ductable type units	4x4.6TR/1412 Cfm & 2x4.0TR/1236 Cfm VRF based Ductable type indoor units	2x4.6TR/1412 Cfm & 1x4.0TR/1236 Cfm VRF based Ductable type indoor units
Cabin-2 & 03 (Typical to above- 2 Nos.)	180					53	2.2	2.0	-0.9	1098			
Cabin- 4 NW-Glazing	90	9.5	3	0.8	0.15	27	1.7	1.4	-0.8	909			
Internal Workstation Area	905	9.5	20	0.8	2.30	201	4.5	4.4	-0.4	2018			
Part Workstation Area NE-Glazing	460	9.5	10	0.8	0.60	101	4.0	3.1	-2.3	2051			
Sub Total-I	**1725**					**408**	**13.4**	**12.0**	**-4.7**	**6625**			
	Block- D												
Cabin adj. to Server Room	180	9.5	3	0.8	0.20	34	0.6	0.6	-0.1	233			
Workstation Area- 7 Nos.	250	9.5	7	0.8	0.70	65	1.5	1.4	-0.5	697			
P.A. Room SW-Glazing	65	9.5	2	0.8	0.15	18	0.8	0.7	-0.3	403			
HOD Cabin	110	9.5	3	0.8	0.15	28	1.6	1.4	-0.9	866			
Sub Total-II	**605**					**145**	**4.5**	**4.2**	**-1.7**	**2198**			
Fresh air arrangement												1x750Cfm/6.4 TR DX TFA unit with 8HP VRV outdoor unit	
Total (Block- C & D)	**2330**					**552**	**17.9**	**16.1**	**-6.4**	**8823**	**2x14HP VRV ODUs**	**Total VRF IDUs : 26.4TR Proposed VRF ODUs : 28HP (2x14HP modules) + 8HP**	**Total VRF IDUs : 13.2TR Proposed VRF ODUs : 14HP**

Space	Area (Sq. ft.)	Height (Ft.)	Occupancy	Lighting Load (W/ Sq. ft.)	Equipment Load (KW)	Fresh Air (Cfm)	TR (S)	TR (M)	Heating (KW)	Dehumidified Air Quantity (Cfm)	Equipment Selection (Existing)	Equipment Selection (Working)	Equipment Selection (Standby)
Total- 3rd F	**7200**					**1713**	**52.7**	**47.6**	**-19.7**	**25746**			
Grand Total	**29675**					**8237**	**191.4**	**185.6**	**-60.7**	**86855**			

* Appliances in the form of food warmers.

Notes:

i. Equipment load for office spaces has been arrived at considering 100 watts as heat dissipation per work station & lighting load has been considered @ 0.8Watt/Sft.

Assumptions:

The above heat load calculations and equipment selection have been considered adequate based on the following assumptions:

a. Window frames to incorporate rubber gaskets to make them air tight.

b. External Windows/Curtain glazing has been considered with Single Glass having Solar factors and "U" Value as mentioned above.

c. Curtain glazing shall be provided with inside roller blinds.

d. All floors are considered to be simultaneously air conditioned.

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TECHNICAL SPECIFICATIONS

A. "SPECIFICATIONS- MAIN EQUIPMENT"

1. VARssIABLE REFRIGERANT VOLUME/FLOW SYSTEM

Scope

The scope shall be supply, installation, testing and commissioning of air cooled variable refrigerant Volume (VRV/VRF) system conforming to these specifications and meeting all design parameters as mentioned in the "Bill of Quantities" and drawings. Variable Refrigerant Volume/Flow System shall be a standard product; however, all these specifications shall fully comply.

Type

Unit shall be heat pump type consisting of outdoor units and multiple indoor units, each suitable to facilitate cooling during summer & monsoon and heating in winter as per the requirements.

It shall be possible to connect minimum 10 indoor units on one refrigerant circuit. The indoor units on any circuit can be of different type and also controlled individually.

Compressor installed in outdoor units shall be equipped with all inverter compressors up to 20 HP and in bigger machines for higher reliability, improved life, better backup and duty cycling purpose. The system shall be capable of changing the rotating speed of inverter compressor by inverter controller to follow variations in cooling and heating load.

Outdoor unit shall be suitable for mix match connection of all type of indoor units.

The refrigerant piping between indoor units and outdoor unit shall be possible to extend up to 165M with maximum 50M level difference **without any oil traps.**

Both indoor units and outdoor unit shall be factory assembled, tested and filled with first charge of refrigerant gas before delivering at site.

Units shall be factory finished with paint as per manufacturer's standard. However, shop coats of paint that have become marred during shipment or erection shall be cleaned off with mineral spirit, wire brushed and spot primed over the affected areas, then coated with enamel paint to match the finish over the adjoining shop painted surfaces.

Capacity

The refrigeration capacity of VRV outdoor and indoor units shall be as mentioned in the "Bill of Quantities" and as reflected on the drawings.

Outdoor Unit

The unit shall be heat pump type with automatic changeover in different seasons.

The outdoor unit shall be a factory assembled unit housed in a sturdy weather proof casing constructed from rust-proofed heavy gauge mild steel panels coated with a baked enamel finish. The unit should be completely factory wired, tested with all necessary controls.

All outdoor units shall have minimum two scroll compressors and be able to operate even in case of breakdown of one compressor. In case of outdoor units above 20HP, the outdoor unit shall have multiple inverter compressors so that the operation is not disrupted with failure of any compressor and if one compressor malfunctions, other continues to provide emergency operation smoothly till repair is effected. The unit shall be provided with duty cycling arrangement for multiple inverter compressors to facilitate sequenced operation of the machine for better stability and prolonged life.

The outdoor unit shall be modular in design and should be allowed for side by side installation. The unit shall be provided with its own microprocessors control panel.

The outdoor unit should have anti-corrosion paint free steel plate for easy mounting of unit.

The machine must have sub cool feature to use coil surface more effectively thru proper circuit/bridge so that it prevents the flushing of refrigerant from long piping due to this effect thereby achieving energy savings.

The outdoor unit should be fitted with low noise, aero spiral design fan with grill for spiral discharge airflow to reduce pressure loss and should be fitted with DC fan motor for better efficiency. The noise level shall not be more than 60dB (A) at normal operation measured horizontally 1M away and 1.5M above ground. For Residential application or wherever night operation is required the unit shall be suitable to operate on nighttime quiet operation mode having minimum three step of operation sound level i.e. 55dB to 45dB. Wherever required or as shown on the drawings the unit shall be selected for high external static pressure (ESP) not less than 78Pa (8mm WG) to meet long exhaust duct connection requirement.

The outdoor unit shall be designed to operate safely when connected to multiple fan coil units.

The unit shall be suitable to operate on environment friendly R 410A refrigerant.

Compressor

The compressor shall be highly efficient, high COP scroll type and capable of inverter control. The inverter compressor shall change the speed in accordance to the variation in cooling or heating load requirement.

All outdoor unit shall have multi-steps of capacity control to meet load fluctuation and indoor unit individual control. All parts compressor shall be sufficiently lubricated stock. Forced lubrication may also be employed.

Oil heater shall be provided in the compressor casing.

Inverter compressor shall preferably by Reluctance DC inverter compressor for higher efficiency and improved reliability.

Heat Exchanger

The heat exchanger shall be constructed with copper tubes mechanically bonded to aluminum fins to form a cross fin coil. The aluminum fins shall be covered by anti-corrosion resin film. The unit should be with e-pass heat exchanger to optimize the path of

heat exchanger and for better efficiency of condenser. The unit shall be provided with necessary number of direct driven low noise level propeller type fans arranged for vertical discharge. Each fan shall have a safety guard.

Refrigerant Circuit

The refrigerant circuit shall include an accumulator, liquid and gas shut off valves and a solenoid valves at condenser end. The equipment must have in built refrigerant stabilization control for proper refrigerant distribution.

All necessary safety devices shall be provided to ensure the safety operation of the system.

Safety Devices

VRV system shall be provided with all safety devices as required and to ensure safe operation of the system, but not restricted to the following :

a. High pressure switch.

b. Low pressure switch.

c. Fuse.

d. Fan drive overload protector.

e. Fusible plug

f. Overload relay.

g. Overload protection for inverter.

h. Fan motor safety thermostat

Oil Recovery System

Each unit shall be equipped, with an oil recovery system to ensure stable operation with long refrigerant piping.

The system must be provided with oil balancing circuit to avoid poor lubrication.

Anti-corrosion Treatment

Outdoor units should be designed with anti-corrosion specifications as detailed below for use in area, which are subject to salt damage and atmospheric pollution as specified in the BOQ.

The portion of machines like side panel, outer panel, bottom frame, which are exposed to corrosive atmosphere, should be of alloyed hot-dip zinc coated steel plate, coated with corrosion protection powder polyester resin coating on both inner and outer surfaces in thickness of 64 micron or more.

Finned coil protection net should have coating of resin coating containing ultraviolet ray absorbent. Fan and its fan protective net should be with weather resistant polypropylene resin.

The copper pipe –aluminium fins shall be special acrylic resin coated and internal supports, frame, control box shall also be hot-dip zinc coated steel plate and with rust preventive powder coating of 64 micron or more on inner and outer surfaces.

All screws and bolts used in outdoor unit shall be provided with SUS410, Zinc-nickel alloy plating, zinc chrome acid film treatment and rust inhibitor coating.

Indoor Units

This section deals with supply, installation, testing, commissioning of various type of indoor units confirming to general specification and suitable for the duty selected. The type capacity and size of indoor units shall be as specified in detail Bill of Quantities.

Indoor unit shall be either ceiling mounted cassette type, or ceiling mounted ductable type or floor standing type or wall mounted type or other as specified in BOQ. Each unit shall have electronic control valve to control refrigerant flow rate respond to load variations of the rooms. The indoor units shall have following features :

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

b. In case of centralized control, it shall be set by liquid crystal remote controller.

c. The fan shall be dual suction, aerodynamically designed turbo, multi blade type, statically & dynamically balanced to ensure low noise and vibration free operation of the system. The fan shall be direct driven type, mounted directly on motor shaft having supported from housing.

d. The cooling coil shall be made out of seamless copper tubes and have continues 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 expended for minimum thermal contact resistance with fins. Each coils shall be factory tested at 21kg/sqm air pressure under water.

e. Unit shall have cleanable type filter fixed to an integrally moulded plastic frame. The filter shall slide away type and neatly inserted.

f. Each indoor unit shall have computerized PID control for maintaining design room temperature. Each unit shall be provided with microprocessor thermostat for cooling and heating.

g. Each unit shall be with wired LCD type remote controller. The remote controller shall memorize the latest malfunction code for easy maintenance. The controller shall have self diagnostic features for easy and quick maintenance and service. The controller shall be able to change fan speed and angle of swing flap individually as per requirement.

The indoor units shall generally be of following type :

Ceiling Mounted Ductable Type Unit

Each Indoor unit shall be ceiling mounted ducted type, as specified in scope of work. It shall have electronic control valve to control refrigerant flow rate in response to load variations of the room. The fan shall be of the dual suction multi blade type and statically and dynamically balanced to ensure low noise and vibration free operation. The unit shall have high static fan for Ductable arrangement.

Ceiling Mounted Cassette Type Unit (Multi Flow/ Round Flow Type)

The unit shall be ceiling mounted type. The unit shall include pre-filter, fan section and DX-coil section. The housing of the unit shall be powder coated galvanized steel. The body shall be light in weight and shall be able to suspend from four corners. The fan shall be aerodynamically designed diffuser turbo fan type. Noise level should not be more then 35 dB at low speed.

Unit shall have an external attractive panel for supply and return air. Unit shall have four way supply air grilles on sides and return air grille in center.

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

All the indoor units regardless of their difference in capacity should have **same decorative panel size** for harmonious aesthetic point of view. It should have provision of connecting branch ducts.

Ceiling Suspended Type

Unit shall be suitable for ceiling suspended arrangement below false ceiling.
The units include pre filter, fan section & DX-coil section. The housing of unit shall be light weight powder coated galvanized steel.

High Wall Mounted Units

The unit shall be wall mounted type. The unit includes pre filter, fan section & DX-coil section. The housing of unit shall be light weight powder coated galvanized steel.

Unit shall have an attractive external casing for supply and return air.

Floor Standing Type

Unit shall be suitable for floor standing arrangement. The units include pre filter, fan section & DX-coil section. The housing of unit shall be light weight powder coated galvanized steel.

Centralized Type Remote Controller

(Optional, if specified in BOQ)

A multifunctional compact centralized controller shall be provided with the system.

The controller must be necessarily a graphic Controller type to act as an advanced air-conditioning management system to give complete control of VRV air-conditioning Equipment, It should have case of use for the user and must have a user friendly colored touch screen, icon display and color LCD display.

a. It shall be able to control up to 64 groups of indoor units with the following functions :

b. Starting/stopping of Air-conditioners as a zone or group or individual unit.

c. Temperature settling for each indoor unit or zone.

d. Switching between temperature control modes, switching of fan speed and direction of airflow, enabling/disabling of individual remote controller operation.

e. Monitoring of operation status such as operation mode & temperature setting of individual indoor units, maintenance information, trouble shooting information.

f. Display of air conditioner operation history.

g. Daily management automation through yearly schedule function with possibility of various schedules.

h. The controller shall have wide screen user friendly color LCD (Liquid Crystal Display) and can be wired by a non polar 2 wire transmission cable to a distance of 1KM away from indoor unit.

2. DX TF AHUs

Scope

The scope shall be supply, installation, testing and commissioning of double skin TFA units, conforming to these specifications and meeting all design parameters as mentioned in the "Bill of Quantities", appendices and drawings.

The TFA units shall be draw-thru type comprising of various sections such as mixing box, filter section, coil section, fan section etc., as mentioned in the "Bill of Quantities". The Air handling units shall be factory tested for rated efficiency.

Material of Construction & Design

The housing shall be so constructed that it can be delivered at site in total/SKD conditions depending upon the requirement.

Inner panels shall be constructed out of 24 gauge (0.63mm) plain galvanized sheet and outer panels shall also be made out of 24 gauge (0.63mm) pre painted galvanized steel sheet. Width of each panel shall not exceed 750mm. Insulation shall be injected polyurethane foam in between the double skin panels of thickness as mentioned in the BOQ. These panels shall be bolted from inside on to the frame work with soft rubber gasket in between to make the joints air tight.

AHU framework shall be made out of extruded aluminium hollow sections filled with preformed insulation section. Frame work for each section shall be bolted together with soft rubber gasket in between to make the joints air tight. Frames shall be assembled using mechanical joints to make a sturdy and strong framework for various sections. Suitable doors with pressure die cast aluminium hinges and latches shall be provided for access to various panels for maintenance. The entire housing shall be mounted on steel channel frame work.

Drain Pan

Drain pan shall be made out of 18 gauge stainless steel with necessary slope to facilitate rapid removal of condensate water. Drain pan shall be insulated with closed cell elastomeric insulation of thickness as required. Necessary supports will be provided to

slide the coil in the drain pan. Outlet shall be provided from the drain pan in a manner that access panel can be opened without disconnecting the drain pipe connection.

Centrifugal Fan & Motor

The AHU fan section shall house the DIDW backward curved centrifugal fan/s .The fan shall be backward curved floor standing double inlet double width type. The wheel and housing shall be fabricated from heavy gauge galvanized steel having thickness not less than 14gauge. The fan impeller shall be mounted on a solid shaft supported to housing with angle iron frame and pillow block heavy duty ball bearings. The fan shall be selected for speed not exceeding 1000 RPM. The impeller and fan shaft shall be statically and dynamically balanced. The fan outlet velocity shall generally not be more than 2000 FPM or as mentioned in the BOQ. Fan housing with motor shall be mounted on a common steel base mounted inside the air handling housing on anti-vibration spring mounts or rubber mounts. The fan outlet shall be connected to casing with the help of fire retardant canvass constructed out of imported fabrics. Centrifugal fans shall conform the detailed specifications of fans elaborated in the preceding clause.

Fans shall be driven by an electric motor as specified in the schedule of quantities. Motor ratings are only tentative and where a fan requires a higher capacity motor, the contractor shall clearly point out the requirement and make his offer accordingly. Motor ratings shall be at least 10% over limit load plus transmission losses.

Fan motors shall be suitable for operation on 415 $\pm$10% volts, 50 cycles, 3 phase, AC power supply and shall be TEFC squirrel cage induction type totally enclosed fan cooled with IP-55 protection. Motors shall be especially designed for quiet operation and motor speed shall not exceed 1440 RPM. Drive to fan shall be provided through belt-drive arrangement. Belts shall be of the oil-resistant type.

Cooling Coils- DX

Coil section shall house the DX coils wall thickness not less than 0.5mm with aluminium fins firmly bonded to copper tubes assembled in zinc coated steel frame. Material of construction of header associated with cooling coil shall be copper. Face and surface areas shall be such as to ensure rated capacity from each unit and such that air velocity across each coil shall not exceed 500 FPM. The coil shall be pitched in the unit casing for proper drainage. Each coil shall be factory tested at 21Kg/Sqcm air pressure under water. Tubes shall be hydraulically/ mechanically expanded for minimum thermal contact resistance with fins. Fin spacing shall be 11 to 13 fins per inch (4 to 5 fins per cm.)

Pre -Filters Section with Filters

Filter section shall house the washable synthetic type air filters having anodized aluminium frame. The media shall be supported with HDP mesh on one side and aluminium mesh on other side. Filter face velocity shall not exceed 450 FPM. Filters shall fit so as to prevent by-pass. Holding frames shall be provided for installing a number of filter cells in banks. These cells shall be held within the frames by sliding the cells between guiding channels. Pre filters shall conform the detailed specifications as elaborated in the preceding clause under sub head “Filters”.

Accessories

Each air handling unit shall be provided with manual air vent at highest point in the cooling/heating coil and drain plug at the bottom of the coil.

Performance Data

Air handling units shall be selected for the lowest operating noise level. Technical submittal of air handling units shall be prepared for Consultants approval prior to procurement as mentioned under Special Conditions. Fan performance rating and power consumption characteristics shall be submitted and verified at the time of testing and commissioning of the entire installation.

Testing

Cooling/heating capacity of various air handling unit models shall be computed from the measurements of air flow and dry and wet bulb temperatures of air entering and leaving the coil. Air flow measurements shall be carried out by an anemometer and temperature measurements by accurately calibrated thermometers. Computed results shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current.

3. VARIABLE FREQUENCY DRIVES

Scope

This section describes the type of frequency converter to be supplied for fan speed control. The drive shall not be a general purpose product, but a dedicated HVAC engineered design.

The manufacturer shall demonstrate a continuous period of manufacture and development for at least 25 years.

The frequency converter shall be supported locally by the manufacturer who will provide full technical support, spares holding and troubleshooting capability from his own local facility. A training course shall be provided by the manufacturer to the consultant / contractor / maintenance engineers.

The manufacturer shall provide full technical detail of the product, with catalogues, dimension drawings, weights etc. and each drive shall be provided with a full technical manual.

Equipment supplied must conform to recognized International Standards and be manufactured to ISO 9001, BS 5750 part 1 & 2 and carry the C.E. Mark on EMC Compliance.

Frequency converters shall be suitable for use in either a 'Stand Alone' mode, complete with all necessary protection or as part of centrally controlled system via a Serial Communication Loop to the main Building Management System (B.M.S.) via in-built RS 485 port (as explained at 3.20 m)

Technical Requirement

The frequency converter (F.C.) shall convert Local Voltage V $\pm$ 10%, 3 Phase, 50/60 Hz utility power supply to an adjustable output voltage and frequency. The FC must be capable of delivering full value of fundamental true RMS output voltage to the motor equal to the

mains input voltage to the FC at full load and speed. In the event the FC cannot meet this requirement an oversized motor at least one frame size higher must be selected. The FC manufacturer must document this capability.

The voltage to frequency ratio shall be suitable for fan control. It should not be possible to set a constant V/F ratio, to prevent damage to connected equipment and to optimize energy usage.

The F.C. shall work in conjunction with any I.E.C. standard design motor and shall not require the motor to be de-rated, or cause the motor temperature to rise above the class 'B' rise expected on normal mains operation. The Motor Shall not require an external blower even at slow speed running.

When selecting the FC, care shall be taken to ensure that protection against electro fluting of motor bearings and/or damage to the motor windings shall be provided. This shall be provided by the inclusion of :

a) Insulated motor bearings
b) Soft switching IGBT's in the FC
c) LC Filters fitted to the FC

The F.C. shall use AMA (Automatic Motor Adaptation) techniques so that operators do not have to input motor characteristic and ensuring proper motor operation, optimize motor performance, improve start capabilities and compensate for motor cable variances.

The F.C. shall be capable of controlling parallel motors of mixed ratings, and allow disconnection of any machine whilst running without causing tripping. The F.C. shall be capable of running with no motor connected for service functions.

The F.C. shall be fully tested at the converter manufacturers works, including motor loading.

Certificates of Compliance should be available on request.

The F.C. shall be of sufficient capacity to provide a quality wave form so as to achieve full output torque of the motor, without causing additional heat rise. The operating conditions shall include:

a) Minimum efficiency at 100% load - 96%
   at 20% load - 92%
b) Rated input voltage (local voltage) -10%, 3 phase, 50/60 Hz $\pm$2 Hz.
c) Working ambient temperature range -10°C to +45°C, humidity to 95% RH, and vibration of 0.7G.RMS in 3 directions
d) Output frequency range - 0.5 to 1000 Hz.
e) Output voltage range 0 to full mains input voltage, 3 phase even at full mains voltage -10% input.
f) The drive shall allow connection of motors one frame size larger and 4 sizes smaller than the nominal converter rating.
g) VFD shall be limited to 110% of rated current for 60 seconds and 160% torque for 0.5 seconds
h) The F.C. shall accept 0-10 VDC, 4-20 mA, or resistive inputs as a control signal.
i) The F.C. shall provide two output relays to provide signals including - ready, run, tripped, and be programmable for other selected information. Two analogue outputs of 4-20 mA or 24 VDC shall be programmable to transmit speed or other parameters

to the B.M.S. In addition, 2 x digital outputs shall provide 24Vdc to signal choice of 27 conditions to the BMS.

j) The F.C. shall log and display "Total kW-hrs consumed" and "Total Hours Run" by the motor without additional instrumentation and the facility to "Reset".

k) 20 preset speeds shall be available (programmable values) for duties such as night setback, smoke extract and morning boost settings.

l) The F.C. shall provide 4 skip frequencies of adjustable bandwidth to overcome mechanical or air resonance.

m) A parameter lock shall be incorporated to prevent unauthorized resetting of parameters.

n) The FC shall be capable of running from an external DC source during periods of mains interruption.

o) Drive acoustic noise shall not exceed 65Dba at full load and 60Dba at 50% load.

Drive Design Requirements

The F.C. shall contain as standard within it's enclosure D.C. Link filtering with both inductive and capacitive elements to control the mains borne harmonics. The document 'Electrical Supply Industry Recommendation G 5/3 limits for harmonic currents in the U.K.' or IEEE519, 1992 shall be used for the basis of calculation of T.H.D. for the point of common coupling. On request, the F.C. manufacturer shall provide T.H.D. figures for the total connected load. The contractor shall provide details of supply transformer rating, impedance, etc. feeding the F.C.s to allow this calculation to be made.

The F.C. shall comply with E.M.C.(Electromagnetic compatibility) (R.F.I. Control) document EN55011 as an integral part of its design, incorporating EMC/ RFI Filters to meet both EN55011 Class 1A (150metres) and Class 1B (50 metres). It shall conform to immunity standard IEC 801 parts 2-5. Must carry the C.E. Mark of Compliance.

The drive shall be capable of automatically reconnecting to a spinning fan, forward or reverse running, without tripping, following mains interruption or on transfer from bypass running.

The F.C. design shall comprise a diode input bridge, fixed voltage D.C. link section with both inductors and capacitors to form a filter, and inverting bridge comprising I.G.B.T.'s (Insulated Gate BiPolar Transistors) . All equipment must be housed within the F.C. enclosure.

The inverting bridge shall be controlled by a 32 bit processor and A.S.I.C.'s (Application Specific Integrated Circuits) to produce a V.V.C. Plus (Voltage Vector Controlled) enhanced P.W.M. waveform naturally resulting in full motor voltage, torque and sinusoidal current of mains supply quality in the motor circuit. Other forms of current source or 6 pulse converters are not accepted.

The F.C. shall protect itself against input transients to VDE0160 class W2; loss of mains phase (3 phase measurement); loss of motor phase (3 phase measurement); grounding of any output phase; loss of speed reference (runs at last setting/preset speed/close down-programmable).

The F.C. shall use overriding frequency fold back control techniques to prevent damage in the event of excessive load during either running or starting.

The F.C. shall model the motor in its software to predict motor overheating without the use of thermistors in the motor. When overheat is predicted, an alarm or automatic shutdown shall be initiated.

The F.C. shall exhibit near unity fundamental power factor at all loads and speeds, and should not require the addition of external A.C./D.C. line reactors for power factor improvement, harmonic control or prevention of zero voltage notching.

The output circuit shall be of such a design, as to allow unlimited switching of the motor circuit, at any load/speed without causing damage to the I.G.B.T. output stage and without needing auxiliary control switching.
F.C.'s shall have self adjusting modulation frequency control from 2.0 kHz to 14 kHz. The control form shall be such as to allow the F.C. to deliver full output at all times without derating, by optimizing the switching frequency dependent on the output load.

Full galvanic isolation between power and control components shall be incorporated to ensure compliance with VDE 0160 P.E.L.V. (Protective Extra Low Voltage) to prevent damage to B.M.S. interface and ensure operator safety. Short circuiting of the control terminals shall not damage the control card.

The F.C. shall include an A.E.O. (Automatic Energy Optimization) circuit to continuously adjust the voltage to frequency ratio and optimize the motor magnetizing current based on the actual torque requirement of the motor at different speeds to optimize motor energy consumption and prevent heating of motor at low speeds.

The design shall include a full 2 zone, 2 setpoint P.I.D. controller as standard to provide closed loop control direct from upto 2 signal transmitters without the need for external signal conditioning.

The F.C. shall not exhibit an inrush current when a 'start' signal is given, and current must not exceed 110% at any time to prevent damage to connected equipment.

The F.C. design shall include a motor preheat circuit to prevent condensation forming in the motor during shutdown periods.he F.C. shall not be damaged if it is energized with a 'start' signal without a motor connected. The F.C. shall provide as standard:

a) Heat sink over-temperature protection.

b) Under-voltage protection.

c) Over-voltage protection.

Display to be in selectable language.

The Local Control Panel (keypad of FC) of FC shall display in 4 line alpha-numeric characters in plain English language, the following operating parameters:

a. Energy consumed in kW-Hr.
b. Power consumed by motor in kW
c. Run time of motor in Hours.
d. Current drawn by the motor in Amperes.
e. Voltage applied to motor terminals by FC in Volts

f. DC link voltage in Volts
g. Output Frequency in Hz.
h. Percentage of maximum output frequency in %.
i. Motor Speed in RPM
j. Thermal Load on Motor in %

4. SUPPLY AIR FAN (FOR FRESH AIR)/EXTRACT FAN SECTION – DOUBLE SKIN TYPE

Scope

The scope shall be supply, installation, testing and commissioning of packaged type supply air fan meeting all design parameters as mentioned in the "Bill of Quantities".

Material of Construction & Design

The housing shall be so constructed that it can be delivered at site in total/SKD conditions depending upon the requirement.

Inner panels shall be constructed out of 24 gauge (0.63mm) plain galvanized sheet and outer panels shall also be made out of 24 gauge (0.63mm) pre painted galvanized steel sheet. Width of each panel shall not exceed 750mm. Insulation shall be injected polyurethane foam in between the double skin panels of thickness as mentioned in the BOQ. These panels shall be bolted from inside on to the frame work with soft rubber gasket in between to make the joints air tight.

Unit framework shall be made out of extruded aluminium hollow sections filled with preformed insulation section. Frame work for each section shall be bolted together with soft rubber gasket in between to make the joints air tight. Frames shall be assembled using mechanical joints to make a sturdy and strong framework for various sections. Suitable doors with pressure die cast aluminium hinges and latches shall be provided for access to various panels for maintenance. The entire housing shall be mounted on steel channel frame work.

Pre -Filters Section with Filters

Filter section shall house the washable synthetic type air filters having anodized aluminium frame. The media shall be supported with HDP mesh on one side and aluminium mesh on other side. Filter face velocity shall not exceed 500 FPM. Filters shall fit so as to prevent by-pass. Holding frames shall be provided for installing a number of filter cells in banks. These cells shall be held within the frames by sliding the cells between guiding channels. Pre filters shall conform the detailed specifications as elaborated in the preceding clause under sub head "Filters".

Centrifugal Fan & Motor

The fan shall be forward curved floor standing double inlet double width type. The wheel and housing shall be fabricated from heavy gauge galvanized steel. The fan impeller shall be mounted on a solid shaft supported to housing with angle iron frame and pillow block heavy duty ball bearings. The fan shall be selected for speed not exceeding 1000 RPM. The impeller and fan shaft shall be statically and dynamically balanced. The fan outlet velocity shall not be more than 2000 FPM. Fan housing with motor shall be mounted on a common steel base mounted inside the air handling housing on anti-vibration spring mounts or rubber

mounts. The fan outlet shall be connected to casing with the help of fire retardant canvass constructed out of imported fabrics.

Fans shall be driven by an electric motor as specified in the schedule of quantities. Motor ratings are only tentative and where a fan requires a higher capacity motor, the contractor shall clearly point out the requirement and make his offer accordingly. Motor ratings shall be at least 10% over limit load plus transmission losses.

Fan motors shall be suitable for operation on 415 ±10% volts, 50 cycles, 3 phase, AC power supply and shall be TEFC squirrel cage induction type totally enclosed fan cooled with IP-55 protection. Motors shall be especially designed for quiet operation and motor speed shall not exceed 1440 RPM. Drive to fan shall be provided through belt-drive arrangement. Belts shall be of the oil-resistant type.

Note :

Construction of EXTRACT FAN SECTION shall generally be similar to supply air fan as elaborated above but without filters. For detail description of extract fan section please refer "Bill of Quantities".

5. **SPLIT UNITS**

Scope

The scope of this section comprises supply, installation, testing and commissioning of self contained air cooled split type air conditioning units each comprising of an outdoor and single/twin indoor units conforming to these specifications and in accordance with the requirement of drawings and schedule of quantities.

Outdoor Unit

Outdoor unit shall be an air cooled condensing unit suitable for outdoor installation conforming to the following specifications.

a. Unit Base & Casing

Base panel shall be constructed out of fabricated steel structure of adequate size. Casing panels shall be of 1.2 mm thick, welded construction, removable type to provide easy access to equipment and shall be bonderized and painted. Casing shall be complete with discharge outlets, grilles, space for refrigeration equipment, fans, condenser coil etc.

b. Compressor

i. Scroll Compressor

The scroll compressor shall be an industrial quality rugged, cast iron, direct hermetic compressor with scroll plates, suction & discharge service valves. The compressor shall be complete with straight suction tube, centrifugal oil pump, oil charging valve, oil level sight glass, crank case heater and check valve on the scroll discharge port. The compressor shall be complete with the provision of two-point lubrication for each motor bearing. The compressor shall be completely enclosed in a chamber with no leakage path and providing the capability for scroll plates to separate. The compressor shall be provided with industrial solid motor mounts internal motor protection and vibration isolation pads. Each compressor shall be

independently wired and piped to its own circuit for efficient operation & ease of maintenance. The compressor speed shall not exceed 3000 RPM.

ii. Rotary Compressor

The rotary compressor shall be an industrial quality rugged, cast iron, hermatic/ semi hermatic compressor with capacity control side valve , oil sump heater & differential pressure refrigerant oil flow system. The compressor shall be provided with multiple pressure lubricated rolling element bearing group shall support the rotating assembly. Suitable overload protection shall be provided & necessary isolating valves shall be provided at suction & discharge . The compressor shall be fitted with electrically operated oil heaters with built in thermostats. The heaters shall be shall be automatically actuated when the compressor is stopped. Necessary time delay shall be provided for restart of compressor. The compressor shall be provided with industrial solid motor mounts internal motor protection and vibration isolation pads. Each compressor shall be independently wired and piped to its own circuit for efficient operation & ease of maintenance. The compressor speed shall not exceed 3000 RPM.

c. Condenser

Condenser shall be air cooled in copper tube & aluminium fins construction. Condensers shall be complete with provisions for refrigerant piping connections, shut off valves and any other standard accessory necessary with the equipment supplied.

d. Condenser Fan

Fan shall be preferably propeller type suitable for fractional horse power drive with IP-55 protection.

Indoor Unit

The indoor unit shall be basically a fan coil unit suitable for wall, floor and under ceiling installation of various types conforming to the following specifications.

a. Indoor units shall be either ceiling mounted cassette type, wall mounted type, floor mounted type or ceiling mounted ductable type in conformity with the design drawings and schedule of quantities.

Each indoor unit shall consist of PID controller for maintaining design room conditions besides microprocessor based thermostat for cooling. The indoor unit shall also be provided with wired LCD type remote controller which shall memorize the latest malfunction code for ease in maintenance. The controller shall incorporate self diagnostic features. Such remote controllers associated with cassette type and hi-wall type indoor units shall incorporate inbuilt feature to be able to change fan speed and angle of swing flap individually as desired by the user.

The ceiling mounted cassette type indoor units shall comprise of an attractive moulded ABS plastic exterior enclosure provided with four way supply air grilles on the periphery and square return air grill at the centre with filter behind. Each cassette type indoor unit shall consist of high efficiency paddle type condensate water pump to facilitate forced disposal of condensate water and low gas detection system.

The hi-wall indoor units shall be suitable for installation on the wall preferably at lintel level. The specifications shall otherwise be similar to above.

Ceiling mounted ductable indoor units shall comprise of high static centrifugal fan, direct driven or belt driven through TEFC squirrel cage induction motor suitable for moderate amount of duct work. The housing shall be of light weight construction fabricated out of powder coated galvanized sheet steel single skin panels, internally insulated with 9mm thick closed cell elastomeric insulation material.

b. Cooling coil

Cooling coil shall be of the fin and tube type, having aluminium fins, firmly bonded to seamless copper tubes. Face and surface areas shall be such as to assure rated capacity and the air velocity across the coil shall not exceed 170 MPM. The coil shall be factory tested under water at 21 Kg/Sqcm air pressure.

c. Fan Section

The fan associated with non ductable indoor units shall be dual suction, aero dynamically designed, multi blade type, statically-dynamically balanced to ensure smooth circulation of air exhibiting lower noise level. The fan shall be direct driven type mounted directly on motor shaft supported from the housing.

Fan associated with ductable indoor unit shall be centrifugal double inlet double width forward curved type, preferably with variable pitch pulleys. The fan housing shall be statically-dynamically balanced at works to ensure noise and vibration free operation.

d. Filters

Filters shall be cleanable, synthetic fibre media of approved make. Velocity through filters shall not exceed 105 MPM and pressure drop across filters shall not exceed 5 mm of WG.

e. Insulation

All indoor unit shall be factory insulated with minimum 9 mm thick closed cell elastomeric insulation material towards thermal/acoustic treatment.

Drain pan shall be insulated with minimum 9mm mm thick closed cell elastomeric insulation material. Fixing of coil section and drain pan shall be done in such a way to avoid direct metal contact with any other un-insulated metal part in order to avoid condensation.

Condensate drain piping around the indoor unit shall also be insulated with minimum 9mm thick closed cell elastomeric insulation preferably in tubing form.

f. **Refrigerant Piping**

The copper refrigerant piping shall be carried out neatly to connect outdoor and indoor unit/s and shall run along with wires/cables. The refrigerant piping associated with ductable units shall be carried out using hard drawn copper pipes & ready made copper fittings for pipe diameter exceeding 19mm. Piping less than 19mm shall be carried out using soft seamless copper pipes. Joints shall be affected by soldering/brazing process using silver rods. Suitable sleeves shall be provided at all wall crossings as required. The refrigerant circuit shall include liquid line and gas shut-off valves at the end of condenser.

After the refrigerant piping installation has been completed, the refrigerant piping system shall be pressure tested using nitrogen at pressure of 21Kg/ Sqcm. Pressure shall be maintained in the system for 24 hours. The system shall then be evacuated to minimum vacuum equivalent to 700mm Hg and held for another 24 hours prior to commencement of gas charging.

All refrigerant pipes shall be properly supported and anchored to the building structure using steel hangers, anchors, brackets and supports which shall be fixed to the building element by means of inserts or expansion shields of adequate size and number to support the load imposed thereon.

The liquid and suction refrigerant lines including all fittings, valves, strainer etc. shall be insulated with 13 mm thick closed cell elastomeric insulation material preferably in tubing form as specified in Schedule of Quantities.

To protect nitrile rubber insulation associated with exposed copper piping from degrading due to ultra violet rays & atmospheric conditions, it shall be covered with polyshield coating. Fiberglass tape shall be helically wrapped & applied with two coats of resin with hardener to give smooth finish.

g. Electrical Installation

Factory fabricated local control panel shall be provided with each three phase ductable unit. The armoured conductor power cabling along with earthing shall be carried out as required and the cables shall be as per the "Approved Makes".

6. FILTERS

6.1 Viscous Metallic Filters

Viscous metal filter shall be all metal, washable type. The filter media shall be composed of layers of crimped GI wire mesh. The velocity over face of filter shall not exceed 90 MPM. and pressure drop shall not exceed 5mm for 50mm thick filter. The filter shall be of GI and suitable for mounting as required at site.

6.2 Synthetic Fibre Filters

Synthetic fibre filter shall be cleanable in light weight aluminium framed with non-woven synthetic fibre replaceable media. The filter shall have an efficiency of 90% down to 10 microns when tested as per BS: 2831 standard. It shall be suitable for operation under 100% Relative Humidity & 120 degree C temperature conditions. The velocity over the face of filter shall not exceed 105 MPM and the pressure drop across the filter shall not exceed 2.5mm WG for 25mm thick filter. The filter frame shall be of aluminium and shall be suitable for mounting in air handling unit as required at site.

7. VOLTAGE STABILIZERS

The stabilizers shall be automatic type of approved make. The stabilizers shall be three step and suitable to convert 140-280V incoming power supply to 200-240V outgoing power supply. Capacities of the stabilizers shall be as reflected in the "Schedule of Quantities". The stabilizers shall be equipped with the following accessories :

a. Low & high voltage trip.
b. Time delay relay.
c. Ammeter.

8. SPLIT UNITS

Scope

The scope of this section comprises supply, installation, testing and commissioning of self contained air cooled split type air conditioning units each comprising of an outdoor and single/twin indoor units conforming to these specifications and in accordance with the requirement of drawings and schedule of quantities.

Outdoor Unit

Outdoor unit shall be an air cooled condensing unit suitable for outdoor installation conforming to the following specifications.

a. Unit Base & Casing

Base panel shall be constructed out of fabricated steel structure of adequate size. Casing panels shall be of 1.2 mm thick, welded construction, removable type to provide easy access to equipment and shall be bonderized and painted. Casing shall be complete with discharge outlets, grilles, space for refrigeration equipment, fans, condenser coil etc.

b. Compressor

i. Scroll Compressor

The scroll compressor shall be an industrial quality rugged, cast iron, direct hermetic compressor with scroll plates, suction & discharge service valves. The compressor shall be complete with straight suction tube, centrifugal oil pump, oil charging valve, oil level sight glass, crank case heater and check valve on the scroll discharge port. The compressor shall be complete with the provision of two-point lubrication for each motor bearing. The compressor shall be completely enclosed in a chamber with no leakage path and providing the capability for scroll plates to separate. The compressor shall be provided with industrial solid motor mounts internal motor protection and vibration isolation pads. Each compressor shall be independently wired and piped to its own circuit for efficient operation & ease of maintenance. The compressor speed shall not exceed 3000 RPM.

ii. Rotary Compressor

The rotary compressor shall be an industrial quality rugged, cast iron, hermatic/ semi hermatic compressor with capacity control side valve , oil sump heater & differential pressure refrigerant oil flow system. The compressor shall be provided with multiple pressure lubricated rolling element bearing group shall support the rotating assembly. Suitable overload protection shall be provided & necessary isolating valves shall be provided at suction & discharge . The compressor shall be fitted with electrically operated oil heaters with built in thermostats. The heaters shall be shall be automatically actuated when the compressor is stopped. Necessary time delay shall be provided for restart of compressor. The compressor shall be provided with industrial solid motor mounts internal motor protection and vibration isolation pads. Each compressor shall be independently wired and piped to its own circuit for efficient operation & ease of maintenance. The compressor speed shall not exceed 3000 RPM.

c. Condenser

Condenser shall be air cooled in copper tube & aluminium fins construction. Condensers shall be complete with provisions for refrigerant piping connections, shut off valves and any other standard accessory necessary with the equipment supplied.

d. Condenser Fan

Fan shall be preferably propeller type suitable for fractional horse power drive with IP-55 protection.

Indoor Unit

The indoor unit shall be basically a fan coil unit suitable for wall, floor and under ceiling installation of various types conforming to the following specifications.

a. Indoor units shall be either ceiling mounted cassette type, wall mounted type, floor mounted type or ceiling mounted ductable type in conformity with the design drawings and schedule of quantities.

Each indoor unit shall consist of PID controller for maintaining design room conditions besides microprocessor based thermostat for cooling. The indoor unit shall also be provided with wired LCD type remote controller which shall memorize the latest malfunction code for ease in maintenance. The controller shall incorporate self diagnostic features. Such remote controllers associated with cassette type and hi-wall type indoor units shall incorporate inbuilt feature to be able to change fan speed and angle of swing flap individually as desired by the user.

The ceiling mounted cassette type indoor units shall comprise of an attractive moulded ABS plastic exterior enclosure provided with four way supply air grilles on the periphery and square return air grill at the centre with filter behind. Each cassette type indoor unit shall consist of high efficiency paddle type condensate water pump to facilitate forced disposal of condensate water and low gas detection system.

The hi-wall indoor units shall be suitable for installation on the wall preferably at lintel level. The specifications shall otherwise be similar to above.

Ceiling mounted ductable indoor units shall comprise of high static centrifugal fan, direct driven or belt driven through TEFC squirrel cage induction motor suitable for moderate amount of duct work. The housing shall be of light weight construction fabricated out of powder coated galvanized sheet steel single skin panels, internally insulated with 9mm thick closed cell elastomeric insulation material.

b. Cooling coil

Cooling coil shall be of the fin and tube type, having aluminium fins, firmly bonded to seamless copper tubes. Face and surface areas shall be such as to assure rated capacity and the air velocity across the coil shall not exceed 170 MPM. The coil shall be factory tested under water at 21 Kg/Sqcm air pressure.

c. Fan Section

The fan associated with non ductable indoor units shall be dual suction, aero dynamically designed, multi blade type, statically-dynamically balanced to ensure smooth circulation of air exhibiting lower noise level. The fan shall be direct driven type mounted directly on motor shaft supported from the housing.

Fan associated with ductable indoor unit shall be centrifugal double inlet double width forward curved type, preferably with variable pitch pulleys. The fan housing shall be statically-dynamically balanced at works to ensure noise and vibration free operation.

d. Filters

Filters shall be cleanable, synthetic fibre media of approved make. Velocity through filters shall not exceed 105 MPM and pressure drop across filters shall not exceed 5 mm of WG.

e. Insulation

All indoor unit shall be factory insulated with minimum 9 mm thick closed cell elastomeric insulation material towards thermal/acoustic treatment.

Drain pan shall be insulated with minimum 9mm mm thick closed cell elastomeric insulation material. Fixing of coil section and drain pan shall be done in such a way to avoid direct metal contact with any other un-insulated metal part in order to avoid condensation.

Condensate drain piping around the indoor unit shall also be insulated with minimum 9mm thick closed cell elastomeric insulation preferably in tubing form.

f. **Refrigerant Piping**

The copper refrigerant piping shall be carried out neatly to connect outdoor and indoor unit/s and shall run along with wires/cables. The refrigerant piping associated with ductable units shall be carried out using hard drawn copper pipes & ready made copper fittings for pipe diameter exceeding 19mm. Piping less than 19mm shall be carried out using soft seamless copper pipes. Joints shall be affected by soldering/brazing process using silver rods. Suitable sleeves shall be provided at all wall crossings as required. The refrigerant circuit shall include liquid line and gas shut-off valves at the end of condenser.

After the refrigerant piping installation has been completed, the refrigerant piping system shall be pressure tested using nitrogen at pressure of 21Kg/ Sqcm. Pressure shall be maintained in the system for 24 hours. The system shall then be evacuated to minimum vacuum equivalent to 700mm Hg and held for another 24 hours prior to commencement of gas charging.

All refrigerant pipes shall be properly supported and anchored to the building structure using steel hangers, anchors, brackets and supports which shall be fixed to the building element by means of inserts or expansion shields of adequate size and number to support the load imposed thereon.

The liquid and suction refrigerant lines including all fittings, valves, strainer etc. shall be insulated with 13 mm thick closed cell elastomeric insulation material preferably in tubing form as specified in Schedule of Quantities.

To protect nitrile rubber insulation associated with exposed copper piping from degrading due to ultra violet rays & atmospheric conditions, it shall be covered with polyshield coating.

Fiberglass tape shall be helically wrapped & applied with two coats of resin with hardener to give smooth finish.

g. Electrical Installation

Factory fabricated local control panel shall be provided with each three phase ductable unit. The armoured conductor power cabling along with earthing shall be carried out as required and the cables shall be as per the "Approved Makes".

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B. "SPECIFICATIONS - VENTILATION FANS"

1. CENTRIFUGAL FANS

1.1 Centrifugal fans shall be of approved make DIDW or SISW of specified arrangement complete with inspection door, squirrel-cage induction motor, V belt drive, belt guard and vibration isolators etc. Type, direction of discharge / rotation, and motor position shall be as per the Approved for Construction shop drawings.

1.2 Fans, Aerofoil, forward or backward curved, SISW or DIDW shall be licensed to bear the AMCA Air and Sound Certified Ratings Seal. The test standard used shall be ANSI/AMCA 210-85, ANSI/ASHRAE Standard 51-1985 "Laboratory Method of Testing Fans for Rating" and AMCA 300 "Reverberant Room Method for Sound Testing of fans".

1.3 All fans shall be dynamically trim-balanced to ISO1940 and AMCA 204/3 - G2.5 quality grade after assembly. A computer printout with vibration spectrum analysis shall be attached to the fans.

1.4 All fans shall be oven-baked with polyester coating for minimum thickness of 60 microns unless the housing scroll and side frame is constructed from galvanized steel sheet (GSS) .Fan should be of G.S.S. , the Steel sheet should be JFE Galvazinc (Base metal cold rolled), JIS G3302, SGCC with Z22 (minimum coating weight on both sides @ 220 g/m2) zinc coating & Zero Spangle, skin passed, chromated and dry.

1.5 Fans housing shall be of an appropriate thickness to prevent vibration and drumming and in no case the housing shall be constructed less than 14 Gauge sheet steel and all parts shall be bonderized and then coated with primer finish of approved colour. The fan scroll shall be attached to the side plate by means of continuous lock seam or welded scam. 18 gauge galvanized wire mesh inlet guards of 5 cm sieves shall be provided on both inlets. Housing shall be provided with standard cleanout and door with quick locking tension handles and neoprene gasket. Rotation arrow shall be clearly marked on the housing.

The wheel and inlet cone shall be aerodynamically designed and constructed to provide maximum performance and efficiency as published by the manufacturer.

1.6 Fans must be physically capable of operating safely at every point of rating at or below the "minimum performance" limit for that class as defined in AMCA standard 99-2408- 69 "Performance Class of Operating Limits for Centrifugal Fans".

1.7 Shafts sizes shall be carefully calculated and designed such that the maximum operating speed (RPM) shall not exceed 75% of the first critical speed. For any application that is not a standard product from catalogue of the fan manufacturer detailed calculation of critical speed characteristic shall be submitted for approval.

1.8 Shafts shall be constructed out of carbon steel (C45) machined and polished to tolerance of standard ISO 286-2 - grade g6. Protective coat of anti-rusting shall be applied to all bare surfaces of the shafts at the factory.

1.9 Bearings shall be of self-alignment (concentric) type with adaptor sleeve bearing. Bearings of eccentric locking collar with grub screw type are not acceptable. Bearing shall be maintenance free with permanently lubricated sealed ball bearing type. Bearing life shall be at least 75,000 hours based on basic rating life, L10 of ISO 281 standard. Calculation sheet of Bearing Life shall be submitted for approval.

1.10 Motor installed shall be of a minimum 130% of the fan power absorbed (Brake horsepower) and shall have sufficient torque available for starting and continuous operation. Motor shall be suitable for 415 $\pm$ 10% volts, 50 Hz, 3 phase power supply.

1.11 Belts and pulleys shall be sized for a minimum 150% of the installed motor horsepower. The belt speed shall not exceed 30m/s. The pulley shall be of Taper Lock SPZ, SPA, SPB or SPC type. Conventional type of pulley is not acceptable. Both fan and motor pulley shall be balanced to the quality grade G.2.5.

1.12 Fan outlet velocity shall not exceed 2000 FPM (10.16 MPS) and maximum fan speed shall be 1000 RPM. Fan wheel and housing shall be statically and dynamically balanced. Necessary documents establishing Dynamic balancing carried out at factory shall be provided with the consignment.

1.13 Computer printout on fan performance rating corresponding to the AMCA licensed data, with corrected rating for altitude and temperature, fan operating speed, bearing life, etc. shall be submitted for approval.

1.14 For Air washer Application, fans should be provided with coat of Pure polyester powder coating. Fans should have Inspection door & Drain plug.

2. **Propeller Type Fans :**

The propeller type fans shall be used for exhaust air or for fresh air supply as shown on the drawings having following constructional features :

a. Fans shall be of ring mounted type having steel hub and MS blade, mounted directly on the shaft of a totally enclosed motor Bearings shall be maintenance free permanently lubricated type.

b. The fan blades shall be constructed out of pressed steel in aerofoil design to achieve high efficiency. The mounting frame shall be of cast/sheet steel with steel brackets to connect the frame with the fan/motor assembly.

c. Rubber mounts shall be provided between the mounting frame and the mounting brackets. The fan shall be direct driven type and motor shall either be capacitor start –run or three phase squirrel cage induction type totally enclosed.

d. The fan shall be fitted with gravity type louvers. The speed of fan shall be as mentioned in “Bill of Quantities” and drawings.

e. All the fans shall be tested for performance and the following test results shall be furnished :

i. Air flow rate in C.F.M.
ii. Static pressure at the fan supply end.

3. **Inline Fans :**

The inline fans shall be used for exhaust air or for fresh air supply as shown on the drawings having following constructional features :

a. The casing shall be constructed out of hot rolled heavy gauge GSS metal epoxy coated embodied with required inspection doors.

b. Fan shall be direct driven SISW forward or backward curved centrifugal type. Material of construction for impeller shall GSS. Fan wheel shall be statically and dynamically balanced.

c. The bearing shall be completely maintenance free and can be used in any mounting position, at maximum indicated temperature.

d. Motor shall be total enclosed external rotor type and suitable for operation on 415±10% volts,3phase or 220±6% volts,1 phase , 50Hz AC power supply.

e. Single phase inline fans shall be provided with factory fitted speed regulators and three phase inline fans shall be provided with GI dampers.

f. All the fans shall be tested for performance and the following test results shall be furnished :

i. Air flow rate in C.F.M.
ii. Static pressure at the fan supply end.

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C. "SPECIFICATIONS - PIPING"

1. General :

a. The scope under this section covers supply, laying, erection, testing and commissioning of pipes, pipe fittings and associated valves conforming to these specifications and the general arrangements shown on the drawings.

b. All piping including pipe fittings and valves shall follow the relevant Indian Standards/manufacturer's recommendations.

2. Refrigerant Piping :

All refrigerant piping for the VRV air conditioning system shall be constructed out of hard drawn copper refrigerant pipes with copper fittings and silver-soldered joints. The refrigerant piping arrangements shall be in accordance with good engineering practice within the air-conditioning industry, and shall be inclusive of charging connections, suction line insulation and all other items normally forming part of proper refrigerant circuits.

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

The Refnet Joints (Y-joints) and Refnet Headers shall be made from copper and would be imported, factory fabricated and pre-insulated.

After the refrigerant piping installation has been completed, the refrigerant piping system shall be pressure tested using nitrogen at pressure of 35Kg/Sq. Cm and 10 Kg/Sq.Cm (low side). Pressure shall be maintained in the system for 24 hours. The system shall then be evacuated to minimum vacuum of 700mm Hg and held for 24 hours.

The air-conditioning system supplier shall verify the refrigerant piping design conceived and brought to the notice of Consultants if any discrepancy is found.

The OD & wall thickness of copper refrigerant piping shall be as follows:

Outside Pipe Dia (mm)	Wall thickness (mm)
54.1	1.5
41.3	1.3
34.9	1.3
28.6	1.2
25.4	1.2
22.2	1.2
19.1	1.0
15.9	1.0
12.7	0.8
9.5	0.8
6.4	0.8

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

The whole of the liquid and suction refrigerant lines including all fittings, valves and strainer bodies, etc. shall be insulated with 19mm thick closed cell elastomeric insulation material.

The joints shall be properly sealed with synthetic glue to ensure proper bonding of the ends.

3. **Drain Piping:**

a. All pipes to be used for drain, condensate drain and fittings shall be galvanized steel class 'B' (medium class) confirming to relevant IS & BIS Codes.

b. All jointing in the pipe system shall be by screwed and / or by screwed flanges using 3mm 3 ply rubber insertion gaskets. Pipe threads and flanges shall be as per relevant BIS Codes.

c. All pipes supports shall be mild steel, thoroughly cleaned and given one primary coat of red oxide paint before being installed.

d. Fittings shall be galvanized steel "medium class" malleable casting of pressure rating suitable for the piping system. Flanges shall be of approved make. Supply of flanges shall include bolts, nuts, and gaskets as required. Sufficient number of flanges and unions shall be provided for future cleaning and servicing of piping. Tee-off connection shall be through equal or reducing Tees. All equipment and valve connections or connections to any other mating pipes shall be through flanges required for the mating connections.

c. All condensate drain piping shall be insulated with closed cell elastomeric insulation material of thickness as mentioned in "Schedule of Quantities".

4. **Insulation**

Drain Pipes shall be insulated as required or as shown on the approved drawings and in line with specifications stipulated in section 'INSULATION'.

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D. "SPECIFICATIONS - DUCTWORK AND AIR TERMINALS"

1. General :

a. The scope under this section covers supply, fabrication, installation and testing of all GS sheet metal ducts and supply, installation, testing and balancing of grilles, diffusers conforming to these specifications and the general arrangements shown on the tender drawings.

b. Duct work shall mean all ducts, dampers, access doors, joints, stiffeners, supports and hangers.

2. Duct Work Fabricated at Site as per BIS Standards

2.1 Duct Material and Fabrication

Material used for ducts shall be galvanized steel sheets class VIII conforming to IS:277-1962(revised) or aluminium sheets conforming to IS:737-1955 as specified in the Bill of Quantities. All ducts shall be fabricated and installed in a workman like manner, generally conforming to IS : 655-1963 (Revised) with amendment- I(1971 edition).Fabrication of ducts shall be through well conditioned Triplex lock former or multiple lock formers, conforming to relevant BIS Codes. Round exposed ducts shall be die formed for achieving perfect circle configuration.

Thickness of the sheet shall be as given hereunder :

		Sheet thickness
Size of Duct	**GSS**	**Aluminium**
Up to 750 mm	24 Gauge (0.63mm)	22 Gauge (0.80mm)
751 mm to 1500mm	22 Gauge (0.80mm)	20 Gauge (1.00mm)
1501 mm to 2250mm	20 Gauge (1.00mm)	18 Gauge (1.25mm)
2251 mm and above	18 Gauge (1.25mm)	16 Gauge (1.6mm)
All Round Ducts	20 Gauge (1.00mm)	--

Joints and bracing of ductwork shall generally be as per IS Specifications. However, minimum size of accessories involved shall be as given hereunder :

Size of Duct	**Joint Type**	**Bracing**
Up to 750 mm	G.I. Flange	--
751 mm to 1000 mm	25 mm x 25 mm x 3 mm angle iron frame with 8 mm dia nuts and bolts.	25 mm x 25 mm x 3 mm angle iron frame at 1000 mm centre

1001 mm to 1500 mm angle	40 mm x 40 mm x 5 mm angle iron frame with 8 mm dia nuts and bolts.	40 mm x 40 mm x3 mm iron frame at 1000 mm centre
1001 mm to 1500 mm angle centre	40 mm x 40 mm x 5 mm angle iron frame with 8 mm dia nuts and bolts.	40 mm x 40 mm x 3 mm iron frame at 1000 mm
1501 mm to 2250 mm angle centre	50 mm x 50 mm x 5 mm angle iron frame with 12 mm dia nuts and bolts. at 125 mm centre.	40 mm x 40 mm x 3mm iron frame at 1200 mm (diagonally cross braced)
2251 mm and above angle centre	50 mm x 50 mm x 6 mm angle iron frame with 12 mm dia nuts and bolts. at 125 mm centre.	40 mm x 40 mm x 3 mm iron frame at 1200 mm (diagonally cross braced)

2.1.2 GI sheets shall be produced using hot deep galvanization process and minimum acceptable coating of zinc shall be 120gm/SqM. Sample of GI sheet along with test certificate to be submitted for approval prior to supply of GI sheets.

2.1.3 GI sheets shall be checked for hardness/flexibility and water marks prior to dispatch. Zinc coating if found peeled –off or duct work with water marks after fabrication shall be rejected..

2.1.4 Ducts shall be straight and smooth on the inside with neatly finished joints. All joints shall be made air tight.

2.1.5 All exposed ducts within conditioned spaces shall have only slip joints and no flanged joints. The internal ends of slip joints shall be made in the direction of air flow.

2.1.6 Change in dimensions and shape of ducts shall be gradual. Curved elbows, unless otherwise approved, shall have a centre line radius equal to one and half times the width of the duct. Air turns 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.

2.1.7 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.

2.1.8 Ductwork shall be fabricated strictly in accordance with the “Approved for Construction” Shop drawings. All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees or angles of ample size to keep the ducts true to shape and to prevent buckling, vibration or breathing.

2.1.9 All sheet metal connections, partitions and plenums required to confine the flow of air to and through the filters and fans, shall be constructed out of 18 gauge galvanized steel sheet, thoroughly stiffened with angle iron braces mentioned above and fitted with all necessary doors as required by the Consultants, to give access to all parts of the apparatus. Doors shall not be less than 45cm x 45cm in size. All hardware fittings such as thunder bolts, hinges, handles etc shall be in extruded aluminium construction.

2.2 Installation of Ductwork

2.2.1 During construction, the contractor shall temporarily close the duct openings with sheet metal covers to prevent debris and any foreign material entering ducts and to maintain opening straight and square.

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

2.2.3. The contractor shall provide and neatly erect all sheet metal work as may be required to carry out the intent of these specifications and drawings. This work shall meet with the approval of the Architects/Owners in all its parts and details.

2.2.4. All ducts shall be supported from the ceiling /slab using 9mm to 12mm dia MS rods depending upon the size of the duct unless & until mentioned otherwise in the BOQ. MS angle iron of size not less than 40mmx40mmx5mm or more if duct size is large enough shall be used at the bottom. The MS rods shall be anchored to RCC slab using suitable metallic expansion fasteners.

2.2.5 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 Architects/Consulting Engineer.

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

2.2.7 All duct work shall be independently supported from building elements or as required by the Architect/ Consultant. All horizontal ducts shall be rigidly and securely supported, in an approved manner, within hangers formed of MS rods and angle iron under ducts not greater than 2 M centers. All vertical duct work shall be supported by structural members at each floor.

2.2.8 Ducting on top of the ceiling shall be supported from the slab above, or from beams with the help of adequate strength dash fasteners, after obtaining approval of the Architect/ Consultant. In no case shall a duct be supported from the ceiling hangers or be permitted to rest on a hung ceiling.

2.2.9 All metal work in dead or closed down spaces shall be erected in time to occasion no delay to other contractors in the building.

2.2.10 All air turns of 45 degrees or more shall include curved metal blades or vanes so as to permit the air to make the abrupt turns without an appreciable turbulence. Turning vanes shall be securely fastened to prevent noise or vibration. All supply air collars shall be provided with GI vanes properly secured using rivets.

2.2.11 All ducts shall be totally free from vibration under all conditions of operations. Whenever duct work is connected to fans, that may cause vibrations in the duct, ducts shall be provided with two flexible connections located close to the unit in mutually perpendicular directions. Flexible connection shall be constructed of fire resistant flexible double canvas sleeves at least 150mm long, secured properly and bolted at both ends. Sleeve shall be made smooth and the connecting duct work rigidly held by independent supports on both ends. The flexible connection shall be suitable for pressures at the point of installation.

2.2.12 The two mating flanges of the ducts being joined with each other shall be made air tight by providing 4mm thick rubber gasket fixed on both mating flanges by means of good quality adhesive. Rubber strip shall also be provided between bottom surface of duct and angle iron at each duct support to avoid metal to metal contact.

2.2.13 All duct supports including MS rods, cleats and angle iron shall be primer coated and thereafter, painted with black enamel paint.

2.3 Round Ductwork

Spiral/round ductwork wherever required shall meet following parameters :

a. Conform to BIS round ductwork requirements.

b. Round Ducts shall be constructed out of galvanized sheet steel as per relevant BIS standards.

c. Upto 1200mm dia ducts spiral lock seam shall be provided.

d. Ducts more than 1200 mm diameter shall be provided with welded longitudinal or spiral seam.

e. Lap or snap lock seams are not permitted for round ductwork of any size.

f. Provide beaded sleeve or flanged and gasketed joints for ducts.

g. Provide all welded long radius elbows.

h. Provide conical tees, all welded.

i. Butt tees or butt taps are not permitted.

All round ducts, 750 mm and larger, shall be supported with two hangers at each support point in an approved manner.

3. Duct Work Fabricated in Factory as per SMACNA Standards

3.1 Duct Material and Fabrication

Material used for ducts shall be galvanized steel sheets class VIII, light coating of zinc, nominal 120gm/SqM surface area conforming to IS:277-1962 (revised) or aluminium sheets conforming to IS:737-1955 as specified in the Bill of Quantities. GI sheet shall be of Lock Forming Quality prime material along with mill test certificates. In addition, if deemed necessary, samples of raw material, selected at random by Client's site representative shall be subject to approval and tested for thickness and zinc coating at contractor's expense.

3.2. Recommended Thickness and Type of Joints

All ducts shall be fabricated using galvanized steel/aluminum sheet with thickness as mentioned hereunder :

3.2.1 For Ducts with External Static Pressure (SP) upto 250 Pa (25mm) :

GSS Rectangular Ducts	**Pressure 250 Pa (25mm)**		
	Duct Section Length 1.2 m (4 ft)		
Maximum Duct Size	**Gauge as per BOQ**	**Joint Type**	**Bracing Spacing**
1–750 mm	26 or 24	**"4 Bolt Transverse Duct Connector-E (TDC) with built in sealant" as per BOQ .**	Nil
751 – 899 mm	26 or 24	4 Bolt Transverse Duct Connector-E (TDC) with built in sealant	Nil
900 – 1200 mm	24 or 22	4 Bolt TDC –E	Nil
1201 – 1500 mm	22	4 Bolt TDC-H	Nil
1501 – 1800 mm	22 or 20	4 Bolt TDC-H	Nil
1801 – 2100 mm	20	4 Bolt TDC-J	Nil
2101 – 2700 mm	18	4 Bolt TDC-J	Nil

3.2.2 For Ducts with External Static Pressure (SP) upto 500 Pa (50mm) :

GSS Rectangular Ducts	**External Pressure 500 Pa (50mm)**		
	Duct Section Length 1.2 m (4 ft)		
Maximum Duct Size	**Gauge**	**Joint Type**	**Bracing Spacing**
1–600 mm	26 or 24	**"4 Bolt Transverse Duct Connector-E (TDC) with built in sealant" as per BOQ .**	Nil
601-700 mm	26 or 24	4 Bolt Transverse Duct Connector-E (TDC) with built in sealant	Nil
701-900 mm	24 or 22	4 Bolt TDC-E	Nil
901-1200 mm	22 or 20	4 Bolt TDC-H	Nil

1201-1300 mm	20	4 Bolt TDC-J	Nil
1301-1500 mm	18	4 Bolt TDC-J	Nil
1501-1800 mm	18	4 Bolt TDC-J	Nil
1801-2100 mm	18	4 Bolt TDC-J	Nil
2101-2250 mm	18	4 Bolt TDC-J	Nil
2251-2400 mm	18	4 Bolt TDC-J	Nil
2401-2700 mm	18	4 Bolt TDC-J	600 *

* Distance of reinforcement/bracing from each joint. Bracing material to be same as of material used for joining of duct sections.

For Aluminium ducts material shall be one commercial gauge higher with 22 gauge as minimum.

3.3 Fabrication Standards and Equipment

All duct construction and installation shall be in accordance with SMACNA standards. In addition ducts shall be factory fabricated utilizing the following machines to provide the requisite quality of ducts.

3.3.1 A coil (Sheet metal in Roll Form) line to facilitate location of longitudinal seams at corners/folded edges only, for required duct rigidity and leakage free characteristics. No longitudinal seams permitted along any face side of the duct.

3.3.2 All ducts, transformation pieces and fittings to be made on CNC profile cutter for requisite accuracy of dimensions, location and dimensions of notches at the folding lines.

3.3.3 All edges to be machine treated using lock formers, flangers and rollers for turning up

edges.

3.4 Duct Construction

All ducts shall be fabricated and installed in workmanlike manner, conforming to relevant SMACNA codes.

a) Ducts so identified on the Drawings shall be acoustically lined and insulated from outside as described in the section “Insulation” and as indicated in schedule of Quantities. Duct dimensions shown on drawings, are overall sheet metal dimensions inclusive of the acoustic lining where required and indicated in Schedule of quantities. The fabricated duct dimensions should be as per approved drawings and care should be taken to ensure that all connecting sections are dimensionally matched to avoid any gaps.

b) Ducts shall be straight and smooth on the inside with longitudinal seams shall be airtight and at corners only which shall be either Pittsburgh or snap button as per SMACNA practice, to ensure air tightness.

c) All concealed ducts up to 750mm width within conditioned spaces shall have slip and drive (C & S/SS) joints. The internal ends of slip joints shall be in the direction of airflow. Care should be taken to ensure that S/SS Cleats are mounted on the longer side of the duct and Cleats on the shorter side. Ducts and accessories within ceiling spaces, visible from air-conditioned areas shall be provided with two coats of mat black finish paint.

d) Changes in dimensions and shape of ducts shall be gradual (between 1:4 and 1:7). Air-turns (vanes) shall be installed in all bends and duct collars designed to permit the air to make the turn without appreciable turbulence.

e) Ducts shall be fabricated as per details shown on Approved for Construction Shop Drawings. All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees, or angles, of ample size to keep the ducts true to shape and to prevent buckling, vibration or breathing.

f) All sheet metal connection, partitions and plenums, required to confine the flow of air to and through the filters and fans, shall be constructed of 18 gauge GSS / 16gauge aluminum, thoroughly stiffened with 25mm x 25mm x 3mm galvanized steel angle braces and fitted with all necessary inspection doors as required, to give access to all parts of the apparatus. Access doors shall be not less than 450mm x 450mm in size.

g) Plenums shall be shop/factory fabricated panel type and assembled at site. Fixing of galvanized angle flanges on duct pieces shall be with rivets heads inside i.e. towards GS sheet and riveting shall be done from outside.

h) Self adhesive Neoprene rubber / UV resistant PVC foam lining 5mm nominal thickness instead of felt, shall be used between duct flanges and between duct supports in all ducting installation

3.5 Duct Installation

All ducts shall be installed generally as per tender Drawings, and in strict accordance with approved shop drawings to be prepared by the Contractor. The contractor shall also carry out the feasibility study at site, coordination with other services and interior drawings before fabrication of duct at the factory. Any fabricated duct rejected due to these reasons shall not be paid and only final measured and installed duct shall be certified for payment.

a. The Contractor shall provide and neatly erect all sheet metal work as may be required to carry out the intent of these Specifications and Drawings . The work shall meet with the approval of Architects/Consultants/Client's site representative in all its parts and details.

b. All necessary allowances and provisions shall be made by the Contractor for beams, pipes, or other obstructions in the building, whether or not the same are shown on the Drawings. Where necessary to avoid beams or other structural work, plumbing or other pipes, and conduits, the ducts shall be transformed,

divided or curved to one side (the required area being maintained) all as per the site requirements.

c. 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, in accordance with other services and as per approval of Client's site representative. Fabrication of duct shall be commenced only after verifying the feasibility at site.

d. All duct work shall be independently supported from building construction. All horizontal ducts shall be rigidly and securely supported, in an approved manner, with trapeze hangers formed of fully threaded galvanized steel rods and galvanized steel angle/channel under ducts at no greater than 2 meter centre. All vertical duct work shall be supported by structural members on each floor slab. Galvanised steel cleat with a hole for passing the hanger rods shall be welded to the plates. Trapeze hanger formed of galvanized steel rods and angles/ channels shall be hung through these cleats. Duct support shall be through dash /anchor fastener driven into the concrete slab by electrically operated gun. Hanger rods shall then hang through the cleats. Size of supports shall be as given hereunder :

Larger Size of Duct	"C" channel size	Fully threaded GI Vertical Rod size	Maximum spacing between supports
Up to 600mm	40mmx40mmx18gauge	8mm	2000mm
601mm to 1200mm	40mmx40mmx16gauge	10mm	2000mm
1201mm to 1800mm	50mmx50mmx5mm MS angle iron duly painted	12mm	2000mm
1801mm & above	65mmx65mmx6mm MS angle iron duly painetd	12mm	2000mm

e. Ducting over false ceiling shall be supported from the slab above, or from beams, after obtaining approval of Client's site representative/Architects. In no case shall any duct be supported from false ceiling hangers or be permitted to rest on false ceiling. All metal work in dead or furred down spaces shall be erected in time to occasion no delay to other Contractor's work in the building. All supports of ducts shall be taken from structural slab/wall by means of fastener.

f. Where ducts pass through brick or masonry openings, it shall be provided with 25 mm thick TF quality expanded polystyrene around the duct and totally covered with mortar for complete sealing. Contractor shall ensure that contact between metal duct and mortar is avoided.

g. All ducts shall be totally free from vibration under all conditions of operation. Whenever duct work is connected to fans, air handling units or blower coil units that may cause vibration in the ducts, ducts shall be provided with a fire resistant double flexible connection, located at the unit discharge. Flexible connections shall be constructed of fire retarding flexible heavy canvas sleeve at least 100mm long securely bonded and bolted on both sides. Sleeve shall be made smooth and the connecting duct work rigidly held by independent supports on both sides of the flexible connection. The flexible connection shall be suitable for pressure at the point of installation.

h. In case of grid type false ceiling, the entire diffuser assembly with plenum shall be independently hung from the ceiling through adjustable GI wires and the same shall be connected to the main duct through a flexible round duct.

i. Duct shall not rest on false ceiling and shall be in level from bottom. Taper pieces shall taper from top.

j. Suitable arrangement shall be provided in duct for fixing of duct smoke sensor (supplied by other vendor).

k. Toilet exhaust duct shall be provided with goose necking as shown in design drawings and exhaust shall continue operation in case of fire.

Duct Support with Steel Wire Rope Hangers

Wire Hangers with following specifications shall be used to suspend static HVAC Air Distribution services as required.

Wire Hangers should consist of a pre-formed wire rope sling with a range of end fixings to fit various substrates and service fixings, these include a ferruled loop, permanently fixed threaded M6 (or M8, M10) stud, permanently fixed nipple end with toggle, at one end or hook or eyelet, cladding hook, barrel, wedge anchor, eyebolt anchor or any other end fixture type or size as per manufacturers recommendation and design. The end fixings and the wire must be of the same manufacturer with several options available. The system should be secured and tensioned with a Hanger self-locking grip at the other end. Once the grip is locked for safety purpose unlocking should only be done by using a separate setting key and should not be an integral part of the self-locking grip. Only wire and/or supports supplied and/or approved, shall be used with the system.

a. Wire Hangers should have been independently tested by Lloyds Register. APAVE, TUV, UL, CSA, Chiltern International fire, ADCAS, Intertek, ECA, and SMACNA, approved by ULC and CSA and comply with the requirements of DW/144 and BSRIA – wire Rope Suspension systems. Wire rope should be manufactured to BSEN 12385: 2002

b. The contractor shall select the correct specification of wire hanger to use for supporting each particular service from table 1 below. Each size is designated with a maximum safe working load limit (which incorporates a 5:1 safety factor).

The correct specification of wire hanger required is determined using the following formula.

Weight per meter of object suspended (kg) x Distance between suspension points (m) = weight loading per Hanger suspension point (kg).

Where the installed wire rope is not vertical then the working load limit shall be reduced in accordance with the manufacturer's recommendations.

The contractor shall select the correct length of wire rope required to support the service. Lengths from 1-10m lengths. Specials can be made, check with manufacturer. No in–line joints should be made in the rope.

Wire (Gripple) Hanger Safe Working Loads		
size	minimum breaking load of Wire Rope	working load limit (kg/lbs)
No. 1	80kg/176 lbs	0-10 kg / 0-22 lbs
No. 2	260kg/572 lbs	10-45 kg / 23-100 lbs
No. 3	580kg/1276 lbs	45-90 kg / 101-200 lbs
No. 4	1500kg/3300 lbs	90-225 kg / 210-495 lbs
No. 5	2160kg/4752 lbs	225-325 kg / 496-715 lbs
No. 6	2500kg/5500 lbs	325-500 kg / 715-1100 lbs

The standard range of Hanger Kits should contain galvanized high tensile steel wire rope or stainless steel wire rope as per the application, the minimum specification is as above and should be manufactured to BS 302 (1987), BSEN12385. Comply with manufacturer's load ratings and recommended installation procedures. It should be noted that the testing has been done to the minimum breaking load of the wire giving a minimum safety factor of 5: 1.

Ducting Supports:

a. All ductwork shall be independently supported from building construction. All horizontal ducts shall be rigidly and securely supported, in an approved manner, with hangers formed of galvanized steel wire ropes and galvanized steel angle/channel or a pair of brackets, connected by galvanized steel wire hangers under ducts, rigid supports may be provided at certain interval if need be**.** The spacing between supports should be not greater than 2 meter. All vertical ductwork shall be supported by structural members on each floor slab. Duct supports may be through galvanized steel insert plates or Toggle end wire fixing left in slab at the time of slab casting. Galvanized steel cleat with a hole for passing the wire rope hanger shall be welded to the plates. Trapeze hanger formed of galvanized steel wire rope using Gripple shall be hung through these cleats. Wherever use of metal insert plates is not feasible, duct support shall be through dash/anchor fastener driven into the concrete slab by electrically operated gun. Wire rope supports shall hang through the cleats or wire rope threaded studs can be screwed into the anchor fasteners. In case of non availability of RCC slab Hanger wires shall then hang around the structural support without use of fastners.

b. All horizontal ducts shall be adequately secured and supported. In an approved manner, with trapeze Hangers formed of galvanized steel wire rope in a cradle support method under ducts at no greater than 1800mm centre, for 1801mm-above appropriate size angle along with neoprene pad in between the duct & MS angle should be used with prior approval. All vertical duct work shall be supported by structural members on each floor slab. Duct support shall be through dash / anchor fastener driven into the concrete slab by electrically operated gun. Hanger wires shall then hang around the ducting. Rigid supports shall be used in conjunction with wire rope hangers to assist with alignment of services where recommended for by the manufacturer. Rigid support must also be used in conjunction with wire rope hangers with duct work at each change of direction or connection. Support ducting in accordance with Schedule I at the end of this Section. Any other Gripple solution can be used based on manufacturer’s recommendation on site conditions after prior approval. In cases of Spiral ducting the wire can be wrapped directly around the ducting without the need for a spiral ducting clamp for sizes above 1100 a cradle support should be provided refer to manufacturer’s recommendations.

c. Ducting over furred ceiling shall be supported from the slab above or from beams after obtaining approval of Construction manager/consultant. In no case shall any duct be supported from false ceiling Hangers or be permitted to rest on false ceiling. All metal work in dead or furred down spaces shall be erected in time to occasion no delay to other Contractor's work in the building. All supports of pipe shall be taken from structural slab/wall by means of fastener.

Catenary Supports: Refer to manufacturer's recommendations on Catenary supports with C clip, special care should be taken with tensioning of the wire and angles at which the installation of services are made.

Stainless Steel Supports should be used for food, chemical and High Corroding environments like areas near coastlines.

Installation should comply with manufacturer's load ratings and recommended installation procedures.

Schedule I: Duct Hanger Schedule

For ducts with external SP upto 250 Pa

Maximum Duct Size (mm)	Gauge	Gripple Hanger No.
1 - 750	26	2
751-1000	26	2
1001-1200	24	3
1201 - 1500	24	3
1501 - 1800	22	4
1801-2100	20	4
2101-2700	18	4

For ducts with external SP upto 500 Pa

Maximum Duct Size (mm)	Gauge	Gripple Hanger No.
1–600 mm	26	2
601-750 mm	26	2
751-1000 mm	24	3
1001-1200 mm	22	4
1201-1300 mm	20	4
1301-1500 mm	18	4
1501-1800 mm	18	4
1801-2100 mm	18	4
2101-2250 mm	18	4
2251-2400 mm	18	4
2401-2700 mm	18	4

Note: All supports are considered at not more 2000 mm interval.

4. **Flat Oval Ductwork**

4.1 Flat oval duct shall be provided where shown and as shown on the tender drawings.

4.2 Minimum duct wall thickness shall be as indicated in below :

Flat oval duct gauge positive pressure to 10 in.wg.

Major Dimension Duct Width (inch)	Longitudinal Seam	SpiralSeam	Fitting Gauge
TO 24	20	24	20
30	20	22	20
36	20	22	20
42	18	22	18
48	18	22	18
54	18	20	18
60	18	20	18
60	16	20	16
71 and UP	16	18	16

Flat oval duct gauge positive pressure to 2500 Pa.

Major Dimension Duct Width (mm)	Longitudinal Seam (mm)	SpiralSeam (mm)	Fitting Gauge (mm)
TO 600	1.00	0.70	1.00
750	1.00	0.85	1.00
900	1.00	0.85	1.00
1000	1.31	0.85	1.31
1200	1.31	0.85	1.31
1300	1.31	1.00	1.31
1500	1.31	1.00	1.31
1650	1.61	1.00	1.61
1775 and UP	1.61	1.31	1.61

4.3 Reinforcement for flat sides of oval duct shall be of the same size and spacing interval as specified for rectangular duct or shall be provided to limit wall deflection to 3/4 (19mm) and reinforcement deflection to 1/4 (6.4 mm)

4.4 Unless otherwise specified, joints and seams shall be similar to those indicated for round duct.

4.5 Fittings shall conform to the thickness schedules in Table 3-15, shall conform to the seam, joint, and connection arrangements permitted for round duct, and shall be reinforced to conform to 2.4.3.

4.6 The duct construction shall be capable of withstanding a pressure 50 percent greater than that of the assigned pressure class without structural failure or permanent deformation.

4.7 Duct wall deflection at atmospheric pressure, with reinforcements and connections in place, shall not exceed 1/4 in. (6.4 mm) on widths of 36 in. (914 mm) or less or 1/2 in (13 mm) on greater widths. Refer Criteria in Chapter 11 of SMACNA Standards 2005 Third Edition.

4.8 Supports shall conform to those permitted for rectangular duct, with the overall dimensions taken as references.

4.9 <u>Documentation & Measurement of ducting</u>

All ducts fabricated and installed should be accompanied and supported by following

documentation :

a. For each drawing, all supply of ductwork must be accompanied by computer generated detailed bill of materials indicating all relevant duct sizes, dimensions and quantities. ln addition, summary sheets are also to be provided showing duct area by gauge and duct size range as applicable.

b. Measurement sheet covering each fabricated duct piece showing dimensions and external surface area along with summary of external surface area of duct gauge-wise.

c. All duct pieces to have a part number, which should correspond to the serial number, assigned to it in the measurement sheet. The above system will ensure speedy and proper site measurement, verification and approvals.

4.10 Testing

After duct installation, total duct work (Air conditioning and Mechanical Ventilation Ducts for Kitchen and toilet exhaust) carried out under this scope of works should be tested for leakage.

4. **Air Terminals**

4.1 Dampers

4.1.1 Opposed blade type louver dampers with quadrant and thumb screw lock shall be used at supply air collars for balancing of air distribution system and box type volume control dampers having lever operation shall be used at the outlet of air conditioning equipment or as shown on the approved shop drawings.

4.1.2. All dampers shall be multi blade type of robust construction of galvanized steel unless and until specified otherwise in the Bill of Quantities and tightly fitted. The design, method of handling, and control shall be suitable for the location and service required.

4.1.3 Dampers shall be provided with suitable links, levers and quadrants as required for their proper operation ; control or setting devices shall be made robust, easily operable and accessible through suitable access doors in the ducts. Every damper shall have an indicating device clearly showing the damper position at all times.

4.1.4 Dampers shall be placed in ducts and at each supply air collar, whether or not indicated on the drawings, for the proper volume control and balancing of the system.

4.1.5 Automatic and manual volume control opposed blade dampers shall be complete with frames and bronze bearings as per drawings. Dampers and frames shall be constructed out of 1.6mm steel sheets and blades shall not be over 225mm wide. The dampers for fresh air

inlet shall additionally be provided with fly mesh screen, on the outside, of 0.8mm thickness with fine mesh.

4.1.6 Wherever required for system balancing, a volume balancing opposed blade damper with quadrant and thumb screw lock shall be provided.

4.1.7 After completion of the duct work, dampers are to be adjusted and set to deliver air flow as specified on the drawings.

4.2 Double Louvered Grilles

4.2.1 The supply air grilles shall be fabricated from extruded aluminium sections. The supply air grilles shall have double adjustable louvers i.e. front horizontal and rear vertical louvers, both adjustable. The louvers shall be suitable to hold deflection settings under all conditions of velocity and pressure. The grilles shall be provided with outer frame. The louvers shall be pivoted in Nylon bushes for smooth operation for return air grilles similar to supply air as described above will be provided but with out volume control damper. The grilles shall be painted as per approved powder coated shade.

4.2.2 Volume control dampers in extruded aluminium construction shall be factory fitted for supply air grilles.

4.2.3 Longer grilles having size more than 45cm shall have intermediate supports for the horizontal louvers. The sample of grille shall have to be got approved by the consultants before delivery.

4.3 Linear Grilles

4.3.1 The linear supply cum return air grilles shall be fabricated from extruded aluminium sections. Flanges shall be of minimum 1.3 mm thick extruded aluminium suitable to hold the louvers tightly in fixed position.

4.3.2 Louvers shall be minimum 3mm thick throughout of extruded aluminium construction with 15 degree deflection unless and until specified otherwise. Grilles shall be provided with removable/fixed internal core as mentioned in the BOQ. The sample of grille shall have to be got approved by the consultants before delivery.

4.3.3 All sections of grills shall be powder coated for color and shade as approved by the Architects to match interior finishes.

4.3.4 Linear grilles at each supply air outlet shall be provided with volume control dampers as mentioned above and accounted for in BOQ separately. The linear grilles shall be fixed in to a plenum chamber having GI spacers with concealed screws. End pieces or corner pieces shall be provided as required.

4.4 Diffusers

4.4.1 Square ceiling diffuser shall be anti-smudge ring type fabricated out of extruded aluminium sections. The four directional air flow diffuser shall consist of outer ring fixed to duct collar with concealed screws. Foam gasket shall be provided between outer ring and suspended ceiling. The central core shall be clip fixed to the outer ring.

4.4.2 Opposed blade volume control damper in extruded aluminium construction shall be fixed to the neck of diffuser. The damper shall be adjusted after removing the central core.

4.4.3 All sections of diffusers shall be powder coated for color and shade as approved by the Architects to match interior finishes. The sample of diffuser shall have to be got approved by the consultants before delivery.

4.5 Multislot Linear Diffuser

Linear ceiling diffuser shall be multislot type. The diffuser shall be fabricated out of extruded aluminium sections. Each slot shall be 19mm wide. Each slot shall be equipped with air flow direction control louver mechanically fixed. Integral sliding type hit & miss type volume control damper in extruded aluminium construction shall be provided for each slot for fine control of air flow in supply air portion only. The damper shall be fabricated out of anodized extruded aluminium sections.

Other sections of ceiling diffuser shall be powder coated in colour & shade approved by the Consultants/Architects.

The linear diffuser shall be fixed in to a plenum chamber with concealed screws. Side end pieces or corner pieces shall be provided if required.

4.6 Air Transfer Grille

4.6.1 Air transfer grilles shall be in extruded aluminium construction. The grilles shall be complete with single /double frame suitable to be fixed on the door panel from both sides. The central core shall be no-see-thru type.

4.6.2 The grilles shall be anodized or powder coated in colour and shade as approved by the Architects. The grilles shall be provided with insect screen.

4.6.3 The ATGs shall be provided at the door of pantry and toilets as shown in the approved drawings. The sample of grille shall have to be got approved by the consultants before delivery.

5. Painting

5.1 All grilles and diffusers shall be powder coated at factory prior to delivery at site of approved color and shade.

5.2 All ducts immediately behind the grilles/diffusers etc. to be applied with two coats of black paint in matt finish.

6. Fire cum Smoke Dampers

Bare Dampers

a. All supply and return air ducts/ return air spaces at AHU room crossings and at all floor crossings shall be provided with approved make motorized fire and smoke dampers of at least 120 minutes fire rating as certified by CBRI Roorkee, India as per clause 10 of UL:555-1995.

b. Fire damper blades and outer frame shall be formed out of 1.6mm (16G) galvanized steel sheet of length as mentioned in the approved for construction shops drawings. The damper

blade shall be pivoted on both ends using chrome-plated spindles in self-lubricated bronze bushes. Stop seals shall be provided on top and bottom of the damper housing made of 16 gauge galvanized sheet steal. For preventing smoke leakage, metallic compression side seals shall be provided. Dual side leakage shall be provided for better structural stability. The construction of the fire damper shall allow maximum free area to reduce pressure drop and noise in the air passage, in normal position damper blade shall be held in open position with the help of a 220 V operated electric actuators thereby providing maximum air pressure without creating any noise or chatter.

c. For wall mounted fire dampers retaining MS angles duly painted with black enamel paint shall be supplied and installed by HVAC Contactor as per established installation procedure. Whereas the fire damper is also used for Smoke management (Smoke and fire damper) the same shall be as per UL-555 S-Class-II.

d. Every motorized fire damper/ Smoke and fire damper shall be tested in the factory and will be certified by the manufacturer in form of the test certificate.
e. For fire dampers/ smoke fire dampers of size higher than one approved by certifying agency the damper shall be supplied in multiple units of size not exceeding the tested damper by CBRI. All the multiple units shall be housed in a common factory fitted sleeve.

f. The fire dampers shall be mounted in fire rated wall with a duct sleeve 400mm/ 500mm long depending upon the wall thickness. The sleeve shall be factory fitted on fire damper. The joints at sleeve end shall be slip on type. Minimum thickness of galvanized sheet shall be 18 gauge.

g. The damper shall be installed in accordance with the installation method recommended by the manufacturer.

Actuators

The actuator shall be maintenance free coupled spring return type suitable to work on 24V electric supply. The torque rating of the actuator shall exceed at least by 15% over torque required to open/ close the damper. The selection of actuator size shall be the responsibility of the manufacturer of the fire damper. Spring return time shall be 20 seconds or less at ambient temperature. Other features of the damper actuator shall be as under:

a. Actuator shall have tamper proof housing with IP-54 protection rating.

b. Actuator shall have mechanical integrity of at least one hour at 900ºC.

c. Actuator shall have minimum 600000 safe position at rated torque. It shall be capable to withstand temperature of 75ºC for 24 Hrs.

d. Actuator shall have electronic over load or digital sensing circuit to prevent damage to actuator.

e. Should be capable of changing direction of rotation by changing mounting orientation .

f. Actuator shall have manual over ride facility.

Damper actuator shall be such that it should close the damper in the event of power failure automatically and open in the same manner in case of power being restored.

Control Panels

The control panel shall be supplied by damper manufacturer fitted on damper compatible with damper actuators. The control panel shall have at least following features:

a. Power on lamps with 230 V/ 24 V Transformer.
b. Damper close and open indication.
c. Reset push button.
d. Push button for manual running of actuator for periodic inspection.
e. Auxiliary contacts 24V/ 230V.
f. Contact points to receive signal from smoke detector/ fire alarm panel.
g. Additional terminal shall be provided to have signal (audio or visual) in central control room.

In addition the Control panel shall have following features as well :

- Potential free contacts for AHU fan/Package Unit ON/ Off and remote alarm indication.
- Accept signal from external smoke / fire detection system for tripping the electrical actuator.
- Test and reset facility.
- Indicating lights / contacts to indicate the following status:
- Power Supply On
- Alarm

.

The control panel shall receive 230V A/C supply and interconnecting wiring between control panel and actuator shall be carried out using fire proof cables.

The Contactor shall ensure that all electrical connections are suitably terminated. The HVAC Contractor shall also check continuity of electrical circuit as recommended by the manufacture. Fire damper inspection door will be provided in AC duct to facilitate access to the system.

7. Flexible Ducts

The scope of this section comprise supply, installation testing and commissioning of flexible ducting conforming to these specifications and in accordance with requirements of drawings and schedule of quantities.

Wherever specified, uninsulated flexible duct shall be made of double lamination of metalized aluminium film permanently bonded to a coated spring steel wire helix. Duct shall be in tear and puncture resistant construction.

Wherever insulated flexible ducts are specified, inner core for the same should be made of double lamination of alumimium permanently bonded to a coated spring steel wire helix. Fiberglass insulation of minimum 24Kg/m^3 density, 25mm thickness shall be wrapped over the inner core and covered with strong outer jacket cum vapour barrier made of fiberglass reinforced metalized polyester film laminate.

Care must be taken to install all flexible ducts in fully extended position and bends made with adequate radius as per manufacturer recommended practices.

8. Flexible Connection Fabric

SCOPE

The scope of this section comprises the supply, erection, testing & commissioning of Flexible Connector conforming to these specifications & in accordance with requirements of Drawings &/of the Schedule Of Quantities

SILICON COATED FLEXIBLE CONNECTOR FABRIC

The Flexible Connector Fabric shall be Non Combustible & shall have Operating Temperature Range of (-) 70 C to (+) 280 C. The fabric shall be suitable to operate for minimum of 1 hour in (+) 280 C high temperature

The Material shall be made of Fiber Fabric. It shall have coating of Silicon on both sides with minimum coating density of 130 g/sq.mtrs each side. Total weight of the material shall not be less than 560 gms/ sq. mtrs.

The tensile strength of the fabric shall not be less than (N) 3000x 2100 while the Anti-Tear strength shall not be less than (N) 260 x 250

The Finished width of the connector shall not be less than 150 mm after accounting for side flanges.

The thickness of the finished Fabric shall not be less than 0.6 mm

9. Testing and Balancing

9.1 After completion of the installation of the complete air distribution system, all ducts shall be tested for air leaks.

9.2 Before painting the interiors, air distribution system shall be allowed to run continuously for 48 hours for driving away any dust or foreign material lodged within ducts during installation.

9.3 The entire air distribution system shall be balanced using approved anemometer. Air quantities at the fan discharge and at various outlets shall be identical to, or less than 5 percent in excess of, those specified and quoted. Leakage in each air distribution system shall be within 3 percent so that supply air volume at each fan shall be identical to , or no greater than 3 percent in excess of, the total air quantity measured at all supply outlets served by the fan. Branch duct adjustments shall be made by volume or splitter dampers. Dampers shall be permanently marked after air balance is complete so that these can be restored to their correct position if disturbed at any time. Complete air balance report shall be submitted to the Consulting Engineer for scrutiny and approval, and six copies of the approved report shall be provided with completion documents.

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E. "SPECIFICATIONS - INSULATION"

1. Scope

The scope of this section comprises of supply and application of insulation conforming to these Specifications and as shown on the drawings & BOQ.

2. Duct Insulation (External)

Material

Insulation material shall be closed cell elastomeric material (nitrile rubber) having fire retardant Class "O" properties. Density of insulation material shall range between 0.04-0.07 gm/Cucm. Thermal conductivity (K value) at 40 C mean temperature and Service temperature limit shall be 0.039 W/M.K and –40C to 105C respectively. Moisture Resistance Factor (μ) shall not be less than 7000. Water absorption shall not be more than 1.5% by weight. Insulation material shall have excellent ozone resistance properties. Excellent Thermal Stability. Insulation material shall be tested for the said properties in accordance with the relevant international codes including BS 874 Part 2 1986, DIN 52612(K Value), DIN 52615 (Water vapour permeability), BS 476 Part6 & Part7 (Flammability).

Application

Duct insulation shall be applied as follows:

a. External surface of the ducts to be cleaned vigorously to remove dirt and any other foreign material from the surface of the ducts.

b. Apply Low VOC adhesive Fevicol AC duct King Eco Fresh/equivalent on the surface of ducts.

c. Wait for around half an hour to develop Tack until the adhesive layer got colorless.

d. Wrap factory aluminum foil laminated/IC cladding finish closed cell insulation material having thickness as mentioned in BOQ butting all joints. All joints to be sealed with adhesive.

3. Accoustic Lining

3.1 Material

Insulation material shall be resin bonded fibre glass. The Thermal conductivity of the insulation material shall not exceed 0.034 K cal./ hr-SqM C/M or 0.27 Btu/hr sft- F/inch at 32 C (90 F) mean temperature, and density shall not be less than 32 Kg/ CuM (2.0 lb/c.ft). Thickness of the insulation shall be as specified for the individual application. Samples of insulation material shall be submitted for approval.

3.2 Application

3.2.1 Duct Lining (Internal)

Acoustical lining of duct wherever specified shall be applied as under :

a. Internal surface of the ducts to be cleaned vigorously to remove dirt and any other foreign material from the surface of the ducts

b. 22 gauge G.S. Sheet channel frames having size 25mm wide & depth equal to thickness of insulation to be fixed at maximum 600mm centre, screwed to the sheet metal using brass metal screws.

c. Fibre Glass blankets of 32 Kg/CuM density and thickness as mentioned in the BOQ to be fixed in the G.S.sheet channel frame work with joints well butted together. Thereafter, insulation shall be covered with R.P tissue.

d. Finally cover the insulation with 26 SWG perforated aluminium sheet having atleast 20% perforation with joints overlapped and screwed to the G.S. Sheet channel frame using brass metal screws, to produce an even surface.

OR

3. Acoustic Lining of Ducts

3.1 Material

Acoustic insulation material shall generally possess the properties mentioned above, however, insulation material shall be processed Nitrile Rubber Foam having fire retardant Class "O" properties. Density of insulation material shall range between 140-180 Kg/CuM. The insulation material shall conform to the international codes including BS 476 Part6 & Part7 (Flammability).

3.2 Application

Acoustical lining of duct wherever specified shall be applied as under:

a. Internal surface of the ducts to be cleaned vigorously to remove dirt and any other foreign material from the surface of the ducts

b. Apply Low VOC adhesive Fevicol AC duct King Eco Fresh/equivalent on the surface of ducts.

c. Wait for around half an hour to develop Tack until the adhesive layer got colorless.

d. Cut foamed sheets into required sizes using sharp knives. Apply adhesive on the foam and stick it to the duct surface.

Note: Specifications shall be applicable as specified in the BOQ

4. Exposed Ducts Thermal Insulation

Material

Insulation material shall be closed cell elastomeric material (nitrile rubber) having fire retardant Class "1" properties followed by Class "O". Density of insulation material shall range between 0.04-0.07 gm/Cucm. Thermal conductivity (K value) at 40 C mean

temperature and Service temperature limit shall be 0.039 W/M.K and –40C to 105C respectively. Moisture Resistance Factor (μ) shall not be less than 7000. Water absorption shall not be more than 1.5% by weight. Insulation material shall have excellent ozone resistance properties. Excellent Thermal Stability. Insulation material shall be tested for the said properties in accordance with the relevant international codes including BS 874 Part 2 1986 ,DIN 52612(K Value),DIN 52615 (Water vapour permeability), BS 476 Part6 & Part7 (Flammability).

Application

Duct insulation shall be applied as follows :

a. External surface of the ducts to be cleaned vigorously to remove dirt and any other foreign material from the surface of the ducts.

b. Apply Low VOC adhesive Fevicol 1K PUR FR /Equivalent on the ducts.

c. Wrap closed cell insulation material having thickness as mentioned in BOQ butting all joints. All joints to be sealed with adhesive.

d. Cover the insulation with necessary glass cloth & ultraviolet (UV) paint towards protection from atmospheric abuse.

OR

4. Exposed Ducts Thermal Insulation

4.1 General

The insulation of ducts exposed to atmosphere shall be carried conforming to these Specifications and as shown on the drawings.

4.2 Material

Exposed ducts shall be insulated with rigid preformed sections of TF quality expanded polystyrene of density not less than 24Kg/CuM and thickness as indicated in the Schedule of Quantities.

4.3 Application

Method for application of Insulation externally shall be as given hereunder :

a. Duct surface shall be cleaned thoroughly and thereafter applied with hot bitumen 85/25 over the cleaned surface.

b. TF quality rigid expanded polystyrene insulation material in specified thickness to be fixed tightly to the surface with joints well butted and secured. All joints to be sealed properly with CPRX compound.

c. Cover the insulation with a two layers of 500G polythene sheet to work as vapour barrier.

d. Finally apply necessary glass cloth coating & UV protection paint of approved make to protect the insulation material from atmospheric abuse.

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F. "SPECIFICATIONS - ELECTRICAL WORK"

1. Scope

In general, the contractor shall supply, store, erect, test and commission all the equipment required for Electrical Installation. The contractor shall furnish all the materials, labour, tools and equipments for the electrical work, as shown in the accompanying drawings and in the bill of quantities and specifications hereinafter described.

2. Definitions

The following abbreviations used in the bill of quantities specifications and drawings represents:

ISS	-	Indian Standard specification.
IER	-	Indian Electricity Rules, 1956.
BS	-	British Standard (where specifically called for)
BSCP	-	British Standard Code of Practice (if called for).
HRC	-	High Rupturing Capacity
GI	-	Galvanised Iron
MS	-	Mild Steel
CI	-	Cast Iron
APLSTS	-	Aluminium conductor, paper insulated lead sheathed, Double steel tape armoured and serving.
PVC	-	Polyvinyl Chloride.
XLPE	-	Cross Linked Polyethylene.
HT	-	High Tension.
LT	-	Low Tension.
A-Amp	-	Ampere.
KV	-	Kilo Volts.
PT	-	Potential Transformers.
CT	-	Current Transformers.
OCB	-	Oil circuit Breakers
VCB	-	Vacuum Circuit Breaker
ACB	-	Air Circuit Breakers
SFU	-	Switch fuse Unit
COS	-	Change Over Switch
CFS	-	Combination Fuse Switch
MCCB	-	Moulded Case Circuit Breaker.
MCB	-	Miniature Circuit Breaker
IC	-	Iron Clad
ICTPN	-	Iron Clad Triple Pole and Neutral
ICDP	-	Iron Clad Double Pole
DB	-	Distribution Board
KVA	-	Kilo Volts Ampere.
KVAR	-	Kilo Volts Ampere - Reactive.
NC	-	Normally Close
NO	-	Normally open
SWG	-	Standard Wire Gauge.

3. REGULATION & STANDARDS

The installation shall conform in all respects to Indian standard Code of Practice for Electrical Wiring Installation I.S. - 732 and 'National Electrical Code'. It shall be in conformity with the current I.E Rules and Regulations and requirements of the local Electric Supply Authority in-so-far as these become applicable to the installation. Wherever this specification calls for a higher standard of materials and/or workmanship then those required by any of the above regulations, this specifications shall take precedence over the said regulations and standards.

In general, the materials, equipments and workmanship not covered by the above, shall conform to the following Indian Standards (Latest Edition) unless otherwise called for:

a. **SWITCHGEAR**

- Requirements of A.C. Circuit Breakers. : IS 2516 (Part I) Sec.1,2 & 3 (Part-II)

- Switches and Switch Isolators above 1000V
- But Not Exceeding 1.1 KV : IS 4710

- Markings & arrangements for switchgear
- bus-bars, main connection & auxiliary wiring : IS 375

- Specification for normal duty air break switches & composites unit for air break switches and fuses for voltage not exceeding 1000 Volts. : IS 4064

- Heavy duty air-break switches and composite units of air-break switches and fuses for voltages not exceeding 1000 Volts. : IS 4047

- Specification for miniature circuit breakers. : IS 8828

- Specification for enclosed distribution, fuse boards and cut-outs for voltage not exceeding 1000 Volts : IS 2675

- Installation and maintenance of switchgear. : IS 3072 (Part I)

- HRC cartridge fuse links 650 Volts. : IS 2208

b. **CABLE & MISCELLANEOUS ITEMS**

- Specification for paper insulated and lead sheathed cables : IS 692

- Code of Practice for installation and maintenance of paper insulated power cables (upto and including 33 KV) : IS 1255

- Specification for PVC insulated (Heavy Duty) electric cables Part-I for Voltage upto 1100 Volts. : IS 1554

• Specification for PVC insulated cables (for voltage upto 1100 V) (Part-II) with Aluminium conductors.	:	IS 694 (Part-II)
• Specification for rigid steel conduit for electrical wiring.	:	IS 9537
• Specifications for rigid non metallic conduits for electrical installations.	:	IS 9537
• Specifications for accessories for rigid steel conduits for Electrical wiring.	:	IS 3837
• Box for the enclosure of electrical accessories steel and C.I. Boxes.	:	IS 5133 (Part I)
• 3Pin plugs and sockets outlets	:	IS 1293
• Adhesive insulating tapes for Electrical purposes (Part- I & II)	:	IS 2448
• Propeller type AG Ventilating fans	:	IS 2312
• Code of Practices for earthing.	:	IS 3043
• Glossary of terms for electrical cable and conductors.	:	IS 1885
• Code of Practice for buildings (General) Electrical installation	:	IS 1646
• Current Transformers	:	IS 2705 (Part-I to III)
• Voltage Transformer	:	IS 3156 (Part-I to III)
• Shunt capacitors for Power system	:	IS 2834
• Direct acting electrical indicating instruments	:	IS 1246
• Factory assembled switchgear	:	IS 8623
• Rating for Cable	:	IS 3961 (Part -II)
• Earthing	:	IS 3843

3. INSPECTION & APPROVAL OF THE WORK BY LOCAL AUTHORITY

On completion of this work, the contractor shall obtain and deliver to the owners the certificates of inspection and approval by electrical inspectorate of Local Administration. The fees paid for inspection will be reimbursed on production of challan/receipt. The contractor shall include in his rates all charges necessary for getting electrical installation approved which includes Sub-station, LT distribution, etc. by the Chief Electrical Inspector to the state government or/ and from any other authority required for this job.

5. INSPECTION OF MATERIALS

The Architect/ owners shall have access to the manufacturer's premises for inspection of any items of the tender for which contractor has made arrangement with manufacturer/ suppliers. All such inspection shall not need any prior intimation by the owners or architects.

6. WORKING DRAWINGS & SHOP DRAWINGS

The contractor shall prepare and submit to the Architects/ owners for approval detailed working drawings & shop drawings of all MCC/panels ,cable layout, earthing etc.

7. AS BUILT DRAWINGS

At the completion of the work and before issuance of certificate of virtual completion, the contractor shall submit to the Architect/ PMCs/Clients layout drawings in Auto-CAD and PDF in approved scale.

8. ENGINEER/ SUPERVISOR

The contractor shall employ a competent, licence, qualified full time electrical engineer / supervisor to direct the work of electrical installations in accordance with the drawings and specifications. The engineer / supervisor shall be available at all times at the site to receive instructions from the Architect/employers in any day to day activities throughout the duration of the contract. The engineer & supervisor shall correlate the progress of the work in conjunction with all the relevant requirements of the supply authority. The skilled workers employed for the work should have requisite qualifications and should possess competency certificate from the Electrical Inspectorate of Local Administration.

9. APPLICATION FOR ELECTRIC SUPPLY/ LIASON

The Contractor shall be responsible for filing and follow up application for electric supply to the project. The contractor shall carry out all the liason work required for obtaining electric supply at site commencing from filing of application. This liason shall be deemed to be a part of the contract.

GENERAL SPECIFICATION FOR: MEDIUM VOLTAGE POWER CONTROL CENTRE AND SWITCH BOARD PANELS:

1.1 GENERAL:

Medium voltage power control centres (generally termed as switch board panels) shall be in sheet steel clad cubicle pattern, free floor standing type, totally enclosed, compartmentalized design. This specification shall cover the following types of panels :

a) Air circuit breaker panels - Drawout type with single or double tier arrangement as per design shown on the drawings.

b) Panels with one or more Air circuit breakers with Draw-out arrangement and switch-fuse units/moulded case circuit breaker of non-drawout design.

c) Panels with switch- fuse unit/moulded case circuit breaker of non- drawout type. However, the switch-fuse units can have drawout fuse-carriage if a particular make of switch-fuse is used.

The panels shall generally be of extensible type with provision for bus extension on or both sides as desired at the time of approved of shop drawings.

1.2 CODE/STANDARDS :

The panels shall generally conform to the requirements of following codes/ specifications:

a) IS-8623
b) IS-4237
c) IS-2147
d) IS-3072
e) IS-375
f) IS-1248 & 2419
g) IS-5082
h) IS-2705
i) IS-722
j) IS-4064
k) IS-2208
l) IS-6875
m) IS-6005

The equipment shall conform to Indian Electricity Rules as amended upto-date.

The supplier shall examine the provision of these codes and confirm or indicate his comments.

1.3 CONSTRUCTION :

Power control centres/ switch board panels shall of free standing type, with sheet steel enclosure having following features :

a) The panel shall be constructed of sheet steel of minimum 1.6mm thickness. The internal frames shall be made of structural steel angles or made up sections (as per standard design of the manufacturer) specifications of which, shall be submitted along with offers.

b) The panel shall be compartmentalised to accommodate one feeder n each compartment. The main bus bar chamber shall be provided at the top of panel or bottom of the panel as required. The compartments shall be arranged in section with metallic/ phenolic barrier in between.

A vertical cable alley of at least 200mm width shall be provided to serve one/ two vertical section of feeders. Cable alley shall have hinged door/ doors with rubber gaskets. Suitable

cable clamping arrangement with slotted steel members shall be provided in the cable alley. Similarly, vertical bus bar shall be housed in-between two feeder compartments in a separate bus chambers. The opening between bus chamber and feeder compartments shall be properly covered with Bakelite/ Hylam sheets of 3mm minimum thickness. The vertical bus chamber shall be provided with removable bolted covers on the front and back side. All the interconnecting links to the feeders shall be shrouded so as to avoid accidental contact, by means of phenolic barriers.

c) Each compartment shall have its own hinged door with concealed hinges. The doors shall have heavy duty rubber gasket fixed on the inner side of the door. The door shall have interlocking facility with the feeder unit.

d) The Panel shall have punched openings for mounting meters, lamps, push buttons, relays, etc.

e) The dimensions of feeder compartments, bus chambers and cable alleys shall be as shown on the relevant drawings. However, the following minimum dimensions shall be strictly adhered to :

i. ACB compartment : Drawout -600mm wide x 1000mm deep x 900mm high.

ii. SWITCH FUSE UNITS/MOULDED CASE CIRCUIT BRACKER (NON-DRAWOUT TYPE) :

Up to 63A/ 100A	:	300mm wide x 225mm high x 400mm deep
250A	:	400mm wide x 400mm high x 400mm deep
400A to 630A	:	400mm wide x 500mm high x 400mm wide. (or vice- versa).

iii. BUS CHAMBER :

Main bus (Horizontal)	:	400mm high x 300mm deep
Vertical bus (Feeder bus)	:	300mm wide x 400mm deep

iv. Cable alley : Min. 200mm wide.

These dimensions are furnished as a guide and the clearances required in between each live bus/ link and between bus/ links to the earth (panel wall/ sheet) shall be as per relevant Indian Standard Code of practice. However, minimum clearance between neutral bus and earth shall not be less than 25mm. The panel supplier shall furnish detailed sectional drawings and also arrange to get the panel inspection done at intermediate stages of fabrication to avoid fault defective fabrication of the panels (however, the compliance of these specifications shall entirely be the suppliers' responsibility).

1.4 BUS BARS :

a) The bus bars shall be suitable for 3 phase, 4 wire, 415 volts 50 Hz AC supply. The bus bars shall be made of high conductivity aluminium. The bus bars shall have uniform cross-section throughout the length. The bus bars shall be designed for carrying rated-current continuosly. The bus bars and links shall be designed for a maximum temperature of $75^{O}C$. The max. current density of bus bars shall be as follows:

i. Copper : 1.4 Ampere/ Sq.mm. of cross section area.
ii. Aluminium : 1.0 Ampere/ Sq.mm. of cross section area.

It may be noted that these ratings are the upper limit to which the bus could be stressed. Suitable derating factors shall be applied to arrive at the correct cross section of bus bars.

b. Bus bars shall be supported on suitable non hygroscopic, non combustible, material such as DMC/ SMC at sufficiently close intervals to prevent bus bar sag. All bus bar joints shall be provided with high tensile steel bolts (electro plated with suitable metal such as Nickel/ Cadmium), spring washer and nuts so as to ensure good contact. Alternatively, electroplated/ tinned brass bolts shall be used. The joints shall be formed with fish-plates on either side of bus bar to provide adequate contact area. Bus supports shall be provided on either side of joints (max. unsupported distance from the joint 400mm)

c. Power shall be distributed to feeders in dual section by a set of vertical bus bars (Phases+neutral). Individual module shall be connected to the vertical bus bars through sleeved connections.

d. Bus bars shall be insulated with PVC sleeves (heat shrink type) with colour coding (Red/ Blue/ Yellow/ Black).

e. The bus bars and their supports shall be able to withstand thermal and dynamic stresses due to the system short-circuits. The supplier shall furnish calculations alongwith his drawing establishing the adequacy of bus bars both for continuous duty and short - circuit rating. Short circuit withstand capacity shall be for one second. Calculations for spacing of supporting of supports shall also be furnished.

1.5 EARTHING :

The panels shall be provided with a copper earth bus running throughout the width of the switchboard. Suitable earthing eyes/bolts shall be provided on the main earthing bus to connect the same to the earth grid at the site. Sufficient number of star washers shall be provided at the joints to achieve earth continuity between the panels and the sheet metal parts.

1.6 MOUNTINGS :

Panels incorporating switchfuse units shall have suitable compartments of standard width. Each compartment shall incorporate a heavy duty load break switch fuse and HRC fuses. Suitable cable termination arrangement shall be provided for switch fuse/ fuse-switch unit feeders. Equipment shall be provided with proper fastening arrangements to ensure vibration free operation. Proper designation as given on the respective drawings, shall be provided for every equipment.

Circuit breakers shall be mounted such that they are accessible from the front of the panel. More than two circuit breakers shall not be incorporated in a vertical section. The breakers compartment shall be divided into two parts, one for the breaker and the other for incorporating associated control gear. The necessary instrumentation shall be provided on the door of the compartment.

1.7 INTERLOCKING

The panels shall be provided with the following interlocking arrangements :

a. The door of the feeder compartments is so interlocked with the switch drive or handle that the door can be opened only if the switch is in “OFF” position. De-interlocking arrangement shall also be provided for inspection.

b. It shall not be possible for the breakers to be withdrawn when in "ON" position.

c. It shall not be possible for the breakers to be switched "ON" unless it is either in fully inserted position or for testing purposes it in fully isolated position.

d. The breaker shall be capable of being racked into "testing", "isolated" and maintenance position and kept in any of these positions.

e. A safety catch to ensure that the movement of the breaker as it is withdrawn, is checked before it is completely out of the cubicle shall be provided.

1.8 PROTECTION AND INSTRUMENTATION :

Protection and instrumentation shall be as per standard specification.

1.9 WIRING

All the interconnections between the incoming, bus and the outgoings of 100A and above rating shall be done by insulated links/ strips of suitable sizes. Switch fuses and equipments below 100A rating shall be wired with PVC insulated copper conductors. The wiring for instrumentation protection and control equipment shall be carried out with PVC insulated flexible copper conductors.

The Power interconnections shall be carried out by means of bolted connections with washers. The wiring shall be terminated by using crimping sockets. Wring shall be laid out neatly in bunches which are fastened to the steel members of the panel. All the potential circuits shall be protected by fuses mounted near the tap-off point from the main connections.

1.10 TERMINALS:

All the control, instrumentation and protection wiring shall be provided with printed PVC ferrules at both ends. For terminating control cables on to the equipment in the panels, suitable terminals blocks shall be provided. The terminal shall also be numbered for easy identification and maintenance.

1.11 SURFACE TREATMENT

All sheet metal accessories and components of power, control centres and switchboard panels shall be thoroughly cleaned, degreased, derusted and phosphatised before redoxide primer is applied. The panel shall be stove enameled to the required final finish. The interior surfaces of the panel shall also be painted to required shade. The supplier shall indicate in his offer, if there is any deviation from the treatment specified above.

1.12 ENCLOSURES

The panel enclosure shall be dust and vermin proof and shall be suitable for indoor installation. Enclosure design shall be in accordance with the requirements of IP 54 as per IS-2147-1962. The supplier shall confirm whether this requirement is met and a type test certificate furnished. If type test certificate for IP-54 is not available, the same shall be brought out clearly in his offer.

1.13 NAME PLATE

The panel as well as the feeders compartment doors shall be provided with name plates giving the switchboard/ feeder descriptions as indicated on the drawings.

1.14 TESTING

The power control centres shall be tested at factory after assembling of all components and completion of all interconnections and wiring. Tests shall be coducted in accordance with the requirements relevant IS Codes/ specifications.

a. INSULATION TEST

i. Insulation of the main circuit, that is, the insulation resistance of each pole to the earth and that between the poles shall be measured.

ii. Insulation resistance to earth of all secondary wiring should be tested with 1000V megger.

Insulation test shall be carried out both before and after high voltage test.

b. HIGH VOLTAGE TEST :

A high voltage test with 2.5KV one minute shall be applied between the poles and earth. Test shall be carried out on each pole in turn with the remaining poles earthed. All units racked in position and the breakers closed. Original test certificate shall be submitted along with panel.

1.15 STORING, ERECTION AND COMMISSIONING

a. STORING

The panels shall be stored in a well ventilated, dry places. Suitable polythene covers shall be provided for necessary protection against moisture.

b. ERECTION

Switchboards shall be installed on suitable foundation. Foundation shall be as per the dimensions supplied by the panel manufacturer. The foundation shall be flat and level. Suitable grouting holes shall be provided in the foundation. The switch boards shall be properly aligned and bolt000ed to the foundation by atleast four bolts. Cable shall terminated on the bottom plate or top plate as the case may be, by using brass compression glands. The individual cables shall then be lead through the panel to the required feeder compartments for necessary terminations. The cables shall be clamped to the supporting arrangement. The switch board earth bus shall be connected to the local earth grid.

c. PRECOMMISSIONING TESTS :

Panels shall be commissioned only after the successful completion of the following tests. The tests shall be carried in the presence of engineer-in-charge.

i. All main and auxiliary bus bar connections shall be checked and tightened

ii. All wiring terminations and bus bar joints shall be checked and tightened.

iii. Wiring shall be checked to ensure that it is according to the drawing.

iv. All wiring shall be tested for insulation resistance by a 1000V megger.

v. Phase sequence/ rotation shall be estimated.

vi. Suitable injection tests shall be applied to all the measuring insuring instruments to establish the correctness and accuracy of calibration and working order.

iii. All relays and protective devices shall be tested for correctness of settings and operation by introducing a current generator and an ammeter in the circuit.

GENERAL SPCIFICATION FOR : MOULDED CASE CIRCUIT BREAKERS

1.1 GENERAL :

Moulded case circuit breakers or fuse free breaker shall be incorporated in the switch board wherever specified. MCCBS shall conform to BS : 3871 Part II or JIS-C-8370 in all respects. MCCBS shall be suitable either for single phase 230V or three phase 415volts.

1.2 CONSTRUCTION :

The MCCB and case shall be made of high strength heat resistant and flame retardant thermo-setting insulating material. Operating handle shall be quick make/quick break, trip-free type. The operating handle shall have suitable “ON”, “OFF” and “TRIPPED” indicators. Three phase MCCBS shall have a common operating handle for simultaneous operation and tripping of all the three phase. Suitable arc extinguishing device shall be provided for each contact. Tripping unit shall be of thermal-magnetic type provided on each pole and connected by a common trip bar such that tripping of any one pole actuates three poles to open simultaneously. Thermal magnetic/tripping device shall have IDMT characteristics for sustained over loads and short circuits. Contact tips shall be made of suitable are resistant, sintered alloy for long electrical life. Terminals shall be of liberal design with adequate clearances.

1.3 ACCESSORIES :

MCCBS shall be provided with the following accessories, if specified in schedule of quantities:

i. Under voltage release
ii. Shunt release
iii. Alarm Trip alarm
iv. Auxiliary contacts.

1.4 INTERLOCKING :

Moulded case circuit breakers shall be provided with the following interlocking devices for interlocking the door of switch board:

a. Handle interlock to prevent unnecessary manipulation of the breaker.
b. Door interlock to prevent the door being opened when the breaker is in "ON" position.
c. De-interlocking device to open the door even, if the breaker is in "ON" position.

1.5 RUPTURING CAPACITY:

The moulded case circuit breaker shall have a returning capacity of not less that 10KA Rms at 415 volts. Wherever required, higher rupturing capacity breakers to meet the system short circuit fault shall be used. All such ratings shall be as per equipment schedule/B.O.Q.

1.6 TESTING:

a. Original certificate of the MCCBS as per BS:3871 or JS-C-8370 shall be furnished.
b. Pre-commissioning tests on the switch boards panel incorporating the MCCB shall be done as per specifications.

GENERAL SPCIFICATION FOR: MEDIUM VOLTAGE CABLES

1.1 TYPE :

Medium voltage cables shall be aluminium conductor, PVC insulated, PVC sheathed and steel wire armoured or steel tape armoured construction. Aluminium conductors up to 10sq.mm. may be solid, circular in cross section, and sizes above 10sq.mm. shall be stranded. Sector shaped stranded conductors shall be used for sizes above 25sq.mm. The cable shall conform to IS 1554 (Part I).

1.2 RATING

The cable shall be rated for a voltage of 650/1100 Volts.

1.3 CONSTRUCTION

The conductors for power cables shall be made of electrical purity aluminium & that for control cable from annealed high conductivity copper. The conductors shall be insulated with high quality PVC base compound. A command covering (bedding) shall be applied over the laid up cores by extrusion or wrapping of a filling material containing unvulcanized rubber or thermoplastic material, armouring shall be applied over the inner shath of bedding, over the armouring a tough outer sheath of PVC sheathing shall be extruded. The outer sheath shall bear the manufacturers name and trade mark at every 30 meter interval.

1.4 CORE IDENTIFICATION :

Core shall be provided with the following colour scheme of PVC insulation.

i. Core : Red/Black/Yellow/Blue
ii. Core : Red and Black
iii. Core : Red, Yellow, and Blue

iv. 3.5/4 core : Red, Yellow, Blue and black.

1.5 CURRENT RATINGS :

The current rating shall be based on the following conditions.

i.	Maximum conductor temperature	:	$70^{O}C$
ii.	Ambient air temperature	:	$40^{O}C/50^{O}C$
iii.	Ground temperature	:	$70^{O}C$
iv.	Depth of laying	:	75cm

1.6 SHORT CIRCUIT RATING:

Short circuit ratings for the cables shall be as specified in IS : 1554 Part -I.

1.7 SELECTION OF CABLES :

Cables have been selected considering the conditions of the maximum connected load, ambient temperature, grouping of cables & the allowable voltage drop. However, the contractor shall recheck the sizes before the cables are fixed and connected to the service.

a. Storing

All the cables shall be supplied in drums. On receipt of cables at site, the cables shall be inspected and stored in drums with flanges of the cable drums in vertical position.

b. Laying

Cables shall be laid as per the specifications given below. The system adopted for this job shall be as per BOQ :

i. Cable on Tray/ Racks:

Cables shall be laid on cable trays/ racks wherever specified. Cable racks/trays shall be of ladder, trough or channel design suitable for the purposes. The nominal depth of the trays/ racks shall be 150mm. The width of the trays shall be as per the design shown on drawing. The cable trays shall be made of steel or aluminium. The trays/ racks shall be completed with end plates, tees, elbows, risers, and all necessary hardware. Steel trays/ Rack shall be painted with two coats of enamel paint of approved shade over a coat of red oxide primer. Cable trays shall be erected properly to present a neat and clean appearance. Suitable cleats or saddles made of aluminium strips with PVC covering shall be used for securing the cables to the cable trays. The cable trays shall comply with following requirements :

1. The trays shall have suitable strength and rigidity to provide adequate supports for all contained cables.

2. It shall not present sharp edged, burrs or projections injurious to the insulation of the wiring/ cables.

3. If made of metal, it shall be adequately protected against corrosion or shall be made of corrosion resistant material.

4. It shall have side rails or equivalent structural members.

5. It shall include fittings or other suitable means for changes in direction and elevation of runs.

1.9 INSTALLATION

1. Cable trays shall be installed as a complete system. Trays shall be supported properly from the building structure. The entire cable tray system shall be rigid.

2. Each run of the cable tray shall be completed before the installation of cables.

3. In portion where additional protection is required, non combustible covers/ enclosures shall be used.

4. Cable tray shall be exposed and accessible.

GENERAL SPECIFICAITON FOR: EARTHING FOR ELECTRICAL WORK

1.1 General

All non-current carrying metal parts of the electrical installation shall be earthed as per IS: 3043. All metal conduits, trunkings, cable armour, switchgear, distribution boards, meter, light fixtures, fans and all other metal parts forming part of the work shall be bonded together and connected by two separate and distinct conductors to earth electrodes. Earthing shall also be in conformity with the provisions of Rules 32, 61, 62, 67 & 68 of IER 1956. These specifications apply to both copper and GI earthing system. The material to be used shall be as per that give in BOQ.

1.2 Earthing Conductors

1.2.1 All earthing conductors shall be of high conductivity copper or GI and shall be protected against mechanical damage and corrosion. The size of earth conductors shall not be less than half that of the largest current carrying conductor. The connection of earth continuity conductors to earth bus and earth electrodes shall be strong and sound and shall be easily accessible. The earth tapes shall be joined together using double rivets. The earthing conductor shall be laid in cable trenches, cable trays or conduits or on cable by using suitable clamps made of non-ferrous metals compatible with the earthing conductor. The following earthing conductors and required to be used for various sections of the installations.

a. 10SWG bare copper wire or GI wire.

b. All single phase switches and DBs above 30A and upto 63A rating shall be earthed with one run of 8SWG bare copper wire or GI wire.

c. All three phase switches/ DBs upto 30A rating shall be earthed with 2 runs of 10SWG copper wire/ GI wire.

d. All three phase switches/ DBs above 30A and upto 63A shall be earthed with 2 runs of 8 SWG copper wires/ GI wires.

e. All three phase switches/DBs above 63A and upto 100A shall be earthed with 2 runs of 25x3mm Copper Strip/GI Strip.

f. All three phase switches/DBs of 200A rating and above shall be earthed with 2 runs of 25x6mm copper Strip / GI Strip.

g. All motor frames shall be earthed by two earthing conductors of specified cross section.

Earth conductors shall be properly terminated with bolts to the frames of panels/eqpts. And provided with crimped sockets in case of wires.

1.2.2 Main earth bus shall be taken from the main medium voltage panel to the earth electrodes. The number of electrodes required shall be arrived at taking into consideration the anticipated fault on the medium voltage net-work and soil resistivity.

1.2.3 All the sub mains and sub circuits shall be provided with earth continuity conductors as specified and connected to the main earth bus. Earthing conductors for equipment shall be run from the exposed metal surface of the equipment and connected to a suitable point on the sub main or main earthing bus. All switches shall be connected through double earthing conductor to the earth bus. Earthing conductors shall be terminated at the equipment using suitable lugs, bolts, washers and nuts.

1.2.4 All conduits, cable armouring, raceway, rising mains, etc. shall be connected to the earth all along their run by earthing conductors of suitable cross sectional area, sprinkler, pipes, LPG pipes, water pipes, steel structural elements, cable trays/ racks lighting conductors shall not used as a means of earthing an installation. The electrical resistance of earthing conductors shall be low enough to permit the passage of fault current necessary to operate a fuse/ protective device a circuit breaker and shall not exceed 2 ohms. As rough guide the following sizes of earth continuity conductors shall be used for circuit wiring.

Size of circuit wires/ cables	Size of copper or GI earth wires
a. 2.5 sq.mm.	16 SWG or 1.5sq.mm. Cu. PVC insulated
b. 4 sq.mm.	14 SWG or 2.5sq.mm. Cu. PVC insulated
c. 6 sq.mm.	12 SWG or 2.5sq.mm. Cu. PVC insulated
d. 10 sq.mm./ 16 sq.mm.	8 SWG or 4.0sq.mm. Cu. PVC insulated
e. 25 sq.mm. / 35 sq.mm.	6 SWG or 6.0sq.mm. Cu. PVC insulated

All Single phase wiring have one run of earth wire and three phase wiring shall be provided with two runs of earth wires.

1.4 PRECAUTIONS :

1.4.1 Earthing system shall be mechanically robust and the joints shall be capable of retaining low resistance even after passages of fault currents.

1.4.2 Joints shall be soldered, tinned and double rivertted in case of copper and joints shall be filed and doubled rivertted in case of GI. All the joints shall be mechanically, electrically, continuous and effective.

1.5 TESTING :

1.5.1 On the completion of the entire installation, the following tests shall be conducted.

a. Earth resistance of electrodes.
b. Earth loop impedance as per IS L 3043/NEC.

1.5.2 All meters, instruments and labour required for the tests shall be provided by the contractor. The results shall be submitted in triplicate to the engineer-in-charge for approval.

5.13 **Other Components**

5.13.1 Moulded Case Circuit Breaker (MCCB)

The MCCB (moulded case circuit breaker) shall conform to the latest IEC 947-2 & IEC 947-3–1989. The Service Short Circuit Breaking Capacity (Ics at 415VAC) should be as specified at the required level.
The MCCB shall be Current Limiting type and comprise of Quick Make – Break switching mechanism, preferably 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 shall be capable of defined Variable overload adjustment. All MCCBs rated 200Amps and above shall have adjustable Magnetic short circuit pick up.

The trip command shall over ride all other commands. The MCCB shall employ maintenance free double break contact system to minimize the let thru energies and capable of achieving discrimination up to the full short circuit capacity of the downstream MCCB. The manufacturer shall provide both the discrimination tables and let thru energy curves. The MCCB shall not be restricted to Line/ Load connections.

The handle position shall give positive indication of 'ON', 'OFF'' or 'Tripped' thus qualifying to Disconnection as per the IEC947-3 indicating the true position of all the contacts. In case of 4 pole MCCB the neutral shall be defined and capable of offering protection . **MCCBs controlling motors should be suitable for motor protection.**

5.13.2 Miniature Circuit Breaker (MCB)

Miniature Circuit Breaker shall comply with IEC898 – 1996. The Miniature circuit breakers (MCB) shall be quick make and break type for 230 / 415 VAC 50 Hz application with thermal magnetic releases for over current and short circuit protection. The Breaking capacity shall not be less than 10 KA at 415VAC. MCBs shall be DIN mounted. The MCB shall be Current Limiting type (Energy Class–3). MCBs shall be classified (B,C,D as per the IEC 898 standards) as per their Tripping characteristic curves defined by the manufacturer. The MCB shall have the minimum power loss (Watts) per pole defined as per the IS/IEC and the manufacturer shall publish the values.

The housing shall be heat resistant and having a high impact strength. The terminals shall be protected against finger contact to IP20 Degree of protection . All DP, TP and TPN miniature circuit breakers shall have a common trip bar independent to the external operating handle.

5.13.3 Switch Fuse Units

a. High rupturing capacity fuse (HRC Fuse) shall carry ISI mark on it and shall be rated for duty as indicated on the drawing/schedule of Quantities. The rating of HRC fuse shall be as per the rating of motor/equipment. The rating of fuse shall be selected so as to provide discrimination.

a. The switch fuse units shall be three pole double break action with switched neutral. All switch fuse units shall be provided with the hinged doors duly interlocked with operating mechanism so as to prevent opening of the door when the switch is 'ON' position and also to prevent energizing the switch when the door is not properly secured. All contacts shall be silver plated and alive parts shall be shrouded. High rupturing capacity (HRC) fuse links shall be provided with switch fuse units and shall have rupturing capacity of not less than 31 MVA at 415 volts. All switch fuse units shall be provided with visible indicators to show that they are in 'ON or OFF' position. All switch units shall be of AC-23 category.

5.13.4 Motor Starter

The Motor Starter shall be a combination starter consisting of motor protection circuit breaker and suitable contactor for remote starting.

a. Motor protection circuit breaker

The motor protection circuit breaker must comply to the latest IEC 947-4 and the corresponding IS 13947-4. The motor protection circuit breaker should be suitable for AC3 duty at 415V. The motor protection circuit breaker should offer built in coordinated overload and short circuit protection. The motor protection circuit breaker should have built in single phase / phase loss preventor. The motor protection circuit breaker should offer separate ON/OFF indication and Fault signal contacts which should be wired onto the panel for indication. The motor protection circuit breaker should offer Type 2 coordination along with the contactor.

b. Contactors

The contactor should be suitable for AC3 duty at 415V and should comply to the latest IEC 947-4 and the corresponding IS 13947-4. The contactor should have minimum 10 x IE rated making / breaking capacity as per the latest standard. The same should be suitable for Type 2 coordination along with motor protection circuit breaker. The contactor should have Class H insulation for the coil to prevent heating and to facilitate frequent start / stop function without heating.

5.13.5 Earth Leakage CB/ Residual Current CB

The ELCB/RCCB shall comply with IEC 1008. The ELCB/RCCB shall current operated independent of the line voltage. ELCB / RCCB shall work on the principle of core balance transformer. The ELCB / RCCB shall be rated for current sensitivity of a Min of 30mA and a Max of 300mA at 240 / 415VAC.The terminals shall be protected against finger contact to IP20 degree of protection. The ELCB / RCCB shall have a minimum of 20,000 electrical operations.

Testing Provision for the Earth Leakage Circuit Breaker

A test device shall be incorporated to check the integrity of the earth leakage detection system and the tripping mechanism. When the unit is connected to service, pressing the test knob shall trip the ELCB and the operating handle shall move to the "OFF" position.

5.13.6 Air Circuit Breaker (ACB) **:**

The ACB shall conform to IEC 947-2-1989 & IS 13947 (Part –2). The Service Short Circuit Breaking Capacity shall be as specified and equal to the Short circuit Withstand Values. The ACB shall be provided for controlling the in coming supply feeder or as required and specified in schedule. Shall be available in 3 or 4 pole with modular construction, fixed or draw out, manually or electrically operated versions as specified. ACB shall be capable of providing short circuit, overload and earth fault protection (in absolute values) if required, through microprocessor based control unit sensing the true RMS values to ensure accurate measurement meeting the EMI/ EMC requirement as per the standard.

The breaker should have 3 distinct positions – SERVICE /TEST / ISOLATED within the cubicle. It should be possible to withdraw the breaker for testing with the door closed. Safety interlock must be provided to prevent the ACB from falling out in a fully withdrawn position. The ACB shall be provided with a door interlock. The contacts should be copper and silver plated only with a feature of contact wear inspection indicating the life of the contacts. The ACB shall have double insulation (Class-II) with moving and fixed contacts totally enclosed for enhanced safety and inaccessibility to live parts.

All electrical closing of breaker should be with Electrical motor wound stored energy spring closing mechanism with Mechanical indicator to provide. ON/ OFF status of ACB.

For all ACBs the Operating handle should be provided for charging the spring in continuous action. The spring shall be released with ON / OFF push button command in one operation at the correct speed independent of operator speed. A direct mechanical coupling should indicate the ACB in ON or OFF position thus qualifying to Disconnection as per the IS/IEC indicating the true position of all the contacts. One set of NO / NC potential free contacts to be provided for operation on Building Management System. All accessories like shunt, under voltage motorized mechanism etc shall be front mounted, requiring no adjustments and can be fitted at site.

The manufacturer shall provide details of opening time and deration with temperature to ensure discrimination and proper selection for feeders protection. All ACBs of 4000 A and above shall be a single ACB and Tandom operated will not be acceptable.

5.13.7 SAFETY FEATURES :

1. The safety shutter shall prevent inadvertent contact with isolating contacts when breaker is withdrawn from the Cradle.
2. It should not be possible to interchange two circuit breakers of two different thermal ratings.
3. There should be a provision of positive earth connection between fixed and moving portion of the ACB either thru connector plug or sliding solid earth mechanism.
4. Earthing bolts must be provided on the cradle or body of fixed ACB.
   Arc Chute covers should be provided wherever necessary.

5. The incoming panel accommodating ACB shall be provided with indicating lamps for ON-OFF positions, voltmeter and ammeter of size not less than 96mm x 96mm, selector switches, fuses for potential circuit and current transformers.
6. It should be possible to bolt the draw out frame not only in connected position but also in TEST and DISCONNECTED position to prevent dislocation due to vibration and shocks.

5.13.8 PROTECTIONS

1. The Electro magnetic and thermal release or Microprocessor based unit should be provided on circuit breaker for short circuit , over current and earth fault protection with adjustable settings.
2. Specific LED indications should be provided for over current and earth fault operation.
3. Relays should be CT operated through shunt trip for short circuit and earth fault protection.
4. Under voltage relays should be provided.
5. Minimum 6 NO and 6 NC auxiliary contacts shall be provided on each breaker. The contacts shall be rated 5 Amps.
6. Rated insulation voltage is 1000 volts AC.

5.13.9 Push Button Stations

Push button stations shall be provided for manual Start & Stop of equipment. Push button shall have ON & OFF indicating lamp in red and green colour. Push button shall be fabricated in 16 gauge sheet steel.

These station shall be factory fabricated. ON & OFF operations shall be carried out from front without opening the door. One set of NO & NC contact shall be provided in push button station as spare.

5.13.10 Toggle Switch

The toggle switch shall be of minimum 5 Amps rating.

5.13.11 Thermal Overload

The relay shall be factory calibrated, sealed and suitable for an ambient temperature at site or 50 deg C whichever is higher.

It should provide reliable and accurate protection against overload, single phasing and locked rotor conditions. Relays are to be provided with :

(a) Trip alarm contact
(b) Trip lever for testing
(c) Auto reset facility

Rated insulation voltage shall be 660 volts AC.

5.14 **Instruments**

a. General :

The specifications hereinafter laid down shall cover all the meters and instruments.

b. **Instrument Transformers**

(i). Current Transformers

Current transformers shall be in conformity with IS : 2705 (Part I,II,III & IV) in all respects . All current transformers used for medium voltage applications shall be rated for 1 KV. However, the rated secondary current shall be 5 A unless otherwise specified. The acceptable minimum class of various applications shall be as given below :

Measuring : Class 0.5 to 1
Protection : Class 10 p

Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault of 35 MVA on medium voltage system. Terminals of the current transformers shall be marked permanently for easy identifications of poles. Current transformers shall be provided with earthing terminals, for earthing chasis frame work and fixed part of the metal casing (If any). Each CT shall be provided with rating plate indicating the following :

i. Name and make
ii. Serial Number
iii. Transformation Ratio
iv. Rated Burden
v. Rated Voltage
vi. Accuracy Class

Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CT's shall be copper conductor, PVC insulated wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat & clean manner.

c. Potential Transformers

Potential transformers shall be provided if specifically called for potential transformers shall comply with the requirements of IS : (Part I,II,III) in all respects.

d. **Measuring Instruments**

i. General

Direct reading electrical instruments shall be in conformity with IEC-51, BS:89 or IS :1248. The accuracy of direct reading shall be 1.0 for voltmeters and 1.5 for ammeters. Other type of instruments shall have accuracy of 1.5. The meters shall be suitable for continuous operation between -10 deg C and +50 deg C. All meters shall be of flush mounting type with square pattern. The meter shall be enclosed in a dust tight housing

. The meters shall be provided with white dials and black scale markings. The pointer shall be black in colour and shall have zero position adjustment device which could be operated from outside.

ii. Ammeters

Ammeters shall be of moving-iron type. The moving part assembly shall be with jewel bearings. The jewel bearing shall be mounted on a spring to prevent damage to pivot due to vibrations and shocks. The ammeters shall be manufactured and calibrated as per the latest edition of IS: 1248 or BS:89. Ammeters shall be instrument transformer operated, and shall be suitable for 5 A secondary.

Upto 30 Amps the ammeter shall be direct operated without current transformer on one phase only. Beyond 30 Amps the ammeter shall be CT operated with selector switch.

iii. Voltmeters

Voltmeters shall be of moving-iron type. The range for 400 volts, 3 phase voltmeters shall be 0 to 500 volts. The voltmeter shall be provided with protection fuse of suitable capacity.

5.15 **Earthing**

a. General

All non-current carrying metal parts of the electrical installation shall be earthed as per IS-3043. All metal conduits, trunking, cable sheathes, switchgear, distribution boards and all other metal parts forming part of the work shall be bonded together and connected by two separate and distinct conductors to control panel. Earthing shall meet the requirements of IER 1956.

b. Earthing Conductor

All earthing conductors shall be of high conductivity copper as specified and shall be protected against mechanical damage and corrosion. The size of the earth conductor shall not be less than half of the largest size of the current carrying conductor. The connection of the earth continuity conductor of earth and earth electrodes shall be strong and sound and shall be rigidly fixed to the walls, cable trenches, cable trays or conduits and cables by using suitable clamps made of non ferrous metals. Incoming power supply along with earthing upto MCC/AHU control panel shall be provided by other agency. The panel shall be earthed to building main earthing. The motor shall be double earthed to the panel.

The earthing shall be done with wires/flat as under :

S.No.	Equipment	Size of Earth Wire/Strip	
		GI	Copper
01.	Motors Upto 5 HP	2 Nos 8 SWG	2 Nos. 14 SWG
02.	Motors Upto 15 Hp	2 Nos 8 SWG	2 Nos 12 SWG
03.	Motors Upto 30 HP	2 Nos 4 SWG	2 Nos. 8 SWG

04.	Motors Upto 50 HP	2 Nos 25x6mm Flat	2 Nos. 4 SWG
05.	Motors above 50 HP Flat.	2 Nos 32x6mm Flat.	2 Nos. 25x3mm

Packaged unit electrical panel shall generally be wall mounted type. Above stated specifications shall also stand good where applicable. The packaged unit motor shall be double earthed with two independent earth conductors as per the Indian Electricity Rules & Regulations-1956.

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PREAMBLE TO BILL OF QUANTITY

1. All equipment described hereafter shall be in accordance with the specifications.

2. All equipment shall be selected and installed for the lowest operating noise level.

3. Supply of various equipment shall include all expenses for correspondence with manufacturers, submission of shop drawings, documents and their approval by the Architects , procurement of equipment, transportation, shipping, payment of all taxes and levies, storage, supply of equipment at the point of installation, furnishing all technical literature required, replacement of defective components and warranty obligations for the individual equipment.

4. Installation of various equipment shall include all material and labour associated with hoisting and lowering of equipment in position, insulation of the components and vibration isolation as required, grouting & anchoring or suspension arrangements and all incidentals associated with the installation as per the specifications and manufacturer's recommendation.

5. Vibration isolators as specified or as recommended by the manufacturer shall be installed with each component. Performance ratings, power consumption and sound power data for each component shall be verified at the time of testing and commissioning of the installation, against the data submitted with the tenders.

6. Shop coats of paint that have become marred during shipment or erection shall be cleaned off with mineral spirit, wire brushed and spot primed over the affected areas, then coated with enamel paint to match the finish over the adjoining shop painted surfaces.

7. Testing and commissioning shall include furnishing all labour, materials, equipment, instruments and incidentals necessary for complete testing of each component as per the specifications & manufacturer's recommendations, submission of test results to the Owners/Architects, obtaining their approval and submission of necessary completion documents & drawings. providing minor dressing of walls and floor, providing and installing pipe sleeves as required and treatment to pipes as per the specifications.

8. All piping should be installed conforming to the relevant Indian Standards, approved shop drawings and the specifications. All water re- circulation piping should be tested as per the specifications.

9. Piping installation should include all costs towards supplying and fixing of pipes and fittings (elbows, tees, reducers) cutting, threading, joining, welding, soldering and affecting connections are required, providing non- hardening sealing material as well as rubber gaskets for screwed flanges, providing and installing adequate number of clamps, hangers, saddles, brackets, rawl plugs and other accessories for pipe supports, providing minor dressing of walls and floor, providing and installing pipe sleeves as required and treatment to pipes as per the specifications.

10. Exposed steel pipes shall be given two coats of approved paint as per the relevant Indian Standards for color coding of pipes and direction of flow of fluid in the pipes shall be visibly marked with identifying arrows.

11. Valves, union, strainers, drain, air- valves, expansion joints, pressure gauges and thermometers shall be provided in the various pipe lines as per the approved shop drawings and specifications.

12. After completion of the installation, the entire piping system shall be tested for leak in accordance with the specifications.

13. All ducts shall be fabricated and installed conforming to the relevant Indian Standards, approved shop drawings and the specifications.

14. Duct installation shall include fabricating and installing the ducts, splitter dampers, turning vanes, distribution grids within the ducts in position extruded aluminium hardware fittings such as handles thunder bolts hinges, factory fabricated access door and providing , installing , MS hangers with dash fasteners, foam rubber insertions, nuts, bolts and screws as required. Making all joints air tight using rubber insertions in addition multi-louvered manually adjustable dampers shall be provided in various branch ducts as required or shown on drawings for proper balancing of air flow. All primer coated MS hangers, dampers, base frames etc. shall be painted with black enamel paint.

15. All registers and diffusers shall be provided with a soft continuous rubber gaskets between their periphery and the surface on which these have to be mounted.

16. MS registres and diffusers shall be given, at the factory, a rust resistant primer coat and enamel paint finish of approved color. Aluminium grilles and diffusers shall be fabricated out of extruded aluminium sections.

17. After completion of the installation, the entire air distribution system shall be tested for leaks and balanced in accordance with the specifications.

18. All equipment and material to be supplied under this contract shall be conforming to the relevant latest Indian Standards and international standards as applicable.

19. Appropriate troughs in the suspended ceiling be provided for terminating duct collars for diffusers and grilles by other agencies to achieve desired interior finishes.

20. Contractor to verify the static pressure of various air handling units and Head of pumps in accordance with the approved for construction shop drawings before selection of motor.

21. **Mode of Measurement**

The mode of measurement for the various items, unless otherwise specified, shall be as follows:

21.1 Ducting

Payment for ducting shall be made on the basis of the external surface area of the ducting including all material and labour for installed duct.

The rates per Sft of the external surface shall include MS angle iron /GSS flanges, gaskets for joints, nuts & bolts , duct supports & hangers, vibration isolation pads or suspenders, dash fasteners, inspection doors, dampers, turning vanes, major hardwares such as thunder bolts, hinges, handles in extruded aluminium construction and any other

item which will be required to complete the duct installation except external insulation and acoustic lining.

The external area shall be calculated by measuring the overall width and depth (including the corner joints) in the centre of the duct sections and overall length of each duct section from flange face incase of duct lengths with uniform cross section. Total area will be arrived at by adding up the areas of all duct sections.

In case of taper pieces average width and depth will be worked out as follows :

W1 = width of small cross section
W2 = width of large cross section
D1 = depth of small cross section
D2 = depth of large cross section

$$\text{Average width} = \frac{W1 + W2}{2}$$

$$\text{Average depth} = \frac{D1 + D2}{2}$$

Width and depth in the case of taper pieces shall be measured at the edge of the collar of the flange for duct sections fitted with angle iron flanges, otherwise at the bottom of the flange where flanges are of duct sheet.

For the circular pieces the diameter of the section mid-way between large and small diameters shall be measured and adopted as the mean diameter for calculating the surface at the taper piece.

For the face length of taper piece shall be the mean of the lengths measured face to face from the centre of the width and depth of flanges.

For the special pieces like bends, branches, and tees etc. same principle of area measurement as for linear lengths shall be adopted except for bends and elbows, the length of which shall be the average of the lengths of inner and outer periphery along with curvature or angle of the piece.

21.2 Duct Insulation

This item is provided separately for various thickness and shall be paid for on area basis of un-insulated duct. The area of the duct to be insulated shall be measured before application of insulation.

21.3 Grilles & Diffusers

All extruded aluminium grilles and diffusers shall be paid on the basis of actual measurement at site on area basis using neck size as base for diffusers having outer size less than 600mm. Minimum Quantity for grilles & diffusers shall be 0.1Sq.m. For 600mm x600mm size diffusers being installed in grid ceiling shall be counted at site and payment shall be made on unit basis.

21.4 Piping

Payment for condensate drain piping shall be made on the basis of linear measurement including all material and labor for installed pipes. The linear rate per meter/feet for each nominal diameter shall include all pipe fittings, pipe supports & hangers, vibration isolation

arrangement, closed cell elastomeric insulation material and any other item required to complete the pipe installation except valves of any kind and strainers. The length of the pipe section with flanges shall be from flange face to flange face.

For fitting like bends, elbows, branches, reducers, tees etc. same principle of linear measurement as for pipe sections shall be adopted except for bends, the length of which shall be the average of the lengths of inner and outer periphery along the curvature.

21.5 Refrigerant Piping – For Split Units

Refrigerant piping shall be measured on linear length basis including bends, fittings, pipe supports & hangers, vibration isolation arrangement, closed cell elastomeric insulation material and any other item required to complete the pipe installation.

21.6 Refrigerant Piping- For VRV System

Payment for refrigerant piping and condensate drain piping shall be made on the basis of linear measurement including all material and labor for installed pipes. The linear rate per meter/feet for each nominal diameter shall include all pipe fittings except refnet joints, pipe supports & hangers, vibration isolation arrangement, closed cell elastomeric insulation material and any other item required to complete the pipe installation except valves of any kind and strainers.

21.7 Refnet Joints

Payment shall be made on unit basis.

22. All quantities reflected in the schedule are for contractor's guidance only.

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GUARANTEE PROFORMA FOR HVAC INSTALLATION

Owner : **BSES OFFICE**

Location : DELHI

1. The Contractor shall furnish the following guarantee:

   "We warrant that everything supplied by us including all components fitted into the equipment manufactured by others also, shall be in all respects free from all defects and faults in material, workmanship and manufacture and shall be of the highest grade and quality to acceptable standards for all materials of the type ordered and shall be in full conformity with all the specifications, drawings or samples if any and we shall be fully responsible for its efficient performance. This guarantee shall survive inspection for acceptance and payment for the equipment and installation, but shall expire (except in respect of the complaints notified to us) 12 months from the date of issue of completion certificate by the Architect/Consultants. The complaints, workmanship, manufacturer or performance of any of the equipment or part/parts thereof shall be notified by fax within 12 months from the date of issue of such completion certificate".

2. The Contractor shall replace such of these parts which require replacement under these conditions free of cost, charge and expenses to the purchaser. In addition, the Contractor shall be responsible for a period of 12 months from the date of issue of completion certificate for any defect that may develop or appear under the conditions provided by the Contractor or use thereof arising from faulty material design or workmanship in the equivalent or any part thereof or faulty installation of the equipment by the Contractor but not otherwise and shall correct such defects within one week from the date of notification at his own cost when called upon to do so by the purchaser who shall state in writing in what respect the portion is faulty.

3. Any faulty component replaced or renewed under the clause shall also be guaranteed for a period of six months from the date of such replacement or removal of until the end of the above mentioned period whichever is later.

4. If defects are not rectified within a reasonable time as mentioned in the written notice, the Project Managers/Architects/Owners shall proceed to do so at the Contractor's risk and cost without prejudice to any other right thereof.

SIGNATURE AND STAMP OF THE CONTRACTOR

DATE :

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TECHNICAL DATA TO BE FILLED UP BY THE VENDORS AND TO BE SUBMITTED ALONG WITH THE OFFERS

VARIABLE REFRIGERANT VOLUME SYSTEM

S. No.	Item	Particulars	
1.	**Outdoor Units**		
	General		
1.1	Manufacturer		
1.2	Country of Origin		
1.3	Type of Unit		
1.4	Model and No. of Units		
1.5	Overall Dimensions (mm)		
1.6	Noise Level (dB) at 1M distance		
1.7	Whether Night time quiet operation feature adopted		
1.8	Operating Weight (Kg)		
1.9	Material of casing		
1.10	Type of finish		
1.11	Cooling Capacity (HP)		
1.11.1	Nominal		
1.11.2	Actual		
1.12	Power consumption of overall unit at 35C ambient (KW)		
1.13	Power consumption of overall unit at 43.3C ambient (KW)		
1.13.1	Running Current drawn (Amp)		
1.13.1	Starting Current drawn (Amp)		
1.14	Recommended Incomer switch rating (Amp)		
1.15	Recommended Aluminium cable size		
1.16	Vibration isolation arrangement		
1.17	COP of overall unit		
1.18	Maximum allowable actual piping length (M)		
1.19	Maximum Level Difference (M)		
2.	**Compressor**		
2.1	Manufacturer		
2.2	Country of origin		
2.3	Type and number of compressor/s		
2.4	Model No.		
2.5	Nominal capacity		
2.6	Suction Temperature		
S.No.	**Item**	**Particulars**	
2.7	Discharge Temperature		

2.8	Actual capacity at above parameters		
2.9	Type of refrigerant		
2.10	Type of capacity control		
2.11	Number of steps of capacity control		
2.12	Power consumption (KW)		
2.13	Number of Fixed Speed Type Compressors		
2.14	Number of Variable Speed Type Compressors		
2.15	Power Supply requirement		
2.16	Power consumption at rated capacity		
3.	**Air Cooled Condenser**		
3.1	Manufacturer		
3.2	Type of condenser		
3.3	Tube material		
3.4	Fin material		
3.5	Coil face velocity (FPM)		
3.6	Type of fans		
3.7	Number of fans		
3.8	Motor rating of each fan		
3.9	Static Pressure of each fan (mmWG)		
4.	**Indoor Units**		
4.1	Manufacturer	--	
4.2	Country of Origin		
4.3	Type of Unit		
4.4	Model No. of Unit		
4.5	Overall Dimensions (mm)		
4.6	Noise Level (dB) Hi/Low		
4.7	Airflow Min/Max (Cfm)		
4.8	Cooling Capacity (TR)	--	
4.9	Operating Weight (Kg)		
4.10	Is remote controller provided with each unit		
4.11	Type of remote controller provided		
4.12	Power Characteristics (3Ph/1Ph)		
S.No.	**Item**	**Particulars**	
4.13	Electrical Power Requirement (Watts)		
5.	**Centralized Controller**		
5.1	Manufacturer		
5.2	Country of Origin		
5.3	Type of Controller		

5.4	Salient Features		
6	**Refrigerant Piping**		
6.1	Material of piping		
6.2	Material of Fittings		

TFA UNITS

S. No.	Item	Particulars
1.	**General**	
1.1	Manufacturer	
1.2	Type of Unit	
1.3	Overall Dimensions (mm)	
1.4	Noise Level at 1M distance from AHU	
1.5	Operating Weight (Kg)	
1.6	Material of casing	
1.7	Thickness of inner skin (mm)	
1.8	Thickness of outer skin (mm)	
1.9	Type of insulation	
1.10	Thickness & density of insulation	
1.11	Material & thickness of drain pan.	
1.12	Whether thermal break profile provided	
1.13	Whether canopy provided	
1.14	Whether heaters proovided	
1.15	Whether Mixing Chamber proovided	
2.	**Centrifugal Fan**	
2.1.	Manufacturer	
2.2	Type of fan	
2.3	Model No.	
2.4	Air Quantity. (Cfm)	
2.5	Static Pressure (mm WG)	
2.6	Fan Outlet Velocity	
3.	**Motor**	
3.1	Manufacturer	
3.2	Type	
3.3	Rating (HP)	
3.4	Speed (RPM)	
3.5	Electrical Characteristics	
4.	**DX Cooling Coil**	
4.1	Manufacturer	
4.2	Type	
4.3	Material & Thickness of tubes	
4.4	Material & Thickness of fins	
4.5	Number of fins per cm	
4.6	Pressure drop (M of water)	
4.7	Water Velocity (MPS)	
4.8	Face velocity (FPM)	
4.9	Material of header	
4.10	Number of rows deep	
5.	**Filters**	

S. No.	Item	Particulars
5.1	Manufacturer	
5.2	Type	
5.3	Thickness (mm)	
5.4	Filter Face Velocity	
6.	**Control for AHUs**	
6.1	Manufacturer	
6.2	Type	

EXTRACT FAN SECTION

S.No.	Item	Particulars
1.	**General**	
1.1	Manufacturer	
1.2	Type of Unit	
1.3	Overall Dimensions (mm)	
1.4	Noise Level	
1.5	Operating Weight (Kg)	
1.6	Material of casing	
1.7	Type of finish	
2.	**Centrifugal Fan**	
2.1.	Manufacturer	
2.2	Type of fan	
2.3	Model No.	
2.4	Air Quantity. (Cfm)	
2.5	Static Pressure (mm WG)	
2.6	Fan Outlet Velocity	
3.	**Motor**	
3.1	Manufacturer	
3.2	Type	
3.3	Rating (HP)	
3.4	Speed (RPM)	
3.5	Electrical Characteristics	

PROPELLER FANS

S.No.	Item	Particulars
1.	**General**	
1.1	Manufacturer	
1.2	Type	
1.3	Electrical Characteristics	
1.4	Whether Capacitors Provided	
1.5	Whether gravity louvers and bird screen provided	

INLINE FANS

S.No.	Item	Particulars
1.	**General**	
1.1	Manufacturer	
1.2	Type	
1.3	Electrical Characteristics	
1.4	Whether Capacitors Provided	
1.5	Whether speed regulators Provided	
1.6	Whether gravity louvers and bird screen provided	

SPLIT UNITS

S. No.	Item	Particulars
1.	**General**	
1.1	Manufacturer	
1.2	Type of Unit	
1.3	Overall Dimensions (mm)	
1.4	Noise Level	
1.5	Operating Weight (Kg)	
1.6	Power consumption of overall unit (KW)	
2.	**Compressor**	
2.1	Manufacturer	
2.2	Country of origin	
2.3	Type and number of compressor/s	
2.4	Model No	
2.5	Nominal capacity	
2.6	Suction Temperature	
2.7	Discharge Temperature	
2.8	Actual capacity at above parameters	
2.9	Type of refrigerant	
2.10	Power consumption (KW)	
3.	**Condenser**	
3.1	Manufacturer	
3.2	Type of condenser	
4.	**DX Cooling Coil**	
3.1	Manufacturer	
3.2	Type of cooling coil	
3.3	Tube material	
3.4	Fin material	
3.5	Coil face velocity (FPM)	
5.	**Supply Air Fan**	
5.1.	Manufacturer	
5.2	Type of fan	
5.3	Model No.	
5.4	Air Quantity. (Cfm)	
5.5	Static Pressure (mm WG)	

S. No.	Item	Particulars
5.6	Fan Outlet Velocity	
6.	**Motor**	
6.1	Manufacturer	
6.2	Type	
6.3	Rating (HP)	
6.4	Speed (RPM)	
6.5	Electrical Characteristics	
7.	**Filters**	
7.1	Manufacturer	
7.2	Type	
7.3	Thickness (mm)	
7.4	Filter Face Velocity	
8.	**Controls**	
8.1	Manufacturer	
8.2	Type	

REFRIGERANT PIPING

S. No.	Item	Particulars
1.	**Hard/ Soft Drawn Piping**	
1.1	Make	
1.2	Material	
1.3	Material of fittings	
1.4	Thickness	
1.5	Make & Material for Drain pipes	

DUCT WORK

S.No.	Item	Particulars
1.	**General**	
1.1	Manufacturer of GI Sheet	
1.2	Class	
1.3	Zinc coating (gm/SqM)	
1.4	Thickness	
1.5	Manufacturer of Factory Fabricated Ducts	
1.6	Type of flanges for factory fabricated ducts For Exposed Ducts For Concealed Ducts	

GRILLES, DIFFUSERS AND DAMPERS

S.No.	Item	Particulars
1.	**General**	
1.1	Manufacturer	

1.2	Material	

ACOUSTIC LINING OF DUCT

S.No.	Item	Particulars
1.	**General**	
1.1	Material	
1.2	Manufacture	
1.3	Density	
1.4	Thickness	
1.5	Thermal Conductivity (K Value)	

EXTERNAL THERMAL INSULATION OF DUCTS

S.No.	Item	Particulars
1.	**General**	
1.1	Material	
1.2	Manufacture	
1.3	Density	
1.4	Thickness	
1.5	Thermal Conductivity (K Value)	
1.6	Class of insulation	

EXPOSED DUCT THERMAL INSULATION

S.No.	Item	Particulars
1.	**General**	
1.1	Manufacturer	
1.2	Material	
1.3	Density	
1.4	Thickness	

ELECTRICAL

S.No.	Item	Particulars
1.	**General**	
1.1	Manufacturer of panels	
1.2	Make of following components	
1.2.1	MCCB	
1.2.2	MCB	
1.2.3	Starters	
1.2.4	Ammeters/Voltmeters	
1.2.5	Push Buttons	
1.2.6	Indication Lights	
1.2.7	Current Transformers	
1.3	Power Cables	
1.4	Control Cables	

1.5	Stabilisers	

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APPROVED MAKES OF EQUIPMENT & MATERIALS

S. No.	EQUIPMENT AND MATERIAL	ACCEPTABLE MAKE
A.	**EQUIPMENT**	
1.	VRV/VRF System	Daikin/Mitsubishi Electric/Toshiba/ O-General
2.	AHUs/ TFA	Zeco/Edgetech
3.	Centrifugal Fans for AHUs	Kruger/Nicotra
4.	Cooling Coil	Zeco/Edgetech
5.	Variable Frequency Drives	Danfoss/Yaskawa /Fuji
6.	Motors	ABB/ Siemens/Bharat Bijli
7.	V- Belts	Fenner India/Dunlop
8.	Hi wall type Split units- Technical Spaces	Toshiba
9.	Inline Fans	Sphere Vent/ Tristar
10.	Vibration isolators/suspenders	Resistoflex/Easyflex
11.	SISW fans	Nicotra/ Kruger
12.	DX Split units/ Condensing unit for TFA	Blue Star/Daikin/Hitachi/ Toshiba
13.	Axial Flow Fans	Kruger/Wolter/Airflow
14.	Extract Fan Sections /Fan Filter Unit	Zeco/Waves/Edgetech/Crystal
15.	Air Curtains	Beacon/Thermadyne/ Tristar/ Euronics
16.	Steel Wire Rope Hangers & Supports	Gripple
17.	Ionizers	Intelligreen/ GPS
18.	Chemical Filters	Purafil/ Camfil
B.	**PIPING**	
1.	Pipes (MS & GI)	Tata Steel /Jindal (Hissar)/SAIL
2.	Copper Refrigerant Piping	Rajco/Mandev/Jindal/Maxflow
3.	Copper Refrigerant Piping Insulation (Closed Cell Elastomeric Insulation)	K Flex/Armaflex/A Flex
4.	cPVC Piping	Astral/Poly Pack/Supreme
5.	Drain Pumps	Aspen

S. No.	EQUIPMENT AND MATERIAL	ACCEPTABLE MAKE
C.	**DUCTWORK AND AIR TERMINALS**	
1.	GS Sheet	SAIL/Tata Steel/National/Jindal/Lloyd
2.	Factory Fabricated Ducts & TDC flanges	Ductofab/Zeco/GP Spira/Dustech
3.	Round/Spiral Factory Fabricated Ducts	Ductofab/Zeco/GP Spira/Dustech
4.	Pre Filters	Purolator/Thermodyne/Spectrum
5.	Extruded Aluminium Grilles & Diffusers	Tristar/ Servex /Dynacraft
6.	Dash Fasteners	HILTI/Fischer
7.	Intake Louvers	Tristar/ Servex /Dynacraft
8.	Duct /grille dampers & Air Transfer Grille	Tristar/ Servex /Dynacraft
9.	Smoke cum Fire Dampers	Caryaire/ Tristar/Systemair
10.	Actuators for Fire Dampers & Motorised dampers	Belimo(Swiss), Joventa (Swiss), Siemens
11.	Fabric for Flexible Connection	Sphere/Easyflex
12.	Flexible Ducts	Sphere/ UP Twiga
13.	Zero Leakage Ex. Al dampers	Tristar/Servex/ Caryaire
14.	Factory Fabricated AHU Plenum	Zeco/ Edgetech/Crystal/Tristar/Waves
15.	Sound Attenuators	Tristar/Caryaire
16.	PLC Auto sequencers/Temp. Sensor Control Panel for motorized VCD	Proton/Creative Technology
D.	**INSULATION**	
1.	Fibre Glass	UP Twiga/ Owens Corning/ K Flex
2.	Closed Cell Elastomeric Insulation	K Flex/Armaflex/ A Flex
3.	Open cell nitrile rubber	K Flex/Armaflex/ A Flex
4.	Expanded Polystyrene	Beardsell/ Toshiba/SHI
5.	RP Tissue	UP Twiga/ Owens Corning/ K Flex
6.	Adhesive for application of closed cell insulation (AC Duct King Eco	Fevicol(Pidilite)/ Paramount Polytreat

S. No.	EQUIPMENT AND MATERIAL	ACCEPTABLE MAKE
	Fresh & 1K PUR FR)	
7.	Glass cloth & UV protection paint	Paramount Polytreat/Armaflex/K Flex
8.	Nitrile Tape for nitrile insulation (Class 'O')	K Flex/Armaflex/ A Flex
E.	**ELECTRICAL**	
	Panel Manufacturers	Indiatech/ Tricolite/ Advance
	Components	
1.	MCCB	L&T/ABB/Siemens/GE power/Merlin Gerin
2.	MCB	L& T/Hager/Merlin Gerin/MDS
3.	ELMCB/ELCB	L& T/Hager/Merlin Gerin/MDS
4.	Contractors	L & T/GE/Siemens
5.	Overload Relay	L & T/GE/Siemens
	Cables	
1.	Power Cables	Havells/Polycab/Rallison/Skytone
2.	Copper Control Cables	Finolex/ National/ Skyline/ Rallison
3.	Cable Gland	Commet
4.	Lugs	Dowells crimping type/3D/Jainsons
5.	Connectors	Elmec/ VKS/ ESSEN
	Meters/Indicators	
1.	Ammeters/Volmeters (Digital Type)	L&T/Rishab/AE/Enercon/Secure
2.	Indicating Lamps (LED Type)/Push Buttons	Siemens/ESBEE/L&T
3.	Current Transformer	AE/L&T/EE/AVK-SEGC
4.	Selector Switches	Salzer (L&T), Kaycee/ Siemens

NOTES :

1. Make of any other equipment/ material not mentioned above shall be got approved from the Architects/ Owners before execution.

2. Relevant catalogue to be submitted alongwith the offers.

3. Relevant Test Certificates to be produced for various equipment & material during billing process.

4. Under electrical, wherever, there is multiple choices of brands /approved makes, the brands/make nominated by Owners/ Architects out of the multiple brands shall have to be supplied.

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PROFORMA FOR TEST RESULTS and NOTES ON TEST INSTRUMENTS and CAPACITY COMPUTATIONS

S. No.	Item		Test Results
1.	Ambient conditions	------	D.B.Temp. - degree C W.B.Temp. - degree C R.H - %
2.	Compressors	------	R PM Refrigerant gas suction pressure -Kg/Sq.cm Refrigerant gas discharge pressure -Kg/Sq.cm Oil pressure -Kg/Sq.cm
3.	Compressor Motors	-------	RPM - Voltage - Volts Current - a. at 100% load - degree C b. at partial load - 1 - Amps 2 - Amps 3 - Amps
4.	Aircooled condensers	------	Air flow rate - Cfm Air temperature entering - degree C leaving - degree C
5.	Pumps	------	R.P.M Motor current - Amps Discharge pressure -Kg/Sq.cm Return pressure - Kg/Sq.cm
6.	Air handling units / Fan coil units/TFA Units	------	Total air quantity across coil CMH Coil face area - SqM Air temperatures entering (D.B) - degree C entering (W.B) - degree C

S.No.	Item	Test Results
		leaving (D.B) - degree C leaving (W.B) - degree C

			Water flow rate	- LPM
			Water temperature entering	- degree C
			leaving	- degree C
			Water pressure	
			entering	- Kg/Sq.cm
			leaving	- Kg/Sq.cm
7.	Fresh air intakes	------	Face area	- SqM
			Air quantity	- CMH
8.	Room conditions at the working plant (No. of readings shall be taken and averaged out)	-------	Temperature	
			D.B.	- degree C
			W.B.	- degree C
9.	Controls	-------	Function of each control shall be tested and report furnished.	

Notes :

A. TEST INSTRUMENTS

1. All instruments for testing shall be provided by the air conditioning contractor.

2. Thermometers used for measurements of temperature of water/ refrigerant shall have graduations of 0.1 degree C and shall be got calibrated from N.P.I., or any recognized test house before hand.

3. Thermometers used in the psychrometers shall have graduations of 0.2 degree C and shall be calibrated as above.

4. Pressure gauges shall also be got calibrated before hand from a recognized test house.

5. Orifice type flow meters shall be used for measuring flow rate through chillers.

6. Where flow rates vs. pressure drop curves for the heat exchangers of the same model as installed, certified by Consultants on the basis of tests conducted at manufacturer's works are produced, flow meters for measuring water flow rate through these may not be provided. Actual water flow shall in such a case, be computed with reference to these curves and the actual pressure drop measured at site.

7. Integrating type flow meters may be used for measuring water flow through the individual air handling units.

8. Air flow rate shall be measured in the supply duct using pitot tube as indicated in figures 3 and 4.

B. CAPACITY COMPUTATIONS

1. Air handling unit /TFA Units :

   The capacity shall be computed from the water temperatures and water flow rate measurements. A tolerance of ± 5% from the specified value shall be acceptable in the capacity so computed. Air quantity shall be measured in the supply duct and checked with the quantity specified in the schedule. A tolerance of ± 10% in the air quantity shall be acceptable. The enthalpy difference of air entering and leaving the coil shall be computed from air temperatures as recorded.

2. If due to any reason, internal load mentioned in the tender specification is not available psychometric computations for actual load conditions will be done and the plant, if found satisfactory will be accepted.

LIST OF EQUIPMENT & ACCESSORIES WHICH CONTRACTOR HAS TO BRING, KEEP AND MAINTAIN, AT HIS OWN COST, AT SITE DURING THE CURRENCY OF THE CONTRACT IN GOOD CONDITION.

S.No.	PLANT/EQUIPMENT	NUMBER
01.	Hydraulic Test Machine	1
02.	Floor mounted drill machine	1
03.	Hand drill machine	2
04.	Lock forming machine for duct fabrication	1
05.	Hand held lock closing machine	1
06.	Collar cutting machine	1
07.	Mechanized saw for cutting angles & channels	1
08.	Duct smoke test kit	1
09.	Thermometers	2
10.	Water line pressure testing kit	1
11.	For application of closed cell elastomeric insulation	
	i. 1200 long steel scale	
	ii. 1200x900 size 40mm thick	1
	commercial ply board	1
	iii. Paper cutter of different sizes	
		12

and any other equipment required for efficient execution of work within the stipulated period.

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ANNEXURE-A : SCHEDULE OF QUANTITIES-R1							
S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
	SECTION 'A' - VRV SYSTEM FOR COMFORT AIR-CONDITIONING						
1.0	**EQUIPMENT**						
1.1	**VARIABLE REFRIGERANT VOLUME SYSTEM (HEAT PUMP)**						
	Supply, Installation, Testing and Commissioning of Variable Refrigerant Volume type multi unit air-conditioning system complete with indoor and outdoor units with individual controller for cooling & heating application as per the specifications and drawings. The quoted price should include clearances charges, local taxes, freight etc. Quoted price shall also be inclusive of loading, unloading, lifting & shifting on outdoor location on Terrace at suitable locations as per drawing, positioning charges besides including charges towards structural steel supports, MS base frame duly painted & vibration isolation arrangement etc.						
1.1.1	**OUTDOOR UNITS- HEAT PUMPS**						
	Supply, Installation, Testing and Commissioning of air cooled variable refrigerant flow modular type Heat Pumps, each comprising of energy efficient multiple scroll compressors, full charge of R-410a refrigerant gas and all accessories as per the specifications. All compressors shall be inverter type. The condensing units shall be suitable to work on cooling as well as heating mode. The condensing units shall be suitable for operation on 415 ±10% volts, 50Hz, 3 phase AC power supply and complete with auto check function for connection error, auto address setting, etc. The outdoor units shall be low noise type. Quoted price shall be inclusive of Power Cable from MCCB to Outdoor unit & MS frame duly applied with 2 coat of primer & one coat of black enamel paint. The outdoor units shall be of following capacities :						
	Quoted price shall be inclusive of factory applied epoxy coating (to prevent erosion of tubes & fins) of Outdoor units.						
	VRV ODUs shall be capable of operating in follwing range : **i. For Cooling : (-)5degC to 50degC** **ii. For Heating : (-)20degC to 15.5degC**						
i	20HP nominal capacity high COP outdoor unit	No	1	-	-	-	1
ii	18HP nominal capacity high COP outdoor unit	No	-	2	-	2	4
iii	16HP nominal capacity high COP outdoor unit	No	-	-	4	-	4
iv	14HP nominal capacity high COP outdoor unit	No	-	-	1	2	3
v	12HP nominal capacity high COP outdoor unit	No	3	1	-	1	5
vi	10HP nominal capacity high COP outdoor unit	No	1	3	-	-	4
vii.	8HP nominal capacity high COP outdoor unit	No	-	-	-	-	0

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
1.1.2	**INDOOR UNITS**						
	Supply, Installation, Testing and Commissioning of variable refrigerant volume modular type indoor units comprising of EEV & all accessories as per the specifications. The indoor units shall be suitable to work on cooling as well as heating mode. The indoor units shall be suitable for operation on 220±6% volts, 50Hz, 1 phase AC power supply except floor standing units suitable for operation on 415±10% volts, 50Hz, 3 phase AC power supply. Ductable indoor units shall be suitable to handle extent of ductwork as shown in the design drawings and dehumidified air quantity as mentioned in the heat load summary sheet under "Special Conditions" and the indoor units shall be of following capacities. **All Indoor Units shall have inbuilt Drain Pumps.** **Price shall be inclusive of Decorative Panels for Cassette units.** Quoted price shall be inclusive of Plug Top & necessary power cable.						
i.	2830Cfm Ductable Type (8.0 TR)	No.	2	-	-	-	2
ii.	2290Cfm Ductable Type (6.4 TR)	No.	-	1	1	1	3
iii.	1620Cfm Ductable Type (4.6 TR)	No.	-	12	-	8	20
iv	1375Cfm Ductable Type (4.0 TR)	No.	-	-	16	6	22
v	1130Cfm Ductable Type (3.2 TR)	No.	-	-	-	-	0
vi.	1240Cfm Cassette Type (4.0TR) - Round Flow	No.	2	1	-	-	3
vii.	1130Cfm Cassette Type (3.2TR) - Round Flow	No.	-	2	-	-	2
viii.	740Cfm Cassette Type (2.0TR) - Round Flow	No.	-	-	-	-	0
ix.	530Cfm Cassette Type (1.3TR) - Round Flow	No.	-	-	1	-	1
x.	400Cfm Cassette Type (1.0TR) - Round Flow	No.	-	-	1	-	1
xi.	495Cfm Cassette Type (1.6TR) - Compact Flow	No.	-	-	-	-	0
xii.	670Cfm Hi Wall Type (2.0TR)	No.	5	1	2	2	10
xiii.	450Cfm Hi Wall Type (1.3TR)	No.	1	1	-	-	2
xiv.	300Cfm Hi Wall Type (1.0TR)	No.	1	-	-	-	1
1.2	**REMOTE CONTROLS**						
i	Supply of Cordless handset type remote controls for the above indoor units.	No	1	-	-	-	1
ii	Supply of Corded remote controls for the above indoor units.	No	10	18	21	17	66
1.3	**CENTRALISED CONTROLLER**						
	Supply, Installation, Testing and Commissioning of main Intelligent Touch Controller with plus adapter as per specifications to hook up indoor units as mentioned above. Controller shall however, be suitable for minimum 128 groups of indoor units. Centralized controller shall act as master controller for controlling of cooling mode of outdoor units and their associated indoor units. Controller shall be suitable of Remote Access with computer and shall have web access. **Controller shall be suitable to autosequence the outdoor as well as indoor units catering to 24x7 operated areas as required**/mentioned under sub head "System Design" of tender document. Controller shall be suitable to configured the inside temperature as per temperature set point on controller. Controller shall have time schedulling arrangement for Indoor Units as well as Outdoor Units. Quoted price shall be inclusive of all necessary cabling as required from ODU & IDUs to controller.	No	1	-	-	-	1

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
1.4	**DRAIN PUMP**						
	Supply, Installation, Testing & Commissioning of On Line Type Condensate drain pump for Hi-wall units complete with water level sensor and accessories as required. Quoted price shall be inclusive of controller, NRVs & water sensors and associated wiring etc. to make installation complete. Drain Pump shall be suitable for operation on 220±6 % volts 50 Hz, 1phase AC power supply.						
	Drain pumps shall automatically ON/Off based on water level.						
	Model of Aspen- Max Hi Flow or Equivalaent						
a.	Drain pump for Hi-wall units	Nos.	5	2	2	2	11
1.5	**PROPELLER/AXIAL FANS - WITH POLYPROPYLENE BLADES**						
	Supply, Installation, Testing and Commissioning of propeller/axial fans for exhaust air as shown on drawings. Fan casing and impellers shall be constructed out of tough injection moulded polypropylene. Front grille shall be constructed out of high quality ABS and neon indicators made of polycarbonate to be provided. Each fan shall be complete with permanent split capacitor, mounting plate and accessories like wire guard, bird screen and gravity louvers for weather protection as required. All single phase propeller fans shall be provided with factory fitted speed regulators and Plug Top and necessary copper power cable. Fan selection arrangement arrangement and electrical characteristics shall be as follows :						
	Fans shall have plesant look with quiet operation.						
a.	150Cfm/150 mm dia fan, single phase.	No	1	2	1	2	6
1.6	**AIR HANDLING UNITS (AHUs)**						
1.6.1	**Ceiling Suspended DX type AHUs - With Thermal Break Profile and Mixing Chamber**						
	Supply, Installation, Testing and Commissioning of double skin air handling units (AHUs) each comprising of following as per the specifications :						
a.	Casing of air handling units shall be in double skin construction. Inner skin shall be constructed out of 24 gauge plain GS sheet & outer skin in 24 gauge pre-plasticized GS sheet sandwitched between 50mm thick injected PU foam insulation of density not less than 40 Kg /CuM and complete with inspection doors including control wiring as required. AHUs shall have access for all parts. **AHUs shall be provided with thermal break profile.**						
b.	Fan section complete with backward curved DIDW type centrifugal fan/s, IP-55, IE3, TEFC squirrel cage induction motor suitable to operate on 415+10%V, 50Hz, spring type vibration isolators below Fans, 3 phase AC power supply and belt drive package. Fan outlet velocity shall not be more than 1600 FPM (8.13MPS). **Fan section should be completed with 25mm thick Armasound acoustic insulation covered with perforated sheet**. All fans should be AMCA certified.						

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
c.	Coil section with multirows deep DX cooling/heating coil of copper tube & copper header and aluminium fins construction having wall thickness of tubes not less than 0.5mm. Drain pan shall be made out of 18 gauge stainless steel duly insulated. Face velocity across cooling coil shall not exceed 500FPM.						
d.	Pre-Filter (EU-4) section complete with 50mm thick washable synthetic fibre filters. Velocity across the filters shall not exceed 500 FPM.						
e.	Fine filter section complete with fine filters. Velocity across fine filters shall not exceed 500FPM. Filters shall have efficiency not less than 95% down to 1 Microns (EU-8/MERV-14).						
f.	AHUs shall be provided with mixing chamber with R/A & F/A openings as per approved shop drawing.						
g.	Multiblade box type zero leakage motorized extruded aluminium volume control dampers shall be factory fitted at outlet of each AHU.						
h.	AHUs shall be complete with suspension arrangement, it shall also include spring type vibration isolators and rubber groomets etc. to make the installation totally vibration free. AHUs shall have separate compartment for housing of all valves or extended insulated auxiliary drain tray.						
i.	In addition to the above, air handling units shall be provided with fire retardant flexible canvass connections made out of canvass sleeve. Sizes of air handling units shall not exceed as mentioned in the design drawings and air handling units shall conform to the design parameters mentioned in specifications.						
	Noise level from AHUs as measured below False Ceiling shall not exceed 50dBA.						
	The Air Handling Units (AHUs) shall be of following duty parameters :						

AHU No	Capacity (TR/ Cfm)	S.P (mmWG)	Motor Rating (HP)	Rows of coil	Area to be fed						
AH-1	16/4500	74-75	5.0	6	Auditorium	No	1	-	-	-	1

1.7	**VARIABLE FREQUENCY DRIVES**					

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
	Supply, Installation, Testing and Commissioning of variable frequency drives for following Air Handling Units. Variable frequency drives shall be provided with necessary sensors and transmitters complete with control wiring in all respect as required and as per specifications. VFDs shall have built-in harmonic filters. The drives shall be suitable for the following motor rating. VFDs shall be housed in precoated, vandal proof enclosure with On/Off Push Buttons, Phase indication lights, A/M Switch and with adequate provisions for ventilation using a fan. The VFDs shall be able to receive the signals from multiple/combination of duct static pressure sensors/Temp. sensors and to ramp the speed of the motor.VFDs shall be suitable to take feed back and connectivity from all the DPS as mentioned below against each motor rating to facilitate averaging activity by VFD. Quoted price shall be inclusive of return air temperature sensor and necessary electrical switches including change over switch & copper cabling for integration with the AHU panel. VFD shall be BMS compatible. VFDs shall be installed within Electrical panels as described under Section 'Electrical Works'. Overall protection of VFDs with Panels shall be IP-54.						
	(i) Sensing Range : 10mm to 50 mm WG						
	(ii) Output Signal : 4 mA to 20 mA						
	OR						
	0 V to 10 V DC						
	AHU No Capacity (Cfm) Motor Rating (HP) Area to be fed						
	AH-1 4500 5.0 Audi	No	1	-	-	-	1
1.8	**KIT FOR AHUs**						
	Supply, Installation, Testing and Commissioning of VRF Kits for AHUs having all controllers & Electonic Expansion Valve (EEV) and temperature set arrangment. It Shall have cut off arrangement after a particular set value of Supply air Temperature. Price should include all control cabling etc. and all necessary arrangements whether mentioned or not to make the system working.						
i.	For 20HP	No	1	-	-	-	1
	TOTAL ITEM NO. 1 (EQUIPMENT)						

S. NO	ITEM DESCRIPTION		UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
2.0	**PIPING**							
2.1	**COPPER REFRIGERANT PIPING**							
	Supply, Installation, Testing & Commissioning of high pressure copper refrigerant piping including R410a refrigerant of suitable size as required and duly insulated with 19mm/13mm thick closed cell elastomeric insulation with class 'O' fire retardant properties with IC Cladding in tubing form. Entire refrigerant piping work shall be carried out in accordance with the specifications. MS sleeves of requisite size shall be provided at wall crossing. Quoted price shall be inclusive of necessary glass cloth and minimum two layers of UV protection paint to be applied over insulation for all exposed pipes of approved make. Piping shall be of							
	Internal Refrigerant piping in exposed ceiling area & external refrigerant piping shall be laid on Powder coated Perforated type cable trays. Cable trays used for external refrigerant piping shall be covered with GI cover.							
	Pipe Size	**Thickness of CSE**						
	(O.D.)	**Insulation**						
a.	41.3 mm	19 mm	RM	-	-	-	-	0
b.	38.1 mm	19 mm	RM	-	-	-	-	0
c.	34.9 mm	19 mm	RM	50	-	-	-	50
d.	31.8 mm	19 mm	RM	-	-	-	-	0
e.	28.6 mm	19 mm	RM	115	130	185	175	605
f.	25.4 mm	19 mm	RM	-	-	-	-	0
g.	22.2 mm	19 mm	RM	70	125	30	30	255
h.	19.1 mm	13 mm	RM	5	5	5	5	20
i.	15.9 mm	13 mm	RM	150	235	250	250	885
j	12.7 mm	13 mm	RM	60	65	210	200	535
k	9.5 mm	13 mm	RM	110	280	280	270	940
l	6.4 mm	13 mm	RM	5	10	10	10	35
2.2	**FITTINGS**							
	Supply, Installation, Testing & Commissioning of following imported copper fittings to be provided in refrigerant pipe line.							
a.	Refnet Joints (Y- Joints)		No	9	12	16	12	49
b.	Refnet Headers		No	-	-	-	-	0
2.3	**CONDENSATE DRAIN PIPING -cPVC**							
	Supply, Installation, Testing and Commissioning of cPVC pipes cut to required lengths and installed for condensate drain. Quoted price shall be inclusive of supply and fixing in position the necessary fittings like elbows, tees reducers etc., and supporting arrangement in accordance with the approved shop drawings and specifications. Pipes shall be insulated with 9mm thick closed cell elastomeric insulation with class 'O' fire retardant properties in tubing form. Pipes shall be of following sizes :							
a.	50mm dia		RM	10	20	20	20	70
b.	40mm dia		RM	20	40	40	40	140
c.	32mm dia		RM	40	60	50	50	200

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
d.	25mm dia	RM	70	110	100	100	380
	TOTAL ITEM NO. 2 (PIPING)						

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
3.0	**DUCTWORK/AIR TERMINALS**						
3.1	**FACTORY FABRICATED DUCTING**						
	Supply, Installation and Testing of factory fabricated GSS (class VIII-120GSM Zinc Coaing) ducting complete with vanes, splitter dampers, fire retardant gaskets hanging arrangement including fully threaded GI rods and GI "C" channels/ rolled steel wires or Gripple Wire Rope Hangers & Supports complete with end fixing, GI "C" channels etc. as approved by clients/consultants in accordance with the approved shop drawings and specifications. Quoted price shall be inclusive of necessary scaffolding charges towards installation of supply/exhaust air ducts outside or within building wherever required. Quoted price should also include necessary charges towards duct supports including MS angle/channel arrangement as required for ducts being installed outside or within building wherever required. **Ducting to be brought in Box form at site.**						
	Spacing between duct supports should not exceed 2m in both cases i.e GI rods with GI "C" channels & Gripple Wire Rope Hanger support. In case of Gripple Wire Rope Hanger support for duct sizes above 1800mm, MS angles duly painted with black enamel paint should be used along with neoprene pad in between the duct & MS angle. All duct support to be provided with check nuts (lock nuts).						
	While selecting the duct supports vendor shall ensure vibration free installation. Quoted price shall be inclusive of light test or smoke test. Necessary arrangement for testing to be made by HVAC Vendor.						
a.	upto 1200mm -- 24G GSS with TDC Joints	SqM	250	240	240	240	970
b.	1201mm to 1800mm - 22G GSS with TDC Joints	SqM	10	10	10	10	40
c.	1801mm to 2100mm - 20G GSS with TDC Joints	SqM	-	-	-	-	0
d.	above 2100mm - 18G GSS with TDC Joints	SqM	5	60	75	65	205
3.2	**SITE FABRICATED DUCTING**						
	Supply, Fabrication, Installation and Testing of GS sheet metal (class VIII-120GSM Zinc Coaing) ducts complete with vanes, splitter dampers, hanging arrangement including check nuts in accordance with the approved shop drawings and specifications.						
	a. 0.63mm (24 gauge) GSS	SqM	30	30	30	30	120
	b. 0.8 mm (22 gauge) GSS	SqM	5	10	10	10	35
	c. 1.0mm (20 gauge) GSS	SqM	-	-	-	-	0
3.3	**FLAT OVAL SPIRAL DUCT**						

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
	Supply, Installation and Testing of factory fabricated & factory internally insulated GSS (class VIII-120GSM Zinc Coaing) flat oval spiral ducting complete with vanes, splitter dampers, fire retardant gaskets hanging arrangement including fully threaded GI rods, GI straps and GI "C" channels/ rolled steel wires or Gripple Wire Rope Hangers & Supports complete with end fixing, GI "C" channels etc. as approved clients/consultants in accordance with the approved shop drawings and specifications. Quoted price shall be inclusive of necessary scaffolding charges towards installation of supply/exhaust air ducts outside or within building wherever required.						
	Insulation material shall be 9mm/13mm thick, food grade material, with antimicrobial properties, Class "O" closed cell elastomeric insulation material. **Adhesive should be Fire Retardant, LEED compliant and Low VOC.**						
	Contractor to involve OEM Expert team for erection of ductwork at site to ensure high quality workmanship of duct joints.						
	Without Powder Coated-With 9mm thick insulation						
a.	1mm to 1700mm -- 20G GSS	SqM	-	-	-	-	0
3.4	**DUCO PAINT (For Flat Oval Exposed Duct)**						
	Supply and Application of minimum two coats of Duco Paint of colour and shade as approved by the Architects for exposed flat oval spiral/ round ducts. Quoted price shall be inclusive of primer before paint and all neceesary arrangement as required for providing the paint over duct. Paint to be applied using spray guns properly for uniform & smooth finish.	SqM	-	-	-	-	0
3.5	**FLEXIBLE CANVASS CONNECTIONS**						
	Supply, Installation, Testing of 125mm deep antivibration flexible joints at the outlet of air handling units/ductable split units//inline fans. Flexible connections shall be constructed using imported fire retardant fabric with extruded aluminium frame/flange on both sides of approved make.	RM	9	55	75	65	204
3.6	**LINEAR GRILLES**						
	Supply, Installation, Testing and Balancing of one way blow linear supply cum return air grilles complete with fixed core as per approved shop drawings and specifications. The grilles shall be of approved colour & shade.						
	Powder coated aluminium grilles of extruded sections with integral flanges on both sides & ends as required complete with corner pieces.						
	i. 100/150/200/250 mm/600mmx600mm Grilles	SqM	-	9	9	6	24
3.7	**CURVED GRILLES**						
	Supply, Installation, Testing and Balancing of one way blow linear curved supply air grilles complete with fixed core as per approved shop drawings and specifications. The grilles shall be of approved colour & shade.						
	Powder coated aluminium grilles of extruded sections with integral flanges on both sides & ends as required complete with corner pieces.						

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
	i. 100/150/200/250 mm High grilles	SqM	-	-	-	-	0
3.8	**DOUBLE LOUVERED GRILLES**						
	Supply, Installation, Testing and Balancing of double louvered supply air grilles as per approved shop drawings and specifications complete with key operated aluminium volume control dampers.						
	a. Powder coated extruded aluminiu grilles.	SqM	-	-	-	-	0
3.9	**AIR TRANSFER GRILLES**						
	Supply, Installation and Testing of extruded aluminium powder coated air transfer grilles to be provided at the door of toilets/pantry.	SqM	-	-	-	-	0
3.10	**ROUND DIFFUSERS**						
	Supply, Installation, Testing and Balancing of round supply air diffusers with removable key operated butterfly volume control dampers as per the approved shop drawings and specifications. The diffusers shall be anti-smudge flush type as approved by the interior designer. Diffuser shall be complete with GI cone with circular connection at the rear.						
	Powder coated extruded aluminium diffusers of approved colour & shade suitable for fixing in exposed duct or in grid/gypsum ceiling as per approved shop drawing.						
3.10.1	**With Volume Control Dampers**						
a.	300mm dia Neck Size round diffuser with GI cone	No	-	-	-	-	0
b.	200mm dia Neck Size round diffuser with GI cone	No	-	-	-	-	0
3.11	**SUPPLY AIR DIFFUSERS**						
3.11.1	Supply, Installation, Testing and Balancing of square supply air diffusers with removable key operated volume control dampers with opposed blades as per the approved shop drawings and specifications. The diffusers shall be anti-smudge ring type/flat type as approved by the interior designer. Diffusers shall be with removable core for the following neck sizes. The diffusers shall be suitable for fixing in the gypsum/grid ceiling. The diffusers shall be of regular type and with outer dimension of 600x600mm, 450 x 450mm, 375mmx375mm & 300mmx300mm.						
	Powder coated extruded aluminium diffusers of approved colour & shade.	SqM	0.5	0.5	0.5	0.5	2
3.11.2	Supply, Installation, Testing and Balancing of square supply air diffusers with removable key operated volume control dampers with opposed blades & 150mm high GSS plenum as per the approved shop drawings and specifications.The diffusers shall be anti-smudge ring type/flat type as approved by the interior designer. Diffusers shall be with removable core for the following neck sizes. The diffusers shall be suitable for fixing in the gypsum/grid ceiling. The diffusers shall be of regular type and with outer dimension of 600 x 600mm.						
	600x600 Powder coated extruded aluminium diffusers of approved colour & shade suitable for fixing in grid ceiling.	No	20	2	3	2	27

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
3.11.3	Supply, Installation, Testing and Balancing of square supply air diffusers with 150mm high GSS plenum with spiggot to facilitate round flexible duct connections as per the approved shop drawings and specifications.The diffusers shall be anti-smudge ring type/flat type as approved by the interior designer. Diffusers shall be with removable core for the following neck sizes. The diffusers shall be suitable for fixing in the gypsum/grid ceiling. The diffusers shall be of regular type and with outer dimension of 600 x 600mm.						
	600x600 Powder coated extruded aluminium diffusers of approved colour & shade suitable for fixing in grid ceiling.	No	0	10	25	18	53
3.12	**RETURN AIR DIFFUSERS**						
3.12.1	Supply, Installation, Testing and Balancing of square return air diffusers same as supply air diffusers but without volume control dampers as per the approved shop drawings and specifications. The diffusers shall be anti -smudge ring type. Diffusers shall be independently hung from the slab through adjustable GI wires.						
	Powder coated extruded aluminium diffusers of approved colour & shade.	SqM	0.5	0.5	0.5	0.5	2
3.12.2	Supply, Installation,Testing and Balancing of square return air diffusers same as supply air diffusers but without volume control dampers as per the approved shop drawings and specifications. The diffusers shall be anti -smudge ring /flat type. All Return air diffusers in false ceiling to be properly supported from real slab using chains or gripple wires.						
	600x600 Powder coated extruded aluminium diffusers of approved colour & shade suitable for fixing in grid ceiling.	No	0	10	22	20	52
3.13	Supply, Installation, Testing and Balancing of linear slot diffusers as per the approved shop drawings and specifications. Each slot shall be 25mm wide. The diffuser face shall be a one piece extrusion so there are no visible joints. Slot diffusers shall be complete with end caps either as end plates or end angles or integral part, air control blades etc. Slot diffuser have a variable neck length and the diffuser face could be optionally be fitted to the plenum box on site. Diffuser shall have provision to access collar dampers for air balancing.						
	Sample & color of Diffusers to be got approved from Clients/Architects befor procurement.						
a.	3 slot/2slot, powder coated extruded aluminium diffusers of approved colour & shade.	SqM	7	16	15	16	54
b.	3 slot/2slot, powder coated extruded aluminium diffusers of approved colour & shade for supply air with Hit & Miss type dampers	SqM	-	-	-	-	0

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
3.14	Supply, Installation, Testing and Balancing of flexible ducting comprising of inner as well as outer skin constructed out of aluminium & fibre glass insulation 25mm thick of minimum 24 kg/cu.m density insulation sandwitched in between. Duct should confirm to fire rating standards BS-476 part 5, 6 & 7. Flexible Ducts of following sizes as per approved shop drawings, specifications : Universal (Jubilee) clamp should be provided to fix the flexible duct in the spigots/Butterfly Dampers and covered with aluminium tape. Circular clip with chain/GI threaded rod to be provided to support the flexible duct.						
a.	250 mm dia	RM	0	10	10	10	30
b.	200 mm dia	RM	5	15	15	15	50
c.	150 mm dia	RM	40	40	50	40	170
3.15	Supply, Installation and Testing of single piece GI round spigot made out of spinning process with 50mm height and having grooves on both sides and circular flanges. Spigots shall be installed on main ducts to facilitate connection of flexible ducts.						
a.	250 mm dia	No	0	2	2	2	6
b.	200 mm dia	No	10	25	10	10	55
c.	150 mm dia	No	80	75	90	75	320
3.16	Supply, Installation and Testing of Butterfly damper of GI sheet construction with two flap with round flange on one side and 10mm grove on other side for fixing of flexible duct with the help of band, 20 Gauge Frame 250mm dia & above, 22 Gauge Frame upto 200mm dia & 22 Gauge Blade in all sizes as per thespecifications and shop drawings.						
a.	250 mm dia	No	0	10	10	10	30
b.	200 mm dia	No	2	5	5	5	17
c.	150 mm dia	No	2	2	2	2	8
3.17	Supply, Installation and Testing of GI box type volume control dampers as per the specifications and shop drawings. **- For Rectangular Ducts**	SqM	2.5	7	9	9	27.5
3.18	Supply, Installation and Testing of GI box type volume control dampers as per the specificationsand shop drawings. **- For Flat Oval Ducts**	SqM	-	-	-	-	0
3.19	Supply, Installation and Testing of Aluminium multi blade type louver dampers as per the specifications and shop drawings of approved colour & shade.	SqM	4	9	12	9	34
3.20	Supply, Installation, Testing and Commissioning of motorised fire dampers suitable for at least 120 minutes fire rating as per the specifications and approved shop drawings. Quoted price shall be inclusive of copper control wiring & Power cabling as required.						
	Fire dampers shall be provided with 450 mm sleeves suitable for the wall mounting, (Sleeve Thickness -1.2mm)						
a.	Bare Fire Dampers	SqM	-	-	-	-	0

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
b.	Spring return action type actuator complete with control panel and temperature sensor. Torque not less than 16NM	No	-	-	-	-	0
3.21	Supply, Installation and Testing of Bird Screens with GI wire mesh to be installed at the suction of fresh air/discharge of Exhaust air as per the specifications and shop drawings. Sample of bird screen to be got approved from consultants and Clients prior to procurement.	SqM	0	0.25	0.25	0.25	0.75
3.22	Supply, Installation and Testing of non return dampers. NRDs to be installed in the ducts as per the specifications and shop drawings. Sample of NRDs to be got approved from consultants and Clients prior to procurement.	SqM	0	5	6	5	16
3.23	**SOUND ATTENUATORS**						
	Supply, Installation & Testing of approved makes sound attenuators for supply/return air ducts of following sizes. The sound attenuators shall be suitable for minimum 18dB reduction at 250Hz octave band.						
	Size (WxH in mm) / Length (mm) / Air Qty. (Cfm) / Max. allowable pressure drop / Location						
	1050x350 / 1200 / 4050 / 12mm / Supply duct	No	1	-	-	-	1
	700x350 / 1200 / 2577 / 12mm / Return duct	No	1	-	-	-	1
	500x400 / 1200 / 1923 / 12mm / Return duct	No	1	-	-	-	1
	TOTAL ITEM NO.3 (Ducting & Air Terminals)						

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
4.0	**INSULATION**						
4.1	**ACOUSTIC LINING OF DUCTS**						
4.1.1	**Using Open Cell Nitirile Rubber**						
	Supply and Application of internal acoustic lining of supply air ducting using open cell nitrile rubber insulation with density within 140-180 Kg/m3 as per the approved shop drawings and specifications. Insulation material shall be bonded with the ducts using metal screw and washers to facilitate grip to the GI sheet.						
a.	15mm thick lining	SqM	210	90	120	120	540
4.2	**THERMAL INSULATION OF DUCTS**						
	(Using aluminium foil faced Class 'O' Fire Retardant Properties Closed Cell Elastomeric insulation)						
	Supply and Application of external thermal insulation of supply /return air ducting using factory laminated aluminium foil faced closed cell elastomeric nitrile rubber insulation with class 'O' fire retardant properties as per the specifications and drawings. Cladding shall provide protection from mechanical impact, and Scratches etc. Both insulation & cladding should have built in antimicrobial protection. Adhesive - AC Duct King Eco Fresh						
a.	9mm thick insulation	SqM	300	350	360	350	1360
	TOTAL ITEM NO. 4 (INSULATION)						

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
5.0	**ELECTRICAL WORKS**						
5.1	**PANELS-For VRF System**	**Not in vendor's scope. Shall be covered in main electrical package through a separate tender.**					
	Supply, Installation, Testing and Commissioning of the following cubical type panels made out of 14 gauge CRCA structure, base channel, complete with, moulded case circuit breakers, meters, indicating lamps, current transformer etc. Complete in all respects, insulated bus bars with heat shrinkable PVC sleeve in suitable bus chambers, interconnection, small wiring, name plate, danger plate, earth bus etc. & comprising of compartments with hinged door for each feeder & its accessories, cable alley with hinged doors, bus chamber with bolted door etc. The panel being of dust & vermin proof construction with rubber gasket attractivel powder coating etc. The panel shall be free standing type / wall mounted type **having IP-65 Protection suitable for outdoor installation** as per relevant drawing and comprising with the following:						
	Notes :						
	1. All MCCBs shall be with operating handle.						
	2. CTs burden shall be 15VA & accuracy class 1.0						
	3. CTs shall be cast resin type.						
	4. All MCCBs shall be with thermal magnetic release.						
	5. All indication lights shall be LED type.						
	6. All meter shall be digital type.						
	7. The outgoing starter feeders shall be provided with push buttons & indicating lamps for status indication.						
	8. Proper isolation switches to be provided near units in weather proof enclosure.						
	9. Bimetal overload relay for all the starters shall have built-in single phasing prevention feature.						
	10. Electrical interlocking wiring shall be provided as per system requirement.						
	11. Power cabling/wiring with necessary earthing from source to each panel and each exhaust fan shall be provided by other agencies.						
	Note :						
i.	**Incoming power supply shall be provided by main electrical contractor/ electrical consultant at each VRF outdoor unit along with a TPN MCCB and earthing.**						
5.2	**CONTROL & TRANSMISSION WIRING**						
	Supply, laying, affecting connections and Testing of the following sizes of control cum transmission wiring to be laid in MS conduits between indoor units and outdoor units.						
	2C x1.5 Sqmm copper wiring	RM	450	510	600	590	2150
5.3	**CONTROLLER WIRING**						

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
	Supply, laying, affecting connections and Testing of the following sizes of control cum transmission wiring to be laid in MS conduits between indoor units and their wired remotes.						
	2C x1.5 Sqmm copper wiring	RM	110	175	210	170	665
5.4	**Panels-For AHUs**						
	Supply, Installation, Testing and Commissioning of the following cubical type panels made out of 14 guage CRCA structure, base channel, complete with, moulded case circuit breakers, meters, indicating lamps, current transformer etc. Complete in all respects, insulated bus bars with heat shrinkable PVC sleeve in suitable bus chambers, interconnection, small wiring, name plate, danger plate, earth bus etc. & comprising of compartments with hinged door for each feeder & its accessories, cable alley with hinged doors, bus chamber with bolted door etc. The panel being of dust & vermin proof construction with rubber gasket attractively powder coating etc. The panel shall be free standing type / wall mounted type as per relavant drawing and comprising with the following:						
	Notes :						
	1. All MCCBs shall be with operating handle.						
	2. CTs burden shall be 15VA & accuracy class 1.0						
	3. CTs shall be cast resin type .						
	4. All MCCBs shall be with thermal magnetic release.						
	5. All indication lights shall be LED type.						
	6. All meter shall be digital type.						
	7. The outgoing starter feeders for pumps,AHUS & ventilation fans shall be provided with push buttons & indicating lamps for status indication.						
	8. Proper isolation switches to be provided near air handling units and ventilation fans in weather proof enclosure.						
	9. Bimetal overload relay for all the starters shall have built-in single phasing prevention feature.						
	10. Electrical interlocking wiring shall be provided as per system requirement.						
	11. Power cabling/wiring with necessary earthing from source to each panel and each exhaust fan shall be						

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
	provided by other agencies.						
	12. All HVAC equipment shall be compatible with						
	BMS and necessary provisions to be made						
	in each panel.						
5.4.1	**AHP-1 (Location: Near AHU)**						
	For AHU - 3.7KW each	No	1	-	-	-	1
	(VFD Panel with Bypass Starter)						
	32 Amps ,TP MCCB -- 1set						
	(0-500) V digital Voltmeter with built in Selector						
	switch -- 1set						
	Digital Ammeter with built in selector						
	switch- 1set						
	Current Transformers - 1set						
	LED type RYB phase indication lights- 1set						
	LED type ON & OFF indication lights -- 1set						
	5.0HP DOL starter with built-in single phasing						
	preventor & overload relay & adjustable timer -- 1 set						
	START-STOP Push Buttons -- 1 set						
	Auto-Manual type selector switch						
	to facilitate auto start of AHUs -- 1set						
	VFD/By Pass Selector Switch-- 01Set						
	Space for VFD Mounting						
	Ventilation Fan for VFD-- 1Set						
	Contactors, Potential Free Contacts, Control wiring and						
	safety circuit as required with start-stop push buttons						
	stay put or lockable type -1set						
5.5	**CABLING**						
5.5.1	Supply, laying, affecting connections and Testing of the following sizes of 1.1 KV armoured PVC insulated aluminium/copper conductor cables. Cables shall be inclusive of all clamps, saddles, screws, cable identification tags, cable terminal joints including terminal lugs, insulating tapes, affecting terminal connections to the equipment as per the specifications and as required. Quoted price shall be inclusive of perforated duly painted 2mm thick MS trays and 8 SWG copper earth wire						
	All cables shall be FRLS type.						
a.	3 C x 4 Sqmm cable (Copper)	RM	-	-	-	-	0
b.	3 C x 2.5 Sqmm cable (Copper)	RM	15	-	-	-	15
c.	3 C x 2.5 Sqmm cable(Copper Control cabling)	RM	-	-	-	-	0
d.	3 C x 1.5 Sqmm cable(Copper Control cabling)	RM	5	-	-	-	5
e.	4 C x 1.5 Sqmm cable(Copper Control cabling)	RM	-	-	-	-	0
5.6	Supply, Installation & Testing of TPN isolator in weather proof enclosure near AHU.	No	1	-	-	-	1
5.7	Supply and fixing of 1.1 KV grade rubber mat 914.4 mm wide 6mm thick to withstand 1.1 KV dielectric strength in front of each panel.	RM				-	0
	TOTAL ITEM NO. 5 (ELECTRICAL)						

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
	SECTION 'B' - DX TFA UNIT FOR FRESH AIR SUPPLY						
1.0	**EQUIPMENT**						
1.1	**VARIABLE REFRIGERANT VOLUME SYSTEM**						
	(HEAT PUMP)						
	Supply, Installation, Testing and Commissioning of Variable Refrigerant Volume type multi unit air-conditioning system complete with indoor and outdoor units with individual controller for cooling & heating application as per the specifications and drawings. The quoted price should include clearances charges, local taxes, freight etc. Quoted price shall also be inclusive of loading, unloading, lifting & shifting on outdoor location on Terrace at suitable locations as per drawing, positioning charges besides including charges towards structural steel supports, MS base frame duly painted & vibration isolation arrangement etc.						
1.1.1	**OUTDOOR UNITS- HEAT PUMPS**						
	Supply, Installation, Testing and Commissioning of air cooled variable refrigerant flow modular type Heat Pumps, each comprising of energy efficient multiple scroll compressors, full charge of R-410a refrigerant gas and all accessories as per the specifications. All compressors shall be inverter type. The condensing units shall be suitable to work on cooling as well as heating mode. The condensing units shall be suitable for operation on 415 ±10% volts, 50Hz, 3 phase AC power supply and complete with auto check function for connection error, auto address setting, etc. The outdoor units shall be low noise type. Quoted price shall be inclusive of Power Cable from MCCB to Outdoor unit & MS frame duly applied with 2 coat of primer & one coat of black enamel paint. The outdoor units shall be of following capacities :						
	Quoted price shall be inclusive of factory applied epoxy coating (to prevent erosion of tubes & fins) of Outdoor units.						
	VRV ODUs shall be capable of operating in follwing range : **i. For Cooling : (-)5degC to 50degC** **ii. For Heating : (-)20degC to 15.5degC**						
i	12HP nominal capacity high COP outdoor unit	No	1	-	-	-	1
ii	10HP nominal capacity high COP outdoor unit	No	-	2	2	1	5
iii	8HP nominal capacity high COP outdoor unit	No	1	-	-	1	2
1.2	**DX TF AIR HANDLING UNITS (AHUs)**						
1.2.1	**Ceiling Suspended type TF AHUs - With Thermal Break Profile and Fresh air Intake Section**						
	Supply, Installation, Testing and Commissioning of DX double skin air handling units (AHUs) each comprising of following as per the specifications :						

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
a.	Casing of air handling units shall be in double skin construction. Inner skin shall be constructed out of 24 gauge plain GS sheet & outer skin in 24 gauge pre-plasticized GS sheet sandwitched between 50mm thick injected PU foam insulation of density not less than 40 Kg /CuM and complete with inspection doors including control wiring as required. AHUs shall have access for all parts. **AHUs shall be provided with thermal break profile and Fresh air Intake Section.**						
b.	Fan section complete with backward curved DIDW type centrifugal fan/s, IP-55, IE3, TEFC squirrel cage induction motor suitable to operate on 415±10%V, 50Hz, **spring type vibration isolators below Fans**, 3 phase AC power supply and belt drive package. Fan outlet velocity shall not be more than 1800 FPM (9.12MPS). **Fan section should be completed with 25mm thick Armasound acoustic insulation covered with perforated sheet**. All fans should be AMCA certified. Motors shall be VFD compatible.						
c.	Coil section with multirows deep DX cooling/heating coil of copper tube & copper header and aluminium fins construction having wall thickness of tubes not less than 0.5mm. Drain pan shall be made out of 18 gauge stainless steel duly insulated. Face velocity across cooling coil shall not exceed 500FPM.						
d.	Pre-Filter (EU-4) section complete with 50mm thick washable synthetic fibre filters. Velocity across the filters shall not exceed 500 FPM.						
e.	Fine filter section complete with fine filters. Velocity across fine filters shall not exceed 500FPM. Filters shall have efficiency not less than 95% down to 1 Microns (EU-8/MERV-14).						
f.	Single stage Chemical filter with Media being manufactured specifically for the removal of the all harmful gases composed of carbon, alumina, Bi-carbonates, Hydroxyls, VOC gases with other binders, duly impregnated with activated catalysts. The air moment across filters shall be turbulent type to increase the contact area & contact time with filter media. Scope of harmful gas removal shall include but shall not be limited to H2s, SO2, NO2 & Cl2. Filters shall be capable of removing all harmful gases present in local air.						
	The Media shall perform effectively under wide range. Temperature: -4° F to 125° F Humidity: 10 - 95% RH						
	Media shall be designed for 99.5% min. removal efficiency. The used filters should be disposable as per the local, state or govt guidelines.						
g.	Semi HEPA (MERV-16) filter section complete with 300mm thick HEPA filters. Velocity across HEPA filters shall not exceed 450FPM. Filters shall have efficiency not less than 97% down to 0.3 microns.						
h.	Fresh Air Intake Section complete with FA dampers in extruded aluminium construction.						

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
i.	AHUs shall be complete with suspension arrangement, it shall also include spring type vibration isolators and rubber groomets etc. to make the installation totally vibration free.						
j.	Multiblade box type zero leakage manually operated extruded aluminium volume control dampers shall be factory fitted at outlet of each AHU.						
k.	In addition to the above, air handling units shall be provided with fire retardant flexible canvass connections made out of canvass sleeve. Sizes of air handling units shall not exceed as mentioned in the design drawings and air handling units shall conform to the design parameters mentioned in specifications.						
	The Air Handling Units (AHUs) shall be of following duty parameters :						
	AHU No Capacity (Cfm/TR) S.P (mmWG) Motor Rating (HP) Rows of coil Area to be fed						
	TFA-1 1500/9.6 110 1.5 6 Office Spaces	No	1	-	-	-	1
	TFA-2 1000/8.0 110 1.5 6 Office Spaces	No	-	2	2	1	5
	TFA-3 750/6.4 110 1.5 6 Office Spaces	No	1	-	-	1	2
1.3	**KIT FOR AHUs**						
	Supply, Installation, Testing and Commissioning of VRF Kits for AHUs having all controllers & Electonic Expansion Valve (EEV) and temperature set arrangment. It Shall have cut off arrangement after a particular set value of Supply air Temperature. Price should include all control cabling etc. and all necessary arrangements whether mentioned or not to make the system working.						
i.	For 12HP	No	1	-	-	-	1
ii.	For 10HP	No	-	2	2	1	5
iii	For 8HP	No	1	-	-	1	2
1.4	**VARIABLE FREQUENCY DRIVES**						
	Supply, Installation, Testing and Commissioning of variable frequency drives for following Air Handling Units. Variable frequency drives shall be provided with necessary sensors and transmitters complete with control wiring in all respect as required and as per specifications. VFDs shall have built-in harmonic filters. The drives shall be suitable for the following motor rating. VFDs shall be housed in precoated, vandal proof enclosure with On/Off Push Buttons, Phase indication lights, A/M Switch and with adequate provisions for ventilation using a fan. The VFDs shall be able to receive the signals from Temp. sensors and to ramp the speed of the motor. Quoted price shall be inclusive of return air temperature sensor and necessary electrical switches including change over switch & copper cabling for integration with the AHU panel. VFDs shall be installed within Electrical panels as described under Section 'Electrical Works'. Overall protection of VFDs with Panels shall be IP-54.						
	(i) Sensing Range : 10mm to 50 mm WG						
	(ii) Output Signal : 4 mA to 20 mA						
	OR						

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
	0 V to 10 V DC						
	AHU No Capacity (Cfm) Motor Rating (HP) Area to be fed						
	AH-1 1.5/1.0 Office Area	No	2	2	2	2	8
	TOTAL ITEM NO. 1 (EQUIPMENT)						

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
2.0	**PIPING**						
2.1	**COPPER REFRIGERANT PIPING**						
	Supply, Installation, Testing & Commissioning of high pressure copper refrigerant piping including R410a refrigerant of suitable size as required and duly insulated with 19mm/13mm thick closed cell elastomeric insulation with class 'O' fire retardant properties with IC Cladding in tubing form. Entire refrigerant piping work shall be carried out in accordance with the specifications. MS sleeves of requisite size shall be provided at wall crossing. Quoted price shall be inclusive of necessary glass cloth and minimum two layers of UV protection paint to be applied over insulation for all exposed pipes of approved make. Piping shall be of						
	Internal Refrigerant piping in exposed ceiling area & external refrigerant piping shall be laid on Powder coated Perforated type cable trays. Cable trays used for external refrigerant piping shall be covered with GI cover.						
	Pipe Size Thickness of CSE						
	(O.D.) Insulation						
a.	28.6 mm 19 mm	RM	40	-	-	-	40
b.	25.4 mm 19 mm	RM	-	-	-	-	0
c.	22.2 mm 19 mm	RM	-	60	55	25	140
d.	19.1 mm 13 mm	RM	40	-	-	25	65
e.	15.9 mm 13 mm	RM	-	-	-	-	0
f	12.7 mm 13 mm	RM	40	-	-	-	40
g	9.5 mm 13 mm	RM	40	60	55	50	205
2.2	**CONDENSATE DRAIN PIPING -cPVC**						
	Supply, Installation, Testing and Commissioning of cPVC pipes cut to required lengths and installed for condensate drain. Quoted price shall be inclusive of supply and fixing in position the necessary fittings like elbows, tees reducers etc., and supporting arrangement in accordance with the approved shop drawings and specifications. Pipes shall be insulated with 9mm thick closed cell elastomeric insulation with class 'O' fire retardant properties in tubing form. Pipes shall be of following sizes :						
a.	32mm dia	RM	10	10	10	10	40
	TOTAL ITEM NO. 2 (PIPING)						

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
3.0	**DUCTWORK/AIR TERMINALS**						
3.1	**FACTORY FABRICATED DUCTING**						
	Supply, Installation and Testing of factory fabricated GSS (class VIII-120GSM Zinc Coaing) ducting complete with vanes, splitter dampers, fire retardant gaskets hanging arrangement including fully threaded GI rods and GI "C" channels/ rolled steel wires or Gripple Wire Rope Hangers & Supports complete with end fixing, GI "C" channels etc. as approved by clients/consultants in accordance with the approved shop drawings and specifications. Quoted price shall be inclusive of necessary scaffolding charges towards installation of supply/exhaust air ducts outside or within building wherever required. Quoted price should also include necessary charges towards duct supports including MS angle/channel arrangement as required for ducts being installed outside or within building wherever required. **Ducting to be brought in Box form at site.**						
	Spacing between duct supports should not exceed 2m in both cases i.e GI rods with GI "C" channels & Gripple Wire Rope Hanger support. In case of Gripple Wire Rope Hanger support for duct sizes above 1800mm, MS angles duly painted with black enamel paint should be used along with neoprene pad in between the duct & MS angle. All duct support to be provided with check nuts (lock nuts).						
	While selecting the duct supports vendor shall ensure vibration free installation. Quoted price shall be inclusive of light test or smoke test. Necessary arrangement for testing to be made by HVAC Vendor.						
a.	upto 1200mm -- 24G GSS with TDC Joints	SqM	70	95	90	90	345
b.	1201mm to 1800mm - 22G GSS with TDC Joints	SqM	5	5	5	10	25
c.	1801mm to 2100mm - 20G GSS with TDC Joints	SqM	-	-	-	-	0
d.	above 2100mm - 18G GSS with TDC Joints	SqM	-	-	-	-	0
3.2	**SITE FABRICATED DUCTING**						
	Supply, Fabrication, Installation and Testing of GS sheet metal (class VIII-120GSM Zinc Coaing) ducts complete with vanes, splitter dampers, hanging arrangement including check nuts in accordance with the approved shop drawings and specifications.						
	a. 0.63mm (24 gauge) GSS	SqM	10	10	10	10	40
	b. 0.8 mm (22 gauge) GSS	SqM	5	5	5	5	20
	c. 1.0mm (20 gauge) GSS	SqM	-	-	-	-	0
3.3	**FLEXIBLE CANVASS CONNECTIONS**						
	Supply, Installation, Testing of 125mm deep antivibration flexible joints at the outlet of air handling units/ductable split units//inline fans. Flexible connections shall be constructed using imported fire retardant fabric with extruded aluminium frame/flange on both sides of approved make.	RM	6	6	6	6	24
3.4	**LINEAR GRILLES**						

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
	Supply, Installation, Testing and Balancing of one way blow linear supply cum return air grilles complete with fixed core as per approved shop drawings and specifications. The grilles shall be of approved colour & shade.						
	Powder coated aluminium grilles of extruded sections with integral flanges on both sides & ends as required complete with corner pieces.						
	i. 100/150/200/250 mm/600mmx600mm Grilles	SqM	1	0.5	0.5	0.5	2.5
3.5	**SUPPLY AIR DIFFUSERS**						
3.5.1	Supply, Installation, Testing and Balancing of square supply air diffusers with removable key operated volume control dampers with opposed blades as per the approved shop drawings and specifications. The diffusers shall be anti-smudge ring type/flat type as approved by the interior designer. Diffusers shall be with removable core for the following neck sizes. The diffusers shall be suitable for fixing in the gypsum/grid ceiling. The diffusers shall be of regular type and with outer dimension of 600x600mm, 450 x 450mm, 375mmx375mm & 300mmx300mm.						
	Powder coated extruded aluminium diffusers of approved colour & shade.	SqM	-	-	-	-	0
3.5.2	Supply, Installation, Testing and Balancing of square supply air diffusers with removable key operated volume control dampers with opposed blades & 150mm high GSS plenum as per the approved shop drawings and specifications.The diffusers shall be anti-smudge ring type/flat type as approved by the interior designer. Diffusers shall be with removable core for the following neck sizes. The diffusers shall be suitable for fixing in the gypsum/grid ceiling. The diffusers shall be of regular type and with outer dimension of 600 x 600mm.						
	600x600 Powder coated extruded aluminium diffusers of approved colour & shade suitable for fixing in grid ceiling.	No	3	1	1	1	6
3.5.3	Supply, Installation, Testing and Balancing of square supply air diffusers with 150mm high GSS plenum with spiggot to facilitate round flexible duct connections as per the approved shop drawings and specifications.The diffusers shall be anti-smudge ring type/flat type as approved by the interior designer. Diffusers shall be with removable core for the following neck sizes. The diffusers shall be suitable for fixing in the gypsum/grid ceiling. The diffusers shall be of regular type and with outer dimension of 600 x 600mm.						
	600x600 Powder coated extruded aluminium diffusers of approved colour & shade suitable for fixing in grid ceiling.	No	0	1	1	1	3
3.6	Supply, Installation and Testing of GI box type volume control dampers as per the specifications and shop drawings. **- For Rectangular Ducts**	SqM	1	2	2	2	7
3.7	Supply, Installation and Testing of Aluminium multi blade type louver dampers as per the specifications and shop drawings of approved colour & shade.	SqM	1	2	2	2	7

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
3.8	Supply, Installation and Testing of fresh air grilles of powder coated / anodised extruded aluminium with GI wire mesh, inlet louvers, Box type VCD & bird screen, as per the approved shop drawings and specifications.	SqM	0.5	0.5	0.5	0.5	2
	TOTAL ITEM NO.3 (Ducting & Air Terminals)						

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
4.0	**INSULATION**						
4.1	**ACOUSTIC LINING OF DUCTS**						
4.1.1	**Using Open Cell Nitirile Rubber**						
	Supply and Application of internal acoustic lining of supply air ducting using open cell nitrile rubber insulation with density within 140-180 Kg/m3 as per the approved shop drawings and specifications. Insulation material shall be bonded with the ducts using metal screw and washers to facilitate grip to the GI sheet.						
a.	15mm thick lining	SqM	10	10	10	10	40
4.2	**THERMAL INSULATION OF DUCTS**						
	(Using aluminium foil faced Class 'O' Fire Retardant Properties Closed Cell Elastomeric insulation)						
	Supply and Application of external thermal insulation of supply /return air ducting using factory laminated aluminium foil faced closed cell elastomeric nitrile rubber insulation with class 'O' fire retardant properties as per the specifications and drawings. Cladding shall provide protection from mechanical impact, and Scratches etc. Both insulation & cladding should have built in antimicrobial protection. Adhesive - AC Duct King Eco Fresh						
a.	13mm thick insulation	SqM	90	110	110	105	415
	TOTAL ITEM NO. 4 (INSULATION)						

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
5.0	**ELECTRICAL WORKS**						
5.1	**PANELS-For VRF System**	**Not in vendor's scope. Shall be covered in main electrical package through a separate tender.**					
	Supply, Installation, Testing and Commissioning of the following cubical type panels made out of 14 gauge CRCA structure, base channel, complete with, moulded case circuit breakers, meters, indicating lamps, current transformer etc. Complete in all respects, insulated bus bars with heat shrinkable PVC sleeve in suitable bus chambers, interconnection, small wiring, name plate, danger plate, earth bus etc. & comprising of compartments with hinged door for each feeder & its accessories, cable alley with hinged doors, bus chamber with bolted door etc. The panel being of dust & vermin proof construction with rubber gasket attractively powder coating etc. The panel shall be free standing type / wall mounted type **having IP54 Protection for Indoor Installation and IP-65 Protection for outdoor installation** as per relevant drawing and comprising with the following:						
	1. All MCCBs shall be with operating handle.						
	2. CTs burden shall be 15VA & accuracy class 1.0						
	3. CTs shall be cast resin type .						
	4. All MCCBs shall be with thermal magnetic release.						
	5. All indication lights shall be LED type.						
	6. All meter shall be digital type.						
	7. The outgoing starter feeders for pumps, AHUs & ventilation fans shall be provided with push buttons & indicating lamps for status indication.						
	8. Proper isolation switches to be provided near air handling units and ventilation fans in weather proof enclosure.						
	9. Bimetal overload relay for all the starters shall have built-in single phasing prevention feature.						
	10. Electrical interlocking wiring shall be provided as per system requirement.						
	11. Power cabling/wiring with necessary earthing from source to each panel and each exhaust fan shall be provided by other agencies.						
	Note :						
i.	**Incoming power supply shall be provided by main**						
	electrical contractor/electrical consultant at each VRF						
	outdoor unit along with a TPN MCCB and earthing.						
5.2	**CONTROL & TRANSMISSION WIRING**						
	Supply, laying, affecting connections and Testing of the following sizes of control cum transmission wiring to be laid in MS conduits between indoor units and outdoor units.						
	2C x1.5 Sqmm copper wiring	RM	95	75	70	65	305

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
5.3	**Panels-For AHUs**						
	Supply, Installation, Testing and Commissioning of the following cubical type panels made out of 14 guage CRCA structure, base channel, complete with, moulded case circuit breakers, meters, indicating lamps, current transformer etc. Complete in all respects, insulated bus bars with heat shrinkable PVC sleeve in suitable bus chambers, interconnection, small wiring, name plate, danger plate, earth bus etc. & comprising of compartments with hinged door for each feeder & its accessories, cable alley with hinged doors, bus chamber with bolted door etc. The panel being of dust & vermin proof construction with rubber gasket attractively powder coating etc. The panel shall be free standing type / wall mounted type as per relavant drawing and comprising with the following:						
	Notes :						
	1. All MCCBs shall be with operating handle.						
	2. CTs burden shall be 15VA & accuracy class 1.0						
	3. CTs shall be cast resin type .						
	4. All MCCBs shall be with thermal magnetic release.						
	5. All indication lights shall be LED type.						
	6. All meter shall be digital type.						
	7. The outgoing starter feeders for pumps,AHUS & ventilation fans shall be provided with push buttons & indicating lamps for status indication.						
	8. Proper isolation switches to be provided near air handling units and ventilation fans in weather proof enclosure.						
	9. Bimetal overload relay for all the starters shall have built-in single phasing prevention feature.						
	10. Electrical interlocking wiring shall be provided as per system requirement.						
	11. Power cabling/wiring with necessary earthing from source to each panel and each exhaust fan shall be provided by other agencies.						
	12. All HVAC equipment shall be compatible with BMS and necessary provisions to be made in each panel.						

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
5.3.1	**AHP-1 (Location: Near AHU)**						
	For TFA units - 1.1/0.75KW each	No	2	2	2	2	8
	(VFD Panel with Bypass Starter)						

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
	25 Amps ,TP MCCB -- 1set						
	(0-500) V digital Voltmeter with built in Selector						
	switch -- 1set						
	Digital Ammeter with built in selector						
	switch- 1set						
	Current Transformers - 1set						
	LED type RYB phase indication lights- 1set						
	LED type ON & OFF indication lights -- 1set						
	1.5HP / 1.0HP DOL starter with built-in single phasing						
	preventor & overload relay & adjustable timer -- 1 set						
	START-STOP Push Buttons -- 1 set						
	Auto-Manual type selector switch						
	to facilitate auto start of AHUs -- 1set						
	VFD/By Pass Selector Switch-- 01Set						
	Space for VFD Mounting						
	Ventilation Fan for VFD-- 1Set						
	Contactors, Potential Free Contacts, Control wiring and						
	safety circuit as required with start-stop push buttons						
	stay put or lockable type -1set						
5.4	**CABLING**						
5.4.1	Supply, laying, affecting connections and Testing of the following sizes of 1.1 KV armoured PVC insulated aluminium/copper conductor cables. Cables shall be inclusive of all clamps, saddles, screws, cable identification tags, cable terminal joints including terminal lugs, insulating tapes, affecting terminal connections to the equipment as per the specifications and as required. Quoted price shall be inclusive of perforated duly painted 2mm thick MS trays and 8 SWG copper earth wire						
	All cables shall be FRLS type.						
a.	3 C x 4 Sqmm cable (Copper)	RM	-	-	-	-	0
b.	3 C x 2.5 Sqmm cable (Copper)	RM	20	20	20	20	80
c.	3 C x 2.5 Sqmm cable(Copper Control cabling)	RM	-	-	-	-	0
d.	3 C x 1.5 Sqmm cable(Copper Control cabling)	RM	5	5	5	5	20
e.	4 C x 1.5 Sqmm cable(Copper Control cabling)	RM	-	-	-	-	0
5.5	Supply, Installation & Testing of TPN isolator in weather proof enclosure near AHU.	No	2	2	2	2	8
5.6	Supply and fixing of 1.1 KV grade rubber mat 914.4 mm wide 6mm thick to withstand 1.1 KV dielectric strength in front of each panel.	RM				-	0
	TOTAL ITEM NO. 5 (ELECTRICAL)						

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
	SECTION 'C' - VRV SYSTEM FOR BACK-UP AIR CONDITIONING						
1.0	**EQUIPMENT**						
1.1	**VARIABLE REFRIGERANT VOLUME SYSTEM**						
	(HEAT PUMP)						
	Supply, Installation, Testing and Commissioning of Variable Refrigerant Volume type multi unit air-conditioning system complete with indoor and outdoor units with individual controller for cooling & heating application as per the specifications and drawings. The quoted price should include clearances charges, local taxes, freight etc. Quoted price shall also be inclusive of loading, unloading, lifting & shifting on outdoor location on Terrace at suitable locations as per drawing, positioning charges besides including charges towards structural steel supports, MS base frame duly painted & vibration isolation arrangement etc.						
1.1.1	**OUTDOOR UNITS- HEAT PUMPS**						
	Supply, Installation, Testing and Commissioning of air cooled variable refrigerant flow modular type Heat Pumps, each comprising of energy efficient multiple scroll compressors, full charge of R-410a refrigerant gas and all accessories as per the specifications. All compressors shall be inverter type. The condensing units shall be suitable to work on cooling as well as heating mode. The condensing units shall be suitable for operation on 415 ±10% volts, 50Hz, 3 phase AC power supply and complete with auto check function for connection error, auto address setting, etc. The outdoor units shall be low noise type. Quoted price shall be inclusive of Power Cable from MCCB to Outdoor unit & MS frame duly applied with 2 coat of primer & one coat of black enamel paint. The outdoor units shall be of following capacities :						
	Quoted price shall be inclusive of factory applied epoxy coating (to prevent erosion of tubes & fins) of Outdoor units.						
	VRV ODUs shall be capable of operating in follwing range : **i. For Cooling : (-)5degC to 50degC** **ii. For Heating : (-)20degC to 15.5degC**						
i	20HP nominal capacity high COP outdoor unit	No	-	-	-	-	0
ii	18HP nominal capacity high COP outdoor unit	No	1	1	-	1	3
iii	16HP nominal capacity high COP outdoor unit	No	-	-	2	-	2
iv	14HP nominal capacity high COP outdoor unit	No	-	-	-	1	1
v	12HP nominal capacity high COP outdoor unit	No	-	-	-	-	0
vi	10HP nominal capacity high COP outdoor unit	No	1	1	-	-	2
vii.	8HP nominal capacity high COP outdoor unit	No	-	-	-	-	0

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
1.1.2	**INDOOR UNITS**						
	Supply, Installation, Testing and Commissioning of variable refrigerant volume modular type indoor units comprising of EEV & all accessories as per the specifications. The indoor units shall be suitable to work on cooling as well as heating mode. The indoor units shall be suitable for operation on 220±6% volts, 50Hz, 1 phase AC power supply except floor standing units suitable for operation on 415±10% volts, 50Hz, 3 phase AC power supply. Ductable indoor units shall be suitable to handle extent of ductwork as shown in the design drawings and dehumidified air quantity as mentioned in the heat load summary sheet under "Special Conditions" and the indoor units shall be of following capacities. **All Indoor Units shall have inbuilt Drain Pumps.** **Price shall be inclusive of Decorative Panels for Cassette units.** Quoted price shall be inclusive of Plug Top & necessary power cable.						
i.	2290Cfm Ductable Type (6.4 TR)	No.	-	-	-	-	0
ii.	1620Cfm Ductable Type (4.6 TR)	No.	6	6	-	4	16
iii.	1375Cfm Ductable Type (4.0 TR)	No.	-	-	8	3	11
iv	1130Cfm Ductable Type (3.2 TR)	No.	-	-	-	-	0
1.2	**REMOTE CONTROLS**						
i	Supply of Cordless handset type remote controls for the above indoor units.	No	-	-	-	-	0
ii	Supply of Corded remote controls for the above indoor units.	No	6	6	8	7	27
	TOTAL ITEM NO. 1 (EQUIPMENT)						

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
2.0	**PIPING**						
2.1	**COPPER REFRIGERANT PIPING**						
	Supply, Installation, Testing & Commissioning of high pressure copper refrigerant piping including R410a refrigerant of suitable size as required and duly insulated with 19mm/13mm thick closed cell elastomeric insulation with class 'O' fire retardant properties with IC Cladding in tubing form. Entire refrigerant piping work shall be carried out in accordance with the specifications. MS sleeves of requisite size shall be provided at wall crossing. Quoted price shall be inclusive of necessary glass cloth and minimum two layers of UV protection paint to be applied over insulation for all exposed pipes of approved make. Piping shall be of						
	Internal Refrigerant piping in exposed ceiling area & external refrigerant piping shall be laid on Powder coated Perforated type cable trays. Cable trays used for external refrigerant piping shall be covered with GI cover.						
	Pipe Size Thickness of CSE						
	(O.D.) Insulation						
a.	31.8 mm 19 mm	RM	-	-	-	-	0
b.	28.6 mm 19 mm	RM	45	45	85	86	261
c.	25.4 mm 19 mm	RM	-	-	-	-	0
d.	22.2 mm 19 mm	RM	45	45	20	21	131
e.	19.1 mm 13 mm	RM	-	-	-	-	0
f.	15.9 mm 13 mm	RM	120	120	100	100	440
g.	12.7 mm 13 mm	RM	-	-	90	90	180
h.	9.5 mm 13 mm	RM	120	120	120	120	480
i.	6.4 mm 13 mm	RM	-	-	-	-	0
2.2	**FITTINGS**						
	Supply, Installation, Testing & Commissioning of following imported copper fittings to be provided in refrigerant pipe line.						
a.	Refnet Joints (Y- Joints)	No	4	4	6	5	19
b.	Refnet Headers	No	-	-	-	-	0
2.3	**CONDENSATE DRAIN PIPING -cPVC**						
	Supply, Installation, Testing and Commissioning of cPVC pipes cut to required lengths and installed for condensate drain. Quoted price shall be inclusive of supply and fixing in position the necessary fittings like elbows, tees reducers etc., and supporting arrangement in accordance with the approved shop drawings and specifications. Pipes shall be insulated with 9mm thick closed cell elastomeric insulation with aluminium foil & class 'O' fire retardant properties in tubing form. Pipes shall be of following sizes						
a.	40mm dia	RM	10	10	15	15	50
b.	32mm dia	RM	20	20	25	20	85
c.	25mm dia	RM	30	30	40	35	135
	TOTAL ITEM NO. 2 (PIPING)						

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
3.0	**ELECTRICAL WORKS**						
3.1	**PANELS-For VRV System**	**Shall be covered in main electrical package**					
	Supply, Installation, Testing and Commissioning of the following cubical type panels made out of 14 gauge CRCA structure, base channel, complete with, moulded case circuit breakers, meters, indicating lamps, current transformer etc. Complete in all respects, insulated bus bars with heat shrinkable PVC sleeve in suitable bus chambers, interconnection, small wiring, name plate, danger plate, earth bus etc. & comprising of compartments with hinged door for each feeder & its accessories, cable alley with hinged doors, bus chamber with bolted door etc. The panel being of dust & vermin proof construction with rubber gasket attractively powder coating etc. The panel shall be free standing type / wall mounted type **having IP-65 Protection suitable for outdoor installation** as per relevant drawing and comprising with the following:						
	Notes :						
	1. All MCCBs shall be with operating handle.						
	2. CTs burden shall be 15VA & accuracy class 1.0						
	3. CTs shall be cast resin type .						
	4. All MCCBs shall be with thermal magnetic release.						
	5. All indication lights shall be LED type.						
	6. All meter shall be digital type.						
	7. The outgoing starter feeders for pumps, AHUS & ventilation fans shall be provided with push buttons & indicating lamps for status indication.						
	8. Proper isolation switches to be provided near air handling units and ventilation fans in weather proof enclosure.						
	9. Bimetal overload relay for all the starters shall have built-in single phasing prevention feature.						
	10. Electrical interlocking wiring shall be provided as per system requirement.						
	11. Power cabling/wiring with necessary earthing from source to each panel and each exhaust fan shall be provided by other agencies.						
	Note :						

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
i.	**Incoming power supply shall be provided by main**						
	electrical contractor/electrical consultant at each VRV						
	outdoor unit along with a TPN MCCB and earthing.						
3.2	**CONTROL & TRANSMISSION WIRING**						
	Supply, laying, affecting connections and Testing of the following sizes of control cum transmission wiring to be laid in MS conduits between indoor units and outdoor units.						
	2C x1.5 Sqmm copper wiring	RM	200	200	250	250	900
3.3	**CONTROLLER WIRING**						
	Supply, laying, affecting connections and Testing of the following sizes of control cum transmission wiring to be laid in MS conduits between indoor units and their wired remotes.						
	2C x1.5 Sqmm copper wiring	RM	60	60	80	70	270
	TOTAL ITEM NO. 3 (ELECTRICAL)						

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
	SECTION 'D' - UNDERDECK INSULATION						
1.0	**UNDERDECK INSULATION WITH IC CLADDING**						
	Supply and Application of 19mm thick Class 'O' closed cell nitrile rubber elastomeric insulation factory laminated with IC cladding for ceiling/ exposed roof towards underdeck insulation. Quoted price shall be inclusive of Low VOC adhesive as required and as per the specifications. Metal screws shall be fixed with dash fasteners at centre & Corners of each piece of insulation with a GI cleat at bottom to give extra precaution in fixing of insulation. Adhesive based tapes shall be applied on all longitudinal and transverse joints. IC cladding shall provide protection from mechanical impact, ultra voilet radiations and Scratches etc. caldding shall not have any fibre erosion. Both insulation & cladding should have built in antimicrobial protection. Color of IC cladding shall be as per Architect's approval.	SqM	-	-	-	650	650
	TOTAL						

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
	SECTION 'E' - INDOOR AIR PURIFICATION ARRANGEMENT						
1.0	**INDOOR AIR PURIFYING IONISERS**						
	(Bi Polar Plasma Ionnisers)						
	Supply, Installation, Testing & Commissioning of Bi Polar Plasma Ionisers cell comprising of quad metallic compound target/ hydrated cataytic matrix cell duly enclosed by a poly casing tube, with the capability to produce friendly oxidizers like ionized hydroxyls, hydrogen peroxide, Super Oxide Ions. The tube should be duly encased in poly tube to prevent glass or mercury leakage into the atmosphere. The cell will have built in fiber optic device as remote indication of this operation.						
	The unit shall have inbuilt multipin ion generator along with ultrasonic radio frequency waves for pest repellancy. System should be suitable for all types of indoor units Ductable ac, Cassette AC & Hi-wall units. The cells shall be installed as required to fit in the plenum, duct at the AHU in the supply air stream.						
	The system shall be capable of reducing microbial bacteria, virus and spores, VoC', odors and particulates matter. The equipment shall conform to UL, TUV, CSA EU,CE, FDA, ISO, RoHS & CCMB Report standards, certifications as applicable and shall be submitted along with the technical submital. System should kill /deactivate microorganism and shall have proven effectiveness on COVID-19 human strain and its surrogate through Certified National/International lab. **Units shall be UL2998 certified for Zero Ozone.**						
	The power / control cabling between the ioniser units and the power source / controls shall be included in the cost. The ionizers should be selected by considering a load factor calculation for each specific area where the equipment is to be installed. Length selection should be per duct piece in which is to be installed. Detailed selection chart to be furnished indicating the model number for each unit. Cells Should be complete with Transformers, control cabling and Plug Top & necessary power cable.						
	Ionizers shal be suitable for following Equipment						
	Total Nos. of ionisers shall be as per air quantity distributed in individual duct drawn from units in Drawing.						
i.	2830Cfm Ductable Type (8.0 TR)	No.	-	-	-	-	0
ii.	2290Cfm Ductable Type (6.4 TR)	No.	1	1	1	1	4
iii.	1620Cfm Ductable Type (4.6 TR)	No.	18	18	-	12	48
iv	1375Cfm Ductable Type (4.0 TR)	No.	-	-	24	9	33
v	1130Cfm Ductable Type (3.2 TR)	No.	-	-	-	-	0
vi.	740Cfm Cassette Type (2.0TR) - Round Flow	No.	-	-	-	-	0
vii.	530Cfm Cassette Type (1.3TR) - Round Flow	No.	-	-	1	-	1
viii.	400Cfm Cassette Type (1.0TR) - Round Flow	No.	-	-	1	-	1
ix.	495Cfm Cassette Type (1.6TR) - Compact Flow	No.	-	-	-	-	0
x.	670Cfm Hi Wall Type (2.0TR)	No.	1	1	2	2	6
xi.	450Cfm Hi Wall Type (1.3TR)	No.	1	1	-	-	2
2.0	**INDOOR AIR QUALITY MONITOR**						

S. NO	ITEM DESCRIPTION	UNIT	QTY-GF	QTY-1F	QTY-2F	QTY-3F	TOTAL QTY.
	Supply, Installation, Testing & commissioning of IAQ Monitor to measure the levels of PM 2.5, VOCs, CO2, Temperature, Humidity on a real time basis. The IAQ Monitor shall be RS485 enabled and should be capable of getting connected with Wi-Fi. Units should have dedicated data browse i.e. sim card etc. The Monitor should be capable of sending the indoor air quality information on display Screen/Mobile/Workstation as per Client's requirement. The Monitor should indicate the quality of air through changing the colours as per the NAAQS standards and should meet the WELL building standards. Quoted price shall be inclusive of all necessary arrangement as required to make the unit proper functional. (LED Screen not included.)	Nos.	2	2	2	2	8
	TOTAL						
SECTION 'F' - DISMANTLING & TRANSPORTATION OF EXISTING INSTALLATION							
1.0	Dismantling of existing Installation and transportation of dismantled items at BYPL storage yard. Vendor to do the site visit to review the Existing Installation.	Lot	-	-	-	-	1
	TOTAL						

ANNEXURE - B (PRICED SCHEDULE OF QUANTITIES)-R1									
S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
	SECTION 'A' - VRV SYSTEM FOR COMFORT AIR-CONDITIONING								
1.0	**EQUIPMENT**								
1.1	**VARIABLE REFRIGERANT VOLUME SYSTEM (HEAT PUMP)**								
	Supply, Installation, Testing and Commissioning of Variable Refrigerant Volume type multi unit air-conditioning system complete with indoor and outdoor units with individual controller for cooling & heating application as per the specifications and drawings. The quoted price should include clearances charges, local taxes, freight etc. Quoted price shall also be inclusive of loading, unloading, lifting & shifting on outdoor location on Terrace at suitable locations as per drawing, positioning charges besides including charges towards structural steel supports, MS base frame duly painted & vibration isolation arrangement etc.								
1.1.1	**OUTDOOR UNITS- HEAT PUMPS**								
	Supply, Installation, Testing and Commissioning of air cooled variable refrigerant flow modular type Heat Pumps, each comprising of energy efficient multiple scroll compressors, full charge of R-410a refrigerant gas and all accessories as per the specifications. All compressors shall be inverter type. The condensing units shall be suitable to work on cooling as well as heating mode. The condensing units shall be suitable for operation on 415 ±10% volts, 50Hz, 3 phase AC power supply and complete with auto check function for connection error, auto address setting, etc. The outdoor units shall be low noise type. Quoted price shall be inclusive of Power Cable from MCCB to Outdoor unit & MS frame duly applied with 2 coat of primer & one coat of black enamel paint. The outdoor units shall be of following capacities :								
	Quoted price shall be inclusive of factory applied epoxy coating (to prevent erosion of tubes & fins) of Outdoor units.								
	VRV ODUs shall be capable of operating in follwing range : **i. For Cooling : (-)5degC to 50degC** **ii. For Heating : (-)20degC to 15.5degC**								
i	20HP nominal capacity high COP outdoor unit	No	1	-	-	-	1		
ii	18HP nominal capacity high COP outdoor unit	No	-	2	-	2	4		
iii	16HP nominal capacity high COP outdoor unit	No	-	-	4	-	4		
iv	14HP nominal capacity high COP outdoor unit	No	-	-	1	2	3		
v	12HP nominal capacity high COP outdoor unit	No	3	1	-	1	5		
vi	10HP nominal capacity high COP outdoor unit	No	1	3	-	-	4		
vii.	8HP nominal capacity high COP outdoor unit	No	-	-	-	-	0		

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
1.1.2	**INDOOR UNITS**								
	Supply, Installation, Testing and Commissioning of variable refrigerant volume modular type indoor units comprising of EEV & all accessories as per the specifications. The indoor units shall be suitable to work on cooling as well as heating mode. The indoor units shall be suitable for operation on 220±6% volts, 50Hz, 1 phase AC power supply except floor standing units suitable for operation on 415±10% volts, 50Hz, 3 phase AC power supply. Ductable indoor units shall be suitable to handle extent of ductwork as shown in the design drawings and dehumidified air quantity as mentioned in the heat load summary sheet under "Special Conditions" and the indoor units shall be of following capacities. **All Indoor Units shall have inbuilt Drain Pumps.** **Price shall be inclusive of Decorative Panels for Cassette units.** Quoted price shall be inclusive of Plug Top & necessary power cable.								
i.	2830Cfm Ductable Type (8.0 TR)	No.	2	-	-	-	2		
ii.	2290Cfm Ductable Type (6.4 TR)	No.	-	1	1	1	3		
iii.	1620Cfm Ductable Type (4.6 TR)	No.	-	12	-	8	20		
iv	1375Cfm Ductable Type (4.0 TR)	No.	-	-	16	6	22		
v	1130Cfm Ductable Type (3.2 TR)	No.	-	-	-	-	0		
vi.	1240Cfm Cassette Type (4.0TR) - Round Flow	No.	2	1	-	-	3		
vii.	1130Cfm Cassette Type (3.2TR) - Round Flow	No.	-	2	-	-	2		
viii.	740Cfm Cassette Type (2.0TR) - Round Flow	No.	-	-	-	-	0		
ix.	530Cfm Cassette Type (1.3TR) - Round Flow	No.	-	-	1	-	1		
x.	400Cfm Cassette Type (1.0TR) - Round Flow	No.	-	-	1	-	1		
xi.	495Cfm Cassette Type (1.6TR) - Compact Flow	No.	-	-	-	-	0		
xii.	670Cfm Hi Wall Type (2.0TR)	No.	5	1	2	2	10		
xiii.	450Cfm Hi Wall Type (1.3TR)	No.	1	1	-	-	2		
xiv.	300Cfm Hi Wall Type (1.0TR)	No.	1	-	-	-	1		
1.2	**REMOTE CONTROLS**								
i	Supply of Cordless handset type remote controls for the above indoor units.	No	1	-	-	-	1		
ii	Supply of Corded remote controls for the above indoor units.	No	10	18	21	17	66		
1.3	**CENTRALISED CONTROLLER**								
	Supply, Installation, Testing and Commissioning of main Intelligent Touch Controller with plus adapter as per specifications to hook up indoor units as mentioned above. Controller shall however, be suitable for minimum 128 groups of indoor units. Centralized controller shall act as master controller for controlling of cooling mode of outdoor units and their associated indoor units. Controller shall be suitable of Remote Access with computer and shall have web access. **Controller shall be suitable to autosequence the outdoor as well as indoor units catering to 24x7 operated areas as required**/mentioned under sub head "System Design" of tender document. Controller shall be suitable to configured the inside temperature as per temperature set point on controller. Controller shall have time schedulling arrangement for Indoor Units as well as Outdoor Units. Quoted price shall be inclusive of all necessary cabling as required from ODU & IDUs to controller.	No	1	-	-	-	1		

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
1.4	**DRAIN PUMP**								
	Supply, Installation, Testing & Commissioning of On Line Type Condensate drain pump for Hi-wall units complete with water level sensor and accessories as required. Quoted price shall be inclusive of controller, NRVs & water sensors and associated wiring etc. to make installation complete. Drain Pump shall be suitable for operation on 220±6 % volts 50 Hz, 1phase AC power supply.								
	Drain pumps shall automatically ON/Off based on water level.								
	Model of Aspen- Max Hi Flow or Equivalaent								
a.	Drain pump for Hi-wall units	Nos.	5	2	2	2	11		
1.5	**PROPELLER/AXIAL FANS - WITH POLYPROPYLENE BLADES**								
	Supply, Installation, Testing and Commissioning of propeller/axial fans for exhaust air as shown on drawings. Fan casing and impellers shall be constructed out of tough injection moulded polypropylene. Front grille shall be constructed out of high quality ABS and neon indicators made of polycarbonate to be provided. Each fan shall be complete with permanent split capacitor, mounting plate and accessories like wire guard, bird screen and gravity louvers for weather protection as required. All single phase propeller fans shall be provided with factory fitted speed regulators and Plug Top and necessary copper power cable. Fan selection arrangement arrangement and electrical characteristics shall be as follows :								
	Fans shall have plesant look with quiet operation.								
a.	150Cfm/150 mm dia fan, single phase.	No	1	2	1	2	6		
1.6	**AIR HANDLING UNITS (AHUs)**								
1.6.1	**Ceiling Suspended DX type AHUs - With Thermal Break Profile and Mixing Chamber**								
	Supply, Installation, Testing and Commissioning of double skin air handling units (AHUs) each comprising of following as per the specifications :								
a.	Casing of air handling units shall be in double skin construction. Inner skin shall be constructed out of 24 gauge plain GS sheet & outer skin in 24 gauge pre-plasticized GS sheet sandwitched between 50mm thick injected PU foam insulation of density not less than 40 Kg /CuM and complete with inspection doors including control wiring as required. AHUs shall have access for all parts. **AHUs shall be provided with thermal break profile.**								
b.	Fan section complete with backward curved DIDW type centrifugal fan/s, IP-55, IE3, TEFC squirrel cage induction motor suitable to operate on 415+10%V, 50Hz, spring type vibration isolators below Fans, 3 phase AC power supply and belt drive package. Fan outlet velocity shall not be more than 1600 FPM (8.13MPS). **Fan section should be completed with 25mm thick Armasound acoustic insulation covered with perforated sheet**. All fans should be AMCA certified.								
c.	Coil section with multirows deep DX cooling/heating coil of copper tube & copper header and aluminium fins construction having wall thickness of tubes not less than 0.5mm. Drain pan shall be made out of 18 gauge stainless steel duly insulated. Face velocity across cooling coil shall not exceed 500FPM.								
d.	Pre-Filter (EU-4) section complete with 50mm thick washable synthetic fibre filters. Velocity across the filters shall not exceed 500 FPM.								

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
e.	Fine filter section complete with fine filters. Velocity across fine filters shall not exceed 500FPM. Filters shall have efficiency not less than 95% down to 1 Microns (EU-8/MERV-14).								
f.	AHUs shall be provided with mixing chamber with R/A & F/A openings as per approved shop drawing.								
g.	Multiblade box type zero leakage motorized extruded aluminium volume control dampers shall be factory fitted at outlet of each AHU.								
h.	AHUs shall be complete with suspension arrangement, it shall also include spring type vibration isolators and rubber groomets etc. to make the installation totally vibration free. AHUs shall have separate compartment for housing of all valves or extended insulated auxiliary drain tray.								
i.	In addition to the above, air handling units shall be provided with fire retardant flexible canvass connections made out of canvass sleeve. Sizes of air handling units shall not exceed as mentioned in the design drawings and air handling units shall conform to the design parameters mentioned in specifications.								
	Noise level from AHUs as measured below False Ceiling shall not exceed 50dBA.								
	The Air Handling Units (AHUs) shall be of following duty parameters :								
	AHU No / Capacity (TR/ Cfm) / S.P (mmWG) / Motor Rating (HP) / Rows of coil / Area to be fed								
	AH-1 — 16/4500 — 74-75 — 5.0 — 6 — Auditorium	No	1	-	-	-	1		
1.7	**VARIABLE FREQUENCY DRIVES**								
	Supply, Installation, Testing and Commissioning of variable frequency drives for following Air Handling Units. Variable frequency drives shall be provided with necessary sensors and transmitters complete with control wiring in all respect as required and as per specifications. VFDs shall have built-in harmonic filters. The drives shall be suitable for the following motor rating. VFDs shall be housed in precoated, vandal proof enclosure with On/Off Push Buttons, Phase indication lights, A/M Switch and with adequate provisions for ventilation using a fan. The VFDs shall be able to receive the signals from multiple/combination of duct static pressure sensors/Temp. sensors and to ramp the speed of the motor.VFDs shall be suitable to take feed back and connectivity from all the DPS as mentioned below against each motor rating to facilitate averaging activity by VFD. Quoted price shall be inclusive of return air temperature sensor and necessary electrical switches including change over switch & copper cabling for integration with the AHU panel. VFD shall be BMS compatible. VFDs shall be installed within Electrical panels as described under Section 'Electrical Works'. Overall protection of VFDs with Panels shall be IP-54.								
	(i) Sensing Range : 10mm to 50 mm WG								
	(ii) Output Signal : 4 mA to 20 mA								
	OR								
	0 V to 10 V DC								
	AHU No / Capacity (Cfm) / Motor Rating (HP) / Area to be fed								
	AH-1 — 4500 — 5.0 — Audi	No	1	-	-	-	1		
1.8	**KIT FOR AHUs**								

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
	Supply, Installation, Testing and Commissioning of VRF Kits for AHUs having all controllers & Electonic Expansion Valve (EEV) and temperature set arrangment. It Shall have cut off arrangement after a particular set value of Supply air Temperature. Price should include all control cabling etc. and all necessary arrangements whether mentioned or not to make the system working.								
i.	For 20HP	No	1	-	-	-	1		
	TOTAL ITEM NO. 1 (EQUIPMENT)								

S. NO	ITEM DESCRIPTION		UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
2.0	**PIPING**									
2.1	**COPPER REFRIGERANT PIPING**									
	Supply, Installation, Testing & Commissioning of high pressure copper refrigerant piping including R410a refrigerant of suitable size as required and duly insulated with 19mm/13mm thick closed cell elastomeric insulation with class 'O' fire retardant properties with IC Cladding in tubing form. Entire refrigerant piping work shall be carried out in accordance with the specifications. MS sleeves of requisite size shall be provided at wall crossing. Quoted price shall be inclusive of necessary glass cloth and minimum two layers of UV protection paint to be applied over insulation for all exposed pipes of approved make. Piping shall be of following sizes :									
	Internal Refrigerant piping in exposed ceiling area & external refrigerant piping shall be laid on Powder coated Perforated type cable trays. Cable trays used for external refrigerant piping shall be covered with GI cover.									
	Pipe Size	**Thickness of CSE**								
	(O.D.)	**Insulation**								
a.	41.3 mm	19 mm	RM	-	-	-	-	0		
b.	38.1 mm	19 mm	RM	-	-	-	-	0		
c.	34.9 mm	19 mm	RM	50	-	-	-	50		
d.	31.8 mm	19 mm	RM	-	-	-	-	0		
e.	28.6 mm	19 mm	RM	115	130	185	175	605		
f.	25.4 mm	19 mm	RM	-	-	-	-	0		
g.	22.2 mm	19 mm	RM	70	125	30	30	255		
h.	19.1 mm	13 mm	RM	5	5	5	5	20		
i.	15.9 mm	13 mm	RM	150	235	250	250	885		
j	12.7 mm	13 mm	RM	60	65	210	200	535		
k	9.5 mm	13 mm	RM	110	280	280	270	940		
l	6.4 mm	13 mm	RM	5	10	10	10	35		
2.2	**FITTINGS**									
	Supply, Installation, Testing & Commissioning of following imported copper fittings to be provided in refrigerant pipe line.									
a.	Refnet Joints (Y- Joints)		No	9	12	16	12	49		
b.	Refnet Headers		No	-	-	-	-	0		
2.3	**CONDENSATE DRAIN PIPING -cPVC**									
	Supply, Installation, Testing and Commissioning of cPVC pipes cut to required lengths and installed for condensate drain. Quoted price shall be inclusive of supply and fixing in position the necessary fittings like elbows, tees reducers etc., and supporting arrangement in accordance with the approved shop drawings and specifications. Pipes shall be insulated with 9mm thick closed cell elastomeric insulation with class 'O' fire retardant properties in tubing form. Pipes shall be of following sizes :									
a.	50mm dia		RM	10	20	20	20	70		
b.	40mm dia		RM	20	40	40	40	140		
c.	32mm dia		RM	40	60	50	50	200		
d.	25mm dia		RM	70	110	100	100	380		
	TOTAL ITEM NO. 2 (PIPING)									

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
3.0	**DUCTWORK/AIR TERMINALS**								
3.1	**FACTORY FABRICATED DUCTING**								
	Supply, Installation and Testing of factory fabricated GSS (class VIII-120GSM Zinc Coaing) ducting complete with vanes, splitter dampers, fire retardant gaskets hanging arrangement including fully threaded GI rods and GI "C" channels/ rolled steel wires or Gripple Wire Rope Hangers & Supports complete with end fixing, GI "C" channels etc. as approved by clients/consultants in accordance with the approved shop drawings and specifications. Quoted price shall be inclusive of necessary scaffolding charges towards installation of supply/exhaust air ducts outside or within building wherever required. Quoted price should also include necessary charges towards duct supports including MS angle/channel arrangement as required for ducts being installed outside or within building wherever required. **Ducting to be brought in Box form at site.**								
	Spacing between duct supports should not exceed 2m in both cases i.e GI rods with GI "C" channels & Gripple Wire Rope Hanger support. In case of Gripple Wire Rope Hanger support for duct sizes above 1800mm, MS angles duly painted with black enamel paint should be used along with neoprene pad in between the duct & MS angle. All duct support to be provided with check nuts (lock nuts).								
	While selecting the duct supports vendor shall ensure vibration free installation. Quoted price shall be inclusive of light test or smoke test. Necessary arrangement for testing to be made by HVAC Vendor.								
a.	upto 1200mm -- 24G GSS with TDC Joints	SqM	250	240	240	240	970		
b.	1201mm to 1800mm - 22G GSS with TDC Joints	SqM	10	10	10	10	40		
c.	1801mm to 2100mm - 20G GSS with TDC Joints	SqM	-	-	-	-	0		
d.	above 2100mm - 18G GSS with TDC Joints	SqM	5	60	75	65	205		
3.2	**SITE FABRICATED DUCTING**								
	Supply, Fabrication, Installation and Testing of GS sheet metal (class VIII-120GSM Zinc Coaing) ducts complete with vanes, splitter dampers, hanging arrangement including check nuts in accordance with the approved shop drawings and specifications.								
	a. 0.63mm (24 gauge) GSS	SqM	30	30	30	30	120		
	b. 0.8 mm (22 gauge) GSS	SqM	5	10	10	10	35		
	c. 1.0mm (20 gauge) GSS	SqM	-	-	-	-	0		
3.3	**FLAT OVAL SPIRAL DUCT**								
	Supply, Installation and Testing of factory fabricated & factory internally insulated GSS (class VIII-120GSM Zinc Coaing) flat oval spiral ducting complete with vanes, splitter dampers, fire retardant gaskets hanging arrangement including fully threaded GI rods, GI straps and GI "C" channels/ rolled steel wires or Gripple Wire Rope Hangers & Supports complete with end fixing, GI "C" channels etc. as approved clients/consultants in accordance with the approved shop drawings and specifications. Quoted price shall be inclusive of necessary scaffolding charges towards installation of supply/exhaust air ducts outside or within building wherever required.								
	Insulation material shall be 9mm/13mm thick, food grade material, with antimicrobial properties, Class "O" closed cell elastomeric insulation material. **Adhesive should be Fire Retardant, LEED compliant and Low VOC.**								
	Contractor to involve OEM Expert team for erection of ductwork at site to ensure high quality workmanship of duct joints.								
	Without Powder Coated-With 9mm thick insulation								
a.	1mm to 1700mm -- 20G GSS	SqM	-	-	-	-	0		

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
3.4	**DUCO PAINT (For Flat Oval Exposed Duct)**								
	Supply and Application of minimum two coats of Duco Paint of colour and shade as approved by the Architects for exposed flat oval spiral/ round ducts. Quoted price shall be inclusive of primer before paint and all neceesary arrangement as required for providing the paint over duct. Paint to be applied using spray guns properly for uniform & smooth finish.	SqM	-	-	-	-	0		
3.5	**FLEXIBLE CANVASS CONNECTIONS**								
	Supply, Installation, Testing of 125mm deep antivibration flexible joints at the outlet of air handling units/ductable split units//inline fans. Flexible connections shall be constructed using imported fire retardant fabric with extruded aluminium frame/flange on both sides of approved make.	RM	9	55	75	65	204		
3.6	**LINEAR GRILLES**								
	Supply, Installation, Testing and Balancing of one way blow linear supply cum return air grilles complete with fixed core as per approved shop drawings and specifications. The grilles shall be of approved colour & shade.								
	Powder coated aluminium grilles of extruded sections with integral flanges on both sides & ends as required complete with corner pieces.								
	i. 100/150/200/250 mm/600mmx600mm Grilles	SqM	-	9	9	6	24		
3.7	**CURVED GRILLES**								
	Supply, Installation, Testing and Balancing of one way blow linear curved supply air grilles complete with fixed core as per approved shop drawings and specifications. The grilles shall be of approved colour & shade.								
	Powder coated aluminium grilles of extruded sections with integral flanges on both sides & ends as required complete with corner pieces.								
	i. 100/150/200/250 mm High grilles	SqM	-	-	-	-	0		
3.8	**DOUBLE LOUVERED GRILLES**								
	Supply, Installation, Testing and Balancing of double louvered supply air grilles as per approved shop drawings and specifications complete with key operated aluminium volume control dampers.								
	a. Powder coated extruded aluminiu grilles.	SqM	-	-	-	-	0		
3.9	**AIR TRANSFER GRILLES**								
	Supply, Installation and Testing of extruded aluminium powder coated air transfer grilles to be provided at the door of toilets/pantry.	SqM	-	-	-	-	0		
3.10	**ROUND DIFFUSERS**								
	Supply, Installation, Testing and Balancing of round supply air diffusers with removable key operated butterfly volume control dampers as per the approved shop drawings and specifications. The diffusers shall be anti-smudge flush type as approved by the interior designer. Diffuser shall be complete with GI cone with circular connection at the rear.								
	Powder coated extruded aluminium diffusers of approved colour & shade suitable for fixing in exposed duct or in grid/gypsum ceiling as per approved shop drawing.								
3.10.1	**With Volume Control Dampers**								
a.	300mm dia Neck Size round diffuser with GI cone	No	-	-	-	-	0		
b.	200mm dia Neck Size round diffuser with GI cone	No	-	-	-	-	0		
3.11	**SUPPLY AIR DIFFUSERS**								

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
3.11.1	Supply, Installation, Testing and Balancing of square supply air diffusers with removable key operated volume control dampers with opposed blades as per the approved shop drawings and specifications. The diffusers shall be anti-smudge ring type/flat type as approved by the interior designer. Diffusers shall be with removable core for the following neck sizes. The diffusers shall be suitable for fixing in the gypsum/grid ceiling. The diffusers shall be of regular type and with outer dimension of 600x600mm, 450 x 450mm, 375mmx375mm & 300mmx300mm.								
	Powder coated extruded aluminium diffusers of approved colour & shade.	SqM	0.5	0.5	0.5	0.5	2		
3.11.2	Supply, Installation, Testing and Balancing of square supply air diffusers with removable key operated volume control dampers with opposed blades & 150mm high GSS plenum as per the approved shop drawings and specifications.The diffusers shall be anti-smudge ring type/flat type as approved by the interior designer. Diffusers shall be with removable core for the following neck sizes. The diffusers shall be suitable for fixing in the gypsum/grid ceiling. The diffusers shall be of regular type and with outer dimension of 600 x 600mm.								
	600x600 Powder coated extruded aluminium diffusers of approved colour & shade suitable for fixing in grid ceiling.	No	20	2	3	2	27		
3.11.3	Supply, Installation, Testing and Balancing of square supply air diffusers with 150mm high GSS plenum with spiggot to facilitate round flexible duct connections as per the approved shop drawings and specifications.The diffusers shall be anti-smudge ring type/flat type as approved by the interior designer. Diffusers shall be with removable core for the following neck sizes. The diffusers shall be suitable for fixing in the gypsum/grid ceiling. The diffusers shall be of regular type and with outer dimension of 600 x 600mm.								
	600x600 Powder coated extruded aluminium diffusers of approved colour & shade suitable for fixing in grid ceiling.	No	0	10	25	18	53		
3.12	**RETURN AIR DIFFUSERS**								
3.12.1	Supply, Installation, Testing and Balancing of square return air diffusers same as supply air diffusers but without volume control dampers as per the approved shop drawings and specifications. The diffusers shall be anti - smudge ring type. Diffusers shall be independently hung from the slab through adjustable GI wires.								
	Powder coated extruded aluminium diffusers of approved colour & shade.	SqM	0.5	0.5	0.5	0.5	2		
3.12.2	Supply, Installation,Testing and Balancing of square return air diffusers same as supply air diffusers but without volume control dampers as per the approved shop drawings and specifications. The diffusers shall be anti - smudge ring /flat type. All Return air diffusers in false ceiling to be properly supported from real slab using chains or gripple wires.								
	600x600 Powder coated extruded aluminium diffusers of approved colour & shade suitable for fixing in grid ceiling.	No	0	10	22	20	52		
3.13	Supply, Installation, Testing and Balancing of linear slot diffusers as per the approved shop drawings and specifications. Each slot shall be 25mm wide. The diffuser face shall be a one piece extrusion so there are no visible joints. Slot diffusers shall be complete with end caps either as end plates or end angles or integral part, air control blades etc. Slot diffuser have a variable neck length and the diffuser face could be optionally be fitted to the plenum box on site. Diffuser shall have provision to access collar dampers for air balancing.								
	Sample & color of Diffusers to be got approved from Clients/Architects befor procurement.								

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
a.	3 slot/2slot, powder coated extruded aluminium diffusers of approved colour & shade.	SqM	7	16	15	16	54		
b.	3 slot/2slot, powder coated extruded aluminium diffusers of approved colour & shade for supply air with Hit & Miss type dampers	SqM	-	-	-	-	0		
3.14	Supply, Installation, Testing and Balancing of flexible ducting comprising of inner as well as outer skin constructed out of aluminium & fibre glass insulation 25mm thick of minimum 24 kg/cu.m density insulation sandwitched in between. Duct should confirm to fire rating standards BS-476 part 5, 6 & 7. Flexible Ducts of following sizes as per approved shop drawings, specifications : Universal (Jubilee) clamp should be provided to fix the flexible duct in the spigots/Butterfly Dampers and covered with aluminium tape. Circular clip with chain/GI threaded rod to be provided to support the flexible duct.								
a.	250 mm dia	RM	0	10	10	10	30		
b.	200 mm dia	RM	5	15	15	15	50		
c.	150 mm dia	RM	40	40	50	40	170		
3.15	Supply, Installation and Testing of single piece GI round spigot made out of spinning process with 50mm height and having grooves on both sides and circular flanges. Spigots shall be installed on main ducts to facilitate connection of flexible ducts.								
a.	250 mm dia	No	0	2	2	2	6		
b.	200 mm dia	No	10	25	10	10	55		
c.	150 mm dia	No	80	75	90	75	320		
3.16	Supply, Installation and Testing of Butterfly damper of GI sheet construction with two flap with round flange on one side and 10mm grove on other side for fixing of flexible duct with the help of band, 20 Gauge Frame 250mm dia & above, 22 Gauge Frame upto 200mm dia & 22 Gauge Blade in all sizes as per thespecifications and shop drawings.								
a.	250 mm dia	No	0	10	10	10	30		
b.	200 mm dia	No	2	5	5	5	17		
c.	150 mm dia	No	2	2	2	2	8		
3.17	Supply, Installation and Testing of GI box type volume control dampers as per the specifications and shop drawings. **- For Rectangular Ducts**	SqM	2.5	7	9	9	27.5		
3.18	Supply, Installation and Testing of GI box type volume control dampers as per the specificationsand shop drawings. **- For Flat Oval Ducts**	SqM	-	-	-	-	0		
3.19	Supply, Installation and Testing of Aluminium multi blade type louver dampers as per the specifications and shop drawings of approved colour & shade.	SqM	4	9	12	9	34		
3.20	Supply, Installation, Testing and Commissioning of motorised fire dampers suitable for at least 120 minutes fire rating as per the specifications and approved shop drawings. Quoted price shall be inclusive of copper control wiring & Power cabling as required.								
	Fire dampers shall be provided with 450 mm sleeves suitable for the wall mounting, (Sleeve Thickness -1.2mm)								
a.	Bare Fire Dampers	SqM	-	-	-	-	0		
b.	Spring return action type actuator complete with control panel and temperature sensor. Torque not less than 16NM	No	-	-	-	-	0		
3.21	Supply, Installation and Testing of Bird Screens with GI wire mesh to be installed at the suction of fresh air/discharge of Exhaust air as per the specifications and shop drawings. Sample of bird screen to be got approved from consultants and Clients prior to procurement.	SqM	0	0.25	0.25	0.25	0.75		

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
3.22	Supply, Installation and Testing of non return dampers. NRDs to be installed in the ducts as per the specifications and shop drawings. Sample of NRDs to be got approved from consultants and Clients prior to procurement.	SqM	0	5	6	5	16		
3.23	**SOUND ATTENUATORS**								
	Supply, Installation & Testing of approved makes sound attenuators for supply/return air ducts of following sizes. The sound attenuators shall be suitable for minimum 18dB reduction at 250Hz octave band.								
	Size (WxH in mm) Length (mm) Air Qty. (Cfm) Max. allowable pressure drop Location								
	1050x350 1200 4050 12mm Supply duct	No	1	-	-	-	1		
	700x350 1200 2577 12mm Return duct	No	1	-	-	-	1		
	500x400 1200 1923 12mm Return duct	No	1	-	-	-	1		
	TOTAL ITEM NO.3 (Ducting & Air Terminals)								

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
4.0	**INSULATION**								
4.1	**ACOUSTIC LINING OF DUCTS**								
4.1.1	**Using Open Cell Nitirile Rubber**								
	Supply and Application of internal acoustic lining of supply air ducting using open cell nitrile rubber insulation with density within 140-180 Kg/m3 as per the approved shop drawings and specifications. Insulation material shall be bonded with the ducts using metal screw and washers to facilitate grip to the GI sheet.								
a.	15mm thick lining	SqM	210	90	120	120	540		
4.2	**THERMAL INSULATION OF DUCTS**								
	(Using aluminium foil faced Class 'O' Fire Retardant Properties Closed Cell Elastomeric insulation)								
	Supply and Application of external thermal insulation of supply /return air ducting using factory laminated aluminium foil faced closed cell elastomeric nitrile rubber insulation with class 'O' fire retardant properties as per the specifications and drawings. Cladding shall provide protection from mechanical impact, and Scratches etc. Both insulation & cladding should have built in antimicrobial protection. Adhesive - AC Duct King Eco Fresh								
a.	9mm thick insulation	SqM	300	350	360	350	1360		
	TOTAL ITEM NO. 4 (INSULATION)								

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
5.0	**ELECTRICAL WORKS**								
5.1	**PANELS-For VRF System**	**Not in vendor's scope. Shall be covered in main electrical package through a separate tender.**							
	Supply, Installation, Testing and Commissioning of the following cubical type panels made out of 14 gauge CRCA structure, base channel, complete with, moulded case circuit breakers, meters, indicating lamps, current transformer etc. Complete in all respects, insulated bus bars with heat shrinkable PVC sleeve in suitable bus chambers, interconnection, small wiring, name plate, danger plate, earth bus etc. & comprising of compartments with hinged door for each feeder & its accessories, cable alley with hinged doors, bus chamber with bolted door etc. The panel being of dust & vermin proof construction with rubber gasket attractivel powder coating etc. The panel shall be free standing type / wall mounted type **having IP-65 Protection suitable for outdoor installation** as per relevant drawing and comprising with the following:								
	Notes :								
	1. All MCCBs shall be with operating handle.								
	2. CTs burden shall be 15VA & accuracy class 1.0								
	3. CTs shall be cast resin type.								
	4. All MCCBs shall be with thermal magnetic release.								
	5. All indication lights shall be LED type.								
	6. All meter shall be digital type.								
	7. The outgoing starter feeders shall be provided with push buttons & indicating lamps for status indication.								
	8. Proper isolation switches to be provided near units in weather proof enclosure.								
	9. Bimetal overload relay for all the starters shall have built-in single phasing prevention feature.								
	10. Electrical interlocking wiring shall be provided as per system requirement.								
	11. Power cabling/wiring with necessary earthing from source to each panel and each exhaust fan shall be provided by other agencies.								
	Note :								
i.	**Incoming power supply shall be provided by main electrical contractor/ electrical consultant at each VRF outdoor unit along with a TPN MCCB and earthing.**								
5.2	**CONTROL & TRANSMISSION WIRING**								
	Supply, laying, affecting connections and Testing of the following sizes of control cum transmission wiring to be laid in MS conduits between indoor units and outdoor units.								
	2C x1.5 Sqmm copper wiring	RM	450	510	600	590	2150		
5.3	**CONTROLLER WIRING**								
	Supply, laying, affecting connections and Testing of the following sizes of control cum transmission wiring to be laid in MS conduits between indoor units and their wired remotes.								
	2C x1.5 Sqmm copper wiring	RM	110	175	210	170	665		
5.4	**Panels-For AHUs**								

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
	Supply, Installation, Testing and Commissioning of the following cubical type panels made out of 14 guage CRCA structure, base channel, complete with, moulded case circuit breakers, meters, indicating lamps, current transformer etc. Complete in all respects, insulated bus bars with heat shrinkable PVC sleeve in suitable bus chambers, interconnection, small wiring, name plate, danger plate, earth bus etc. & comprising of compartments with hinged door for each feeder & its accessories, cable alley with hinged doors, bus chamber with bolted door etc. The panel being of dust & vermin proof construction with rubber gasket attractively powder coating etc. The panel shall be free standing type / wall mounted type as per relavant drawing and comprising with the following:								
	Notes :								
	1. All MCCBs shall be with operating handle.								
	2. CTs burden shall be 15VA & accuracy class 1.0								
	3. CTs shall be cast resin type .								
	4. All MCCBs shall be with thermal magnetic release.								
	5. All indication lights shall be LED type.								
	6. All meter shall be digital type.								
	7. The outgoing starter feeders for pumps,AHUS & ventilation fans shall be provided with push buttons & indicating lamps for status indication.								
	8. Proper isolation switches to be provided near air handling units and ventilation fans in weather proof enclosure.								
	9. Bimetal overload relay for all the starters shall have built-in single phasing prevention feature.								
	10. Electrical interlocking wiring shall be provided as per system requirement.								
	11. Power cabling/wiring with necessary earthing from source to each panel and each exhaust fan shall be provided by other agencies.								
	12. All HVAC equipment shall be compatible with BMS and necessary provisions to be made in each panel.								
5.4.1	**AHP-1 (Location: Near AHU)**								
	For AHU - 3.7KW each	No	1	-	-	-	1		
	(VFD Panel with Bypass Starter)								
	32 Amps ,TP MCCB -- 1set								
	(0-500) V digital Voltmeter with built in Selector								
	switch -- 1set								
	Digital Ammeter with built in selector								
	switch- 1set								
	Current Transformers - 1set								
	LED type RYB phase indication lights- 1set								
	LED type ON & OFF indication lights -- 1set								

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
	5.0HP DOL starter with built-in single phasing								
	preventor & overload relay & adjustable timer -- 1 set								
	START-STOP Push Buttons -- 1 set								
	Auto-Manual type selector switch								
	to facilitate auto start of AHUs -- 1set								
	VFD/By Pass Selector Switch-- 01Set								
	Space for VFD Mounting								
	Ventilation Fan for VFD-- 1Set								
	Contactors, Potential Free Contacts, Control wiring and								
	safety circuit as required with start-stop push buttons								
	stay put or lockable type -1set								
5.5	**CABLING**								
5.5.1	Supply, laying, affecting connections and Testing of the following sizes of 1.1 KV armoured PVC insulated aluminium/copper conductor cables. Cables shall be inclusive of all clamps, saddles, screws, cable identification tags, cable terminal joints including terminal lugs, insulating tapes, affecting terminal connections to the equipment as per the specifications and as required. Quoted price shall be inclusive of perforated duly painted 2mm thick MS trays and 8 SWG copper earth wire for AHUs.								
	All cables shall be FRLS type.								
a.	3 C x 4 Sqmm cable (Copper)	RM	-	-	-	-	0		
b.	3 C x 2.5 Sqmm cable (Copper)	RM	15	-	-	-	15		
c.	3 C x 2.5 Sqmm cable(Copper Control cabling)	RM	-	-	-	-	0		
d.	3 C x 1.5 Sqmm cable(Copper Control cabling)	RM	5	-	-	-	5		
e.	4 C x 1.5 Sqmm cable(Copper Control cabling)	RM	-	-	-	-	0		
5.6	Supply, Installation & Testing of TPN isolator in weather proof enclosure near AHU.	No	1	-	-	-	1		
5.7	Supply and fixing of 1.1 KV grade rubber mat 914.4 mm wide 6mm thick to withstand 1.1 KV dielectric strength in front of each panel.	RM				-	0		
	TOTAL ITEM NO. 5 (ELECTRICAL)								

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
	SECTION 'B' - DX TFA UNIT FOR FRESH AIR SUPPLY								
1.0	**EQUIPMENT**								
1.1	**VARIABLE REFRIGERANT VOLUME SYSTEM**								
	(HEAT PUMP)								
	Supply, Installation, Testing and Commissioning of Variable Refrigerant Volume type multi unit air-conditioning system complete with indoor and outdoor units with individual controller for cooling & heating application as per the specifications and drawings. The quoted price should include clearances charges, local taxes, freight etc. Quoted price shall also be inclusive of loading, unloading, lifting & shifting on outdoor location on Terrace at suitable locations as per drawing, positioning charges besides including charges towards structural steel supports, MS base frame duly painted & vibration isolation arrangement etc.								
1.1.1	**OUTDOOR UNITS- HEAT PUMPS**								
	Supply, Installation, Testing and Commissioning of air cooled variable refrigerant flow modular type Heat Pumps, each comprising of energy efficient multiple scroll compressors, full charge of R-410a refrigerant gas and all accessories as per the specifications. All compressors shall be inverter type. The condensing units shall be suitable to work on cooling as well as heating mode. The condensing units shall be suitable for operation on 415 ±10% volts, 50Hz, 3 phase AC power supply and complete with auto check function for connection error, auto address setting, etc. The outdoor units shall be low noise type. Quoted price shall be inclusive of Power Cable from MCCB to Outdoor unit & MS frame duly applied with 2 coat of primer & one coat of black enamel paint. The outdoor units shall be of following capacities :								
	Quoted price shall be inclusive of factory applied epoxy coating (to prevent erosion of tubes & fins) of Outdoor units.								
	VRV ODUs shall be capable of operating in follwing range : **i. For Cooling : (-)5degC to 50degC** **ii. For Heating : (-)20degC to 15.5degC**								
i	12HP nominal capacity high COP outdoor unit	No	1	-	-	-	1		
ii	10HP nominal capacity high COP outdoor unit	No	-	2	2	1	5		
iii	8HP nominal capacity high COP outdoor unit	No	1	-	-	1	2		
1.2	**DX TF AIR HANDLING UNITS (AHUs)**								
1.2.1	**Ceiling Suspended type TF AHUs - With Thermal Break Profile and Fresh air Intake Section**								
	Supply, Installation, Testing and Commissioning of DX double skin air handling units (AHUs) each comprising of following as per the specifications :								
a.	Casing of air handling units shall be in double skin construction. Inner skin shall be constructed out of 24 gauge plain GS sheet & outer skin in 24 gauge pre-plasticized GS sheet sandwitched between 50mm thick injected PU foam insulation of density not less than 40 Kg /CuM and complete with inspection doors including control wiring as required. AHUs shall have access for all parts. **AHUs shall be provided with thermal break profile and Fresh air Intake Section.**								

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
b.	Fan section complete with backward curved DIDW type centrifugal fan/s, IP-55, IE3, TEFC squirrel cage induction motor suitable to operate on 415±10%V, 50Hz, **spring type vibration isolators below Fans**, 3 phase AC power supply and belt drive package. Fan outlet velocity shall not be more than 1800 FPM (9.12MPS). **Fan section should be completed with 25mm thick Armasound acoustic insulation covered with perforated sheet**. All fans should be AMCA certified. Motors shall be VFD compatible.								
c.	Coil section with multirows deep DX cooling/heating coil of copper tube & copper header and aluminium fins construction having wall thickness of tubes not less than 0.5mm. Drain pan shall be made out of 18 gauge stainless steel duly insulated. Face velocity across cooling coil shall not exceed 500FPM.								
d.	Pre-Filter (EU-4) section complete with 50mm thick washable synthetic fibre filters. Velocity across the filters shall not exceed 500 FPM.								
e.	Fine filter section complete with fine filters. Velocity across fine filters shall not exceed 500FPM. Filters shall have efficiency not less than 95% down to 1 Microns (EU-8/MERV-14).								
f.	Single stage Chemical filter with Media being manufactured specifically for the removal of the all harmful gases composed of carbon, alumina, Bi-carbonates, Hydroxyls, VOC gases with other binders, duly impregnated with activated catalysts. The air moment across filters shall be turbulent type to increase the contact area & contact time with filter media. Scope of harmful gas removal shall include but shall not be limited to H2s, SO2, NO2 & Cl2. Filters shall be capable of removing all harmful gases present in local air.								
	The Media shall perform effectively under wide range. Temperature: -4° F to 125° F Humidity: 10 - 95% RH								
	Media shall be designed for 99.5% min. removal efficiency. The used filters should be disposable as per the local, state or govt guidelines.								
g.	Semi HEPA (MERV-16) filter section complete with 300mm thick HEPA filters. Velocity across HEPA filters shall not exceed 450FPM. Filters shall have efficiency not less than 97% down to 0.3 microns.								
h.	Fresh Air Intake Section complete with FA dampers in extruded aluminium construction.								
i.	AHUs shall be complete with suspension arrangement, it shall also include spring type vibration isolators and rubber groomets etc. to make the installation totally vibration free.								
j.	Multiblade box type zero leakage manually operated extruded aluminium volume control dampers shall be factory fitted at outlet of each AHU.								
k.	In addition to the above, air handling units shall be provided with fire retardant flexible canvass connections made out of canvass sleeve. Sizes of air handling units shall not exceed as mentioned in the design drawings and air handling units shall conform to the design parameters mentioned in specifications.								
	The Air Handling Units (AHUs) shall be of following duty parameters :								

AHU No	Capacity (Cfm/TR)	S.P (mmWG)	Motor Rating (HP)	Rows of coil	Area to be fed							
TFA-1	1500/9.6	110	1.5	6	Office Spaces	No	1	-	-	-	1	
TFA-2	1000/8.0	110	1.5	6	Office Spaces	No	-	2	2	1	5	
TFA-3	750/6.4	110	1.5	6	Office Spaces	No	1	-	-	1	2	

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
1.3	**KIT FOR AHUs**								
	Supply, Installation, Testing and Commissioning of VRF Kits for AHUs having all controllers & Electonic Expansion Valve (EEV) and temperature set arrangment. It Shall have cut off arrangement after a particular set value of Supply air Temperature. Price should include all control cabling etc. and all necessary arrangements whether mentioned or not to make the system working.								
i.	For 12HP	No	1	-	-	-	1		
ii.	For 10HP	No	-	2	2	1	5		
iii	For 8HP	No	1	-	-	1	2		
1.4	**VARIABLE FREQUENCY DRIVES**								
	Supply, Installation, Testing and Commissioning of variable frequency drives for following Air Handling Units. Variable frequency drives shall be provided with necessary sensors and transmitters complete with control wiring in all respect as required and as per specifications. VFDs shall have built-in harmonic filters. The drives shall be suitable for the following motor rating. VFDs shall be housed in precoated, vandal proof enclosure with On/Off Push Buttons, Phase indication lights, A/M Switch and with adequate provisions for ventilation using a fan. The VFDs shall be able to receive the signals from Temp. sensors and to ramp the speed of the motor. Quoted price shall be inclusive of return air temperature sensor and necessary electrical switches including change over switch & copper cabling for integration with the AHU panel. VFDs shall be installed within Electrical panels as described under Section 'Electrical Works'. Overall protection of VFDs with Panels shall be IP-54.								
	(i) Sensing Range : 10mm to 50 mm WG								
	(ii) Output Signal : 4 mA to 20 mA								
	OR								
	0 V to 10 V DC								
	AHU No Capacity (Cfm) Motor Rating (HP) Area to be fed								
	AH-1 1.5/1.0 Office Area	No	2	2	2	2	8		
	TOTAL ITEM NO. 1 (EQUIPMENT)								

S. NO	ITEM DESCRIPTION		UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
2.0	**PIPING**									
2.1	**COPPER REFRIGERANT PIPING**									
	Supply, Installation, Testing & Commissioning of high pressure copper refrigerant piping including R410a refrigerant of suitable size as required and duly insulated with 19mm/13mm thick closed cell elastomeric insulation with class 'O' fire retardant properties with IC Cladding in tubing form. Entire refrigerant piping work shall be carried out in accordance with the specifications. MS sleeves of requisite size shall be provided at wall crossing. Quoted price shall be inclusive of necessary glass cloth and minimum two layers of UV protection paint to be applied over insulation for all exposed pipes of approved make. Piping shall be of following sizes :									
	Internal Refrigerant piping in exposed ceiling area & external refrigerant piping shall be laid on Powder coated Perforated type cable trays. Cable trays used for external refrigerant piping shall be covered with GI cover.									
	Pipe Size	**Thickness of CSE**								
	(O.D.)	**Insulation**								
a.	28.6 mm	19 mm	RM	40	-	-	-	40		
b.	25.4 mm	19 mm	RM	-	-	-	-	0		
c.	22.2 mm	19 mm	RM	-	60	55	25	140		
d.	19.1 mm	13 mm	RM	40	-	-	25	65		
e.	15.9 mm	13 mm	RM	-	-	-	-	0		
f	12.7 mm	13 mm	RM	40	-	-	-	40		
g	9.5 mm	13 mm	RM	40	60	55	50	205		
2.2	**CONDENSATE DRAIN PIPING -cPVC**									
	Supply, Installation, Testing and Commissioning of cPVC pipes cut to required lengths and installed for condensate drain. Quoted price shall be inclusive of supply and fixing in position the necessary fittings like elbows, tees reducers etc., and supporting arrangement in accordance with the approved shop drawings and specifications. Pipes shall be insulated with 9mm thick closed cell elastomeric insulation with class 'O' fire retardant properties in tubing form. Pipes shall be of following sizes :									
a.	32mm dia		RM	10	10	10	10	40		
	TOTAL ITEM NO. 2 (PIPING)									

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
3.0	**DUCTWORK/AIR TERMINALS**								
3.1	**FACTORY FABRICATED DUCTING**								
	Supply, Installation and Testing of factory fabricated GSS (class VIII-120GSM Zinc Coaing) ducting complete with vanes, splitter dampers, fire retardant gaskets hanging arrangement including fully threaded GI rods and GI "C" channels/ rolled steel wires or Gripple Wire Rope Hangers & Supports complete with end fixing, GI "C" channels etc. as approved by clients/consultants in accordance with the approved shop drawings and specifications. Quoted price shall be inclusive of necessary scaffolding charges towards installation of supply/exhaust air ducts outside or within building wherever required. Quoted price should also include necessary charges towards duct supports including MS angle/channel arrangement as required for ducts being installed outside or within building wherever required. **Ducting to be brought in Box form at site.**								
	Spacing between duct supports should not exceed 2m in both cases i.e GI rods with GI "C" channels & Gripple Wire Rope Hanger support. In case of Gripple Wire Rope Hanger support for duct sizes above 1800mm, MS angles duly painted with black enamel paint should be used along with neoprene pad in between the duct & MS angle. All duct support to be provided with check nuts (lock nuts).								
	While selecting the duct supports vendor shall ensure vibration free installation. Quoted price shall be inclusive of light test or smoke test. Necessary arrangement for testing to be made by HVAC Vendor.								
a.	upto 1200mm -- 24G GSS with TDC Joints	SqM	70	95	90	90	345		
b.	1201mm to 1800mm - 22G GSS with TDC Joints	SqM	5	5	5	10	25		
c.	1801mm to 2100mm - 20G GSS with TDC Joints	SqM	-	-	-	-	0		
d.	above 2100mm - 18G GSS with TDC Joints	SqM	-	-	-	-	0		
3.2	**SITE FABRICATED DUCTING**								
	Supply, Fabrication, Installation and Testing of GS sheet metal (class VIII-120GSM Zinc Coaing) ducts complete with vanes, splitter dampers, hanging arrangement including check nuts in accordance with the approved shop drawings and specifications.								
	a. 0.63mm (24 gauge) GSS	SqM	10	10	10	10	40		
	b. 0.8 mm (22 gauge) GSS	SqM	5	5	5	5	20		
	c. 1.0mm (20 gauge) GSS	SqM	-	-	-	-	0		
3.3	**FLEXIBLE CANVASS CONNECTIONS**								
	Supply, Installation, Testing of 125mm deep antivibration flexible joints at the outlet of air handling units/ductable split units//inline fans. Flexible connections shall be constructed using imported fire retardant fabric with extruded aluminium frame/flange on both sides of approved make.	RM	6	6	6	6	24		
3.4	**LINEAR GRILLES**								
	Supply, Installation, Testing and Balancing of one way blow linear supply cum return air grilles complete with fixed core as per approved shop drawings and specifications. The grilles shall be of approved colour & shade.								
	Powder coated aluminium grilles of extruded sections with integral flanges on both sides & ends as required complete with corner pieces.								
	i. 100/150/200/250 mm/600mmx600mm Grilles	SqM	1	0.5	0.5	0.5	2.5		
3.5	**SUPPLY AIR DIFFUSERS**								

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
3.5.1	Supply, Installation, Testing and Balancing of square supply air diffusers with removable key operated volume control dampers with opposed blades as per the approved shop drawings and specifications. The diffusers shall be anti-smudge ring type/flat type as approved by the interior designer. Diffusers shall be with removable core for the following neck sizes. The diffusers shall be suitable for fixing in the gypsum/grid ceiling. The diffusers shall be of regular type and with outer dimension of 600x600mm, 450 x 450mm, 375mmx375mm & 300mmx300mm.								
	Powder coated extruded aluminium diffusers of approved colour & shade.	SqM	-	-	-	-	0		
3.5.2	Supply, Installation, Testing and Balancing of square supply air diffusers with removable key operated volume control dampers with opposed blades & 150mm high GSS plenum as per the approved shop drawings and specifications.The diffusers shall be anti-smudge ring type/flat type as approved by the interior designer. Diffusers shall be with removable core for the following neck sizes. The diffusers shall be suitable for fixing in the gypsum/grid ceiling. The diffusers shall be of regular type and with outer dimension of 600 x 600mm.								
	600x600 Powder coated extruded aluminium diffusers of approved colour & shade suitable for fixing in grid ceiling.	No	3	1	1	1	6		
3.5.3	Supply, Installation, Testing and Balancing of square supply air diffusers with 150mm high GSS plenum with spiggot to facilitate round flexible duct connections as per the approved shop drawings and specifications.The diffusers shall be anti-smudge ring type/flat type as approved by the interior designer. Diffusers shall be with removable core for the following neck sizes. The diffusers shall be suitable for fixing in the gypsum/grid ceiling. The diffusers shall be of regular type and with outer dimension of 600 x 600mm.								
	600x600 Powder coated extruded aluminium diffusers of approved colour & shade suitable for fixing in grid ceiling.	No	0	1	1	1	3		
3.6	Supply, Installation and Testing of GI box type volume control dampers as per the specifications and shop drawings. **- For Rectangular Ducts**	SqM	1	2	2	2	7		
3.7	Supply, Installation and Testing of Aluminium multi blade type louver dampers as per the specifications and shop drawings of approved colour & shade.	SqM	1	2	2	2	7		
3.8	Supply, Installation and Testing of fresh air grilles of powder coated / anodised extruded aluminium with GI wire mesh, inlet louvers, Box type VCD & bird screen, as per the approved shop drawings and specifications.	SqM	0.5	0.5	0.5	0.5	2		
	TOTAL ITEM NO.3 (Ducting & Air Terminals)								

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
4.0	**INSULATION**								
4.1	**ACOUSTIC LINING OF DUCTS**								
4.1.1	**Using Open Cell Nitirile Rubber**								
	Supply and Application of internal acoustic lining of supply air ducting using open cell nitrile rubber insulation with density within 140-180 Kg/m3 as per the approved shop drawings and specifications. Insulation material shall be bonded with the ducts using metal screw and washers to facilitate grip to the GI sheet.								
a.	15mm thick lining	SqM	10	10	10	10	40		
4.2	**THERMAL INSULATION OF DUCTS**								
	(Using aluminium foil faced Class 'O' Fire Retardant Properties Closed Cell Elastomeric insulation)								
	Supply and Application of external thermal insulation of supply /return air ducting using factory laminated aluminium foil faced closed cell elastomeric nitrile rubber insulation with class 'O' fire retardant properties as per the specifications and drawings. Cladding shall provide protection from mechanical impact, and Scratches etc. Both insulation & cladding should have built in antimicrobial protection. Adhesive - AC Duct King Eco Fresh								
a.	13mm thick insulation	SqM	90	110	110	105	415		
	TOTAL ITEM NO. 4 (INSULATION)								

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
5.0	**ELECTRICAL WORKS**								
5.1	**PANELS-For VRF System**	**Not in vendor's scope. Shall be covered in main electrical package through a separate tender.**							
	Supply, Installation, Testing and Commissioning of the following cubical type panels made out of 14 gauge CRCA structure, base channel, complete with, moulded case circuit breakers, meters, indicating lamps, current transformer etc. Complete in all respects, insulated bus bars with heat shrinkable PVC sleeve in suitable bus chambers, interconnection, small wiring, name plate, danger plate, earth bus etc. & comprising of compartments with hinged door for each feeder & its accessories, cable alley with hinged doors, bus chamber with bolted door etc. The panel being of dust & vermin proof construction with rubber gasket attractively powder coating etc. The panel shall be free standing type / wall mounted type **having IP54 Protection for Indoor Installation and IP-65 Protection for outdoor installation** as per relevant drawing and comprising with the following:								
	1. All MCCBs shall be with operating handle.								
	2. CTs burden shall be 15VA & accuracy class 1.0								
	3. CTs shall be cast resin type .								
	4. All MCCBs shall be with thermal magnetic release.								
	5. All indication lights shall be LED type.								
	6. All meter shall be digital type.								
	7. The outgoing starter feeders for pumps, AHUs & ventilation fans shall be provided with push buttons & indicating lamps for status indication.								
	8. Proper isolation switches to be provided near air handling units and ventilation fans in weather proof enclosure.								
	9. Bimetal overload relay for all the starters shall have built-in single phasing prevention feature.								
	10. Electrical interlocking wiring shall be provided as per system requirement.								
	11. Power cabling/wiring with necessary earthing from source to each panel and each exhaust fan shall be provided by other agencies.								
	Note :								
i.	**Incoming power supply shall be provided by main**								
	electrical contractor/electrical consultant at each VRF								
	outdoor unit along with a TPN MCCB and earthing.								
5.2	**CONTROL & TRANSMISSION WIRING**								
	Supply, laying, affecting connections and Testing of the following sizes of control cum transmission wiring to be laid in MS conduits between indoor units and outdoor units.								
	2C x1.5 Sqmm copper wiring	RM	95	75	70	65	305		

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
5.3	**Panels-For AHUs**								
	Supply, Installation, Testing and Commissioning of the following cubical type panels made out of 14 guage CRCA structure, base channel, complete with, moulded case circuit breakers, meters, indicating lamps, current transformer etc. Complete in all respects, insulated bus bars with heat shrinkable PVC sleeve in suitable bus chambers, interconnection, small wiring, name plate, danger plate, earth bus etc. & comprising of compartments with hinged door for each feeder & its accessories, cable alley with hinged doors, bus chamber with bolted door etc. The panel being of dust & vermin proof construction with rubber gasket attractively powder coating etc. The panel shall be free standing type / wall mounted type as per relavant drawing and comprising with the following:								
	Notes :								
	1. All MCCBs shall be with operating handle.								
	2. CTs burden shall be 15VA & accuracy class 1.0								
	3. CTs shall be cast resin type .								
	4. All MCCBs shall be with thermal magnetic release.								
	5. All indication lights shall be LED type.								
	6. All meter shall be digital type.								
	7. The outgoing starter feeders for pumps,AHUS & ventilation fans shall be provided with push buttons & indicating lamps for status indication.								
	8. Proper isolation switches to be provided near air handling units and ventilation fans in weather proof enclosure.								
	9. Bimetal overload relay for all the starters shall have built-in single phasing prevention feature.								
	10. Electrical interlocking wiring shall be provided as per system requirement.								
	11. Power cabling/wiring with necessary earthing from source to each panel and each exhaust fan shall be provided by other agencies.								
	12. All HVAC equipment shall be compatible with BMS and necessary provisions to be made in each panel.								
5.3.1	**AHP-1 (Location: Near AHU)**								
	For TFA units - 1.1/0.75KW each	No	2	2	2	2	8		
	(VFD Panel with Bypass Starter)								

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
	25 Amps ,TP MCCB -- 1set								
	(0-500) V digital Voltmeter with built in Selector								
	switch -- 1set								
	Digital Ammeter with built in selector								
	switch- 1set								
	Current Transformers - 1set								
	LED type RYB phase indication lights- 1set								
	LED type ON & OFF indication lights -- 1set								
	1.5HP / 1.0HP DOL starter with built-in single phasing								
	preventor & overload relay & adjustable timer -- 1 set								
	START-STOP Push Buttons -- 1 set								
	Auto-Manual type selector switch								
	to facilitate auto start of AHUs -- 1set								
	VFD/By Pass Selector Switch-- 01Set								
	Space for VFD Mounting								
	Ventilation Fan for VFD-- 1Set								
	Contactors, Potential Free Contacts, Control wiring and								
	safety circuit as required with start-stop push buttons								
	stay put or lockable type -1set								
5.4	**CABLING**								
5.4.1	Supply, laying, affecting connections and Testing of the following sizes of 1.1 KV armoured PVC insulated aluminium/copper conductor cables. Cables shall be inclusive of all clamps, saddles, screws, cable identification tags, cable terminal joints including terminal lugs, insulating tapes, affecting terminal connections to the equipment as per the specifications and as required. Quoted price shall be inclusive of perforated duly painted 2mm thick MS trays and 8 SWG copper earth wire for AHUs.								
	All cables shall be FRLS type.								
a.	3 C x 4 Sqmm cable (Copper)	RM	-	-	-	-	0		
b.	3 C x 2.5 Sqmm cable (Copper)	RM	20	20	20	20	80		
c.	3 C x 2.5 Sqmm cable(Copper Control cabling)	RM	-	-	-	-	0		
d.	3 C x 1.5 Sqmm cable(Copper Control cabling)	RM	5	5	5	5	20		
e.	4 C x 1.5 Sqmm cable(Copper Control cabling)	RM	-	-	-	-	0		
5.5	Supply, Installation & Testing of TPN isolator in weather proof enclosure near AHU.	No	2	2	2	2	8		
5.6	Supply and fixing of 1.1 KV grade rubber mat 914.4 mm wide 6mm thick to withstand 1.1 KV dielectric strength in front of each panel.	RM				-	0		
	TOTAL ITEM NO. 5 (ELECTRICAL)								

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
	SECTION 'C' - VRV SYSTEM FOR BACK-UP AIR CONDITIONING								
1.0	**EQUIPMENT**								
1.1	**VARIABLE REFRIGERANT VOLUME SYSTEM**								
	(HEAT PUMP)								
	Supply, Installation, Testing and Commissioning of Variable Refrigerant Volume type multi unit air-conditioning system complete with indoor and outdoor units with individual controller for cooling & heating application as per the specifications and drawings. The quoted price should include clearances charges, local taxes, freight etc. Quoted price shall also be inclusive of loading, unloading, lifting & shifting on outdoor location on Terrace at suitable locations as per drawing, positioning charges besides including charges towards structural steel supports, MS base frame duly painted & vibration isolation arrangement etc.								
1.1.1	**OUTDOOR UNITS- HEAT PUMPS**								
	Supply, Installation, Testing and Commissioning of air cooled variable refrigerant flow modular type Heat Pumps, each comprising of energy efficient multiple scroll compressors, full charge of R-410a refrigerant gas and all accessories as per the specifications. All compressors shall be inverter type. The condensing units shall be suitable to work on cooling as well as heating mode. The condensing units shall be suitable for operation on 415 ±10% volts, 50Hz, 3 phase AC power supply and complete with auto check function for connection error, auto address setting, etc. The outdoor units shall be low noise type. Quoted price shall be inclusive of Power Cable from MCCB to Outdoor unit & MS frame duly applied with 2 coat of primer & one coat of black enamel paint. The outdoor units shall be of following capacities :								
	Quoted price shall be inclusive of factory applied epoxy coating (to prevent erosion of tubes & fins) of Outdoor units.								
	VRV ODUs shall be capable of operating in follwing range : **i. For Cooling : (-)5degC to 50degC** **ii. For Heating : (-)20degC to 15.5degC**								
i	20HP nominal capacity high COP outdoor unit	No	-	-	-	-	0		
ii	18HP nominal capacity high COP outdoor unit	No	1	1	-	1	3		
iii	16HP nominal capacity high COP outdoor unit	No	-	-	2	-	2		
iv	14HP nominal capacity high COP outdoor unit	No	-	-	-	1	1		
v	12HP nominal capacity high COP outdoor unit	No	-	-	-	-	0		
vi	10HP nominal capacity high COP outdoor unit	No	1	1	-	-	2		
vii.	8HP nominal capacity high COP outdoor unit	No	-	-	-	-	0		

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
1.1.2	**INDOOR UNITS**								
	Supply, Installation, Testing and Commissioning of variable refrigerant volume modular type indoor units comprising of EEV & all accessories as per the specifications. The indoor units shall be suitable to work on cooling as well as heating mode. The indoor units shall be suitable for operation on 220±6% volts, 50Hz, 1 phase AC power supply except floor standing units suitable for operation on 415±10% volts, 50Hz, 3 phase AC power supply. Ductable indoor units shall be suitable to handle extent of ductwork as shown in the design drawings and dehumidified air quantity as mentioned in the heat load summary sheet under "Special Conditions" and the indoor units shall be of following capacities. **All Indoor Units shall have inbuilt Drain Pumps.** **Price shall be inclusive of Decorative Panels for Cassette units.** Quoted price shall be inclusive of Plug Top & necessary power cable.								
i.	2290Cfm Ductable Type (6.4 TR)	No.	-	-	-	-	0		
ii.	1620Cfm Ductable Type (4.6 TR)	No.	6	6	-	4	16		
iii.	1375Cfm Ductable Type (4.0 TR)	No.	-	-	8	3	11		
iv	1130Cfm Ductable Type (3.2 TR)	No.	-	-	-	-	0		
1.2	**REMOTE CONTROLS**								
i	Supply of Cordless handset type remote controls for the above indoor units.	No	-	-	-	-	0		
ii	Supply of Corded remote controls for the above indoor units.	No	6	6	8	7	27		
	TOTAL ITEM NO. 1 (EQUIPMENT)								

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
2.0	**PIPING**								
2.1	**COPPER REFRIGERANT PIPING**								
	Supply, Installation, Testing & Commissioning of high pressure copper refrigerant piping including R410a refrigerant of suitable size as required and duly insulated with 19mm/13mm thick closed cell elastomeric insulation with class 'O' fire retardant properties with IC Cladding in tubing form. Entire refrigerant piping work shall be carried out in accordance with the specifications. MS sleeves of requisite size shall be provided at wall crossing. Quoted price shall be inclusive of necessary glass cloth and minimum two layers of UV protection paint to be applied over insulation for all exposed pipes of approved make. Piping shall be of following sizes :								
	Internal Refrigerant piping in exposed ceiling area & external refrigerant piping shall be laid on Powder coated Perforated type cable trays. Cable trays used for external refrigerant piping shall be covered with GI cover.								
	Pipe Size Thickness of CSE								
	(O.D.) Insulation								
a.	31.8 mm 19 mm	RM	-	-	-	-	0		
b.	28.6 mm 19 mm	RM	45	45	85	86	261		
c.	25.4 mm 19 mm	RM	-	-	-	-	0		
d.	22.2 mm 19 mm	RM	45	45	20	21	131		
e.	19.1 mm 13 mm	RM	-	-	-	-	0		
f.	15.9 mm 13 mm	RM	120	120	100	100	440		
g.	12.7 mm 13 mm	RM	-	-	90	90	180		
h.	9.5 mm 13 mm	RM	120	120	120	120	480		
i.	6.4 mm 13 mm	RM	-	-	-	-	0		
2.2	**FITTINGS**								
	Supply, Installation, Testing & Commissioning of following imported copper fittings to be provided in refrigerant pipe line.								
a.	Refnet Joints (Y- Joints)	No	4	4	6	5	19		
b.	Refnet Headers	No	-	-	-	-	0		
2.3	**CONDENSATE DRAIN PIPING -cPVC**								
	Supply, Installation, Testing and Commissioning of cPVC pipes cut to required lengths and installed for condensate drain. Quoted price shall be inclusive of supply and fixing in position the necessary fittings like elbows, tees reducers etc., and supporting arrangement in accordance with the approved shop drawings and specifications. Pipes shall be insulated with 9mm thick closed cell elastomeric insulation with aluminium foil & class 'O' fire retardant properties in tubing form. Pipes shall be of following sizes								
a.	40mm dia	RM	10	10	15	15	50		
b.	32mm dia	RM	20	20	25	20	85		
c.	25mm dia	RM	30	30	40	35	135		
	TOTAL ITEM NO. 2 (PIPING)								

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
3.0	**ELECTRICAL WORKS**								
3.1	**PANELS-For VRV System**	**Shall be covered in main electrical package**							
	Supply, Installation, Testing and Commissioning of the following cubical type panels made out of 14 gauge CRCA structure, base channel, complete with, moulded case circuit breakers, meters, indicating lamps, current transformer etc. Complete in all respects, insulated bus bars with heat shrinkable PVC sleeve in suitable bus chambers, interconnection, small wiring, name plate, danger plate, earth bus etc. & comprising of compartments with hinged door for each feeder & its accessories, cable alley with hinged doors, bus chamber with bolted door etc. The panel being of dust & vermin proof construction with rubber gasket attractively powder coating etc. The panel shall be free standing type / wall mounted type **having IP-65 Protection suitable for outdoor installation** as per relevant drawing and comprising with the following:								
	Notes :								
	1. All MCCBs shall be with operating handle.								
	2. CTs burden shall be 15VA & accuracy class 1.0								
	3. CTs shall be cast resin type .								
	4. All MCCBs shall be with thermal magnetic release.								
	5. All indication lights shall be LED type.								
	6. All meter shall be digital type.								
	7. The outgoing starter feeders for pumps, AHUS & ventilation fans shall be provided with push buttons & indicating lamps for status indication.								
	8. Proper isolation switches to be provided near air handling units and ventilation fans in weather proof enclosure.								
	9. Bimetal overload relay for all the starters shall have built-in single phasing prevention feature.								
	10. Electrical interlocking wiring shall be provided as per system requirement.								
	11. Power cabling/wiring with necessary earthing from source to each panel and each exhaust fan shall be provided by other agencies.								
	Note :								
i.	**Incoming power supply shall be provided by main electrical contractor/electrical consultant at each VRV outdoor unit along with a TPN MCCB and earthing.**								
3.2	**CONTROL & TRANSMISSION WIRING**								
	Supply, laying, affecting connections and Testing of the following sizes of control cum transmission wiring to be laid in MS conduits between indoor units and outdoor units.								
	2C x1.5 Sqmm copper wiring	RM	200	200	250	250	900		

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
3.3	**CONTROLLER WIRING**								
	Supply, laying, affecting connections and Testing of the following sizes of control cum transmission wiring to be laid in MS conduits between indoor units and their wired remotes.								
	2C x1.5 Sqmm copper wiring	RM	60	60	80	70	270		
	TOTAL ITEM NO. 3 (ELECTRICAL)								

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
	SECTION 'D' - UNDERDECK INSULATION								
1.0	**UNDERDECK INSULATION WITH IC CLADDING**								
	Supply and Application of 19mm thick Class 'O' closed cell nitrile rubber elastomeric insulation factory laminated with IC cladding for ceiling/ exposed roof towards underdeck insulation. Quoted price shall be inclusive of Low VOC adhesive as required and as per the specifications. Metal screws shall be fixed with dash fasteners at centre & Corners of each piece of insulation with a GI cleat at bottom to give extra precaution in fixing of insulation. Adhesive based tapes shall be applied on all longitudinal and transverse joints. IC cladding shall provide protection from mechanical impact, ultra voilet radiations and Scratches etc. caldding shall not have any fibre erosion. Both insulation & cladding should have built in antimicrobial protection. Color of IC cladding shall be as per Architect's approval.	SqM	-	-	-	650	650		
	TOTAL								

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
	SECTION 'E' - INDOOR AIR PURIFICATION ARRANGEMENT								
1.0	**INDOOR AIR PURIFYING IONISERS**								
	(Bi Polar Plasma Ionnisers)								
	Supply, Installation, Testing & Commissioning of Bi Polar Plasma Ionisers cell comprising of quad metallic compound target/ hydrated cataytic matrix cell duly enclosed by a poly casing tube, with the capability to produce friendly oxidizers like ionized hydroxyls, hydrogen peroxide, Super Oxide Ions. The tube should be duly encased in poly tube to prevent glass or mercury leakage into the atmosphere. The cell will have built in fiber optic device as remote indication of this operation.								
	The unit shall have inbuilt multipin ion generator along with ultrasonic radio frequency waves for pest repellancy. System should be suitable for all types of indoor units Ductable ac, Cassette AC & Hi-wall units. The cells shall be installed as required to fit in the plenum, duct at the AHU in the supply air stream.								
	The system shall be capable of reducing microbial bacteria, virus and spores, VoC', odors and particulates matter. The equipment shall conform to UL, TUV, CSA EU,CE, FDA, ISO, RoHS & CCMB Report standards, certifications as applicable and shall be submitted along with the technical submital. System should kill /deactivate microorganism and shall have proven effectiveness on COVID-19 human strain and its surrogate through Certified National/International lab. **Units shall be UL2998 certified for Zero Ozone.**								
	The power / control cabling between the ioniser units and the power source / controls shall be included in the cost. The ionizers should be selected by considering a load factor calculation for each specific area where the equipment is to be installed. Length selection should be per duct piece in which is to be installed. Detailed selection chart to be furnished indicating the model number for each unit. Cells Should be complete with Transformers, control cabling and Plug Top & necessary power cable.								
	Ionizers shal be suitable for following Equipment								
	Total Nos. of ionisers shall be as per air quantity distributed in individual duct drawn from units in Drawing.								
i.	2830Cfm Ductable Type (8.0 TR)	No.	-	-	-	-	0		
ii.	2290Cfm Ductable Type (6.4 TR)	No.	1	1	1	1	4		
iii.	1620Cfm Ductable Type (4.6 TR)	No.	18	18	-	12	48		
iv	1375Cfm Ductable Type (4.0 TR)	No.	-	-	24	9	33		
v	1130Cfm Ductable Type (3.2 TR)	No.	-	-	-	-	0		
vi.	740Cfm Cassette Type (2.0TR) - Round Flow	No.	-	-	-	-	0		
vii.	530Cfm Cassette Type (1.3TR) - Round Flow	No.	-	-	1	-	1		
viii.	400Cfm Cassette Type (1.0TR) - Round Flow	No.	-	-	1	-	1		
ix.	495Cfm Cassette Type (1.6TR) - Compact Flow	No.	-	-	-	-	0		
x.	670Cfm Hi Wall Type (2.0TR)	No.	1	1	2	2	6		
xi.	450Cfm Hi Wall Type (1.3TR)	No.	1	1	-	-	2		
2.0	**INDOOR AIR QUALITY MONITOR**								

S. NO	ITEM DESCRIPTION	UNIT	QTY- GF	QTY- 1F	QTY- 2F	QTY- 3F	TOTAL QTY.	UNIT LANDED RATE (Rs)	TOTAL LANDED COST (Rs)
	Supply, Installation, Testing & commissioning of IAQ Monitor to measure the levels of PM 2.5, VOCs, CO2, Temperature, Humidity on a real time basis. The IAQ Monitor shall be RS485 enabled and should be capable of getting connected with Wi-Fi. Units should have dedicated data browse i.e. sim card etc. The Monitor should be capable of sending the indoor air quality information on display Screen/Mobile/Workstation as per Client's requirement. The Monitor should indicate the quality of air through changing the colours as per the NAAQS standards and should meet the WELL building standards. Quoted price shall be inclusive of all necessary arrangement as required to make the unit proper functional. (LED Screen not included.)	Nos.	2	2	2	2	8		
	TOTAL								
SECTION 'F' - DISMANTLING & TRANSPORTATION OF EXISTING INSTALLATION									
1.0	Dismantling of existing Installation and transportation of dismantled items at BYPL storage yard. Vendor to do the site visit to review the Existing Installation.	Lot	-	-	-	-	1		
	TOTAL								