



AROR UNIVERSITY
OF ART, ARCHITECTURE,
DESIGN & HERITAGE,
SUKKUR, SINDH

[TENDER DOCUMENTS]

JUNE 2024.

DOCUMENTS TYPE

**HVAC SYSTEM FOR
AUDITORIUM AREA AROR
UNIVERSITY OF ART &
HERITAGE SUKKUR SINDH.**

PROJECT NO- AR(AD)-2024-21

M&P CONSULTANT.



**N.Z ENGINEERING
M&P CONSULTANT**

ARCHITECT.

M/s HABIB FIDA ALI.

HVAC SYSTEM WORKS		
1	SECTION-01	SPECIMEN GUARANTEES
2	SECTION-02	INSTRUCTIONS TO TENDERERS AND TERMS & CONDITIONS
3	SECTION-03	TERMS OF PAYMENT.
4	SECTION-04	EVALUATION CRITERIA
5	SECTION-05	SPECIAL CONDATION OF CONTRACT
6	SECTION-06	SPECIFICATION OF HVAC WORKS
7	SECTION-07	BILL OF QUANTITY
8	SECTION-08	COMPLETE TENDER DRAWINGS

SECTION – 01

SPECIMENGUARANTEES, ETC.

01. FORM OF CONTRACT AGREEMENT

THIS AGREEMENT made and entered at ----- on this ----- day of ----- by and between -----(name and address)----- (hereinafter called the "Employer" which expression shall include its successors, assigns and legal representatives) of the one part and ----- (name and address) ----- (hereinafter called the "Contractor" which expression shall include its successors, legal representatives and permitted assign) of the other part.

WHEREAS the Employer is desirous for the manufacture, supply, assembly, construction, installation, completion, testing, commissioning, adjusting, balancing and maintenance of certain works, viz., -----

(hereinafter called the "works") and has caused his Consultants, NZ ENGINEERING, M-01,Plot # 70c Jami Commercial Lane-9 Phase-7 DHA , KARACHI. Pakistan, (hereinafter called the "Consultant") to prepare specifications, schedules, and drawings detailing and describing the works.

WHEREAS, under the procedure, tenders have heretofore been received by the Employer for the works and the tender of the Contractor for the works has been accepted by the Employer.

NOW THEREFORE, for and in consideration of the promises, covenants, agreements hereinafter contained and to be performed by the parties hereto, the said parties hereby covenant and agree as follows:

1. In this Agreement words and expressions shall have the same meaning as are respectively assigned to them in the General Conditions of Contract hereinafter referred to:

2. The following documents shall be deemed to form and be read and constructed as part of this Agreement, viz.,

- (a) The said Tender No. ----- dated ----- and Salient Features of Contract, as amended herein.
- (b) The instructions to tenderers & terms & conditions
- (c) The Special Conditions of Contract.
- (d) The term and payment
- (e) The evaluation criteria
- (f) The Specifications.
- (g) The Drawings.
- (h) The Schedule of bill of quantities.
- (i) Addenda Nos. (if any).
- (j) The letter of Award of Work No. ----- dated ----- and all related correspondence mentioned therein.
- (k) -----

3. In consideration of the covenants and agreements to be kept and performed by the Contractor, and for the faithful performance of this contract, and the completion of the works embraced therein, according to the specifications, drawings and conditions herein contained and referred to, the Employer shall pay and the

Contractor shall receive and accept as full compensation for everything furnished and done by the Contractor under this Agreement, the contract price at the time and in the manner prescribed by the contract.

4. The Contractor, at his own proper cost and expense, shall do all work and furnish all labour, equipment, materials, tools, machinery and supplies for the manufacture, assembly, construction, installation, completion, testing, commissioning, adjusting, balancing and maintenance of the said works as outlined and described in the specifications, schedules and drawings except such equipment and materials which are to be furnished by the Employer.

5. The maintenance of a rate of progress in the works, which will result in its completion within the specified time, is an essential feature of this contract, and the Contractor agrees to proceed with all due diligence and care at all times to take full precautions to ensure the time of completion as defined herein. The said works shall be started on the date shown in the Memorandum of the tender and the Contractor shall have the works called for under the contract fully completed within the times stated in the Memorandum of the tender except for maintenance which shall be completed in the period named in the said Memorandum after issuance of Certificate of Substantial Completion.

6. The term the "Consultant" in this Agreement and conditions of contract shall mean the said N.Z ENGINEERING , or in the event of their dissolution or in any way ceasing to be the Consultant for the purpose of this contract, such other person(s) as may be nominated or appointed for this purpose by the Employer and notified in writing to the Contractor.

IN WITNESS whereof the parties hereto or herein have hereinto set their respective hands and seals on the day the month and the year first above-mentioned.

Signed, sealed and delivered
by -----

Signed, sealed and delivered
by -----

for and on behalf of

(Employer)

for and on behalf of

(Contractor)

in the presence of

(name and designation)

in the presence of

(name and designation)

02. SPECIMEN OF TENDER EARNEST MONEY GUARANTEE

KNOW ALL MEN BY THESE PRESENTS that ----- (name and address) ----- (hereinafter called the "Tenderer" which expression shall include its successors and permitted assigns) and -----(name and address) --- ----- (hereinafter called the "Guarantor" which expression shall include its successors and assigns) are jointly and severally held firmly bound in the sum of Rs.------(Rupees-----only)to --- ----- (name and address) ----- (hereinafter called the "Employer" which expression shall include its successors, assigns and legal representatives).

WHEREAS the Tenderer has submitted the accompanying Tender dated ----- for ----- ----- (hereinafter called the "works") to the said Employer, and

WHEREAS the Employer has required as a condition for considering the said tender that the Tenderer deposit with the Employer either by a Pay Order or Demand Draft of a scheduled Bank in favour of the Employer or by a confirmed and irrevocable Guarantee (Bond) for an amount of Rs.----- (Rupees----- only) conditioned that in the event of failure of the Tenderer to abide by his Tender for a period of ----- days from -----(date of opening of Tender) ----- and if the Tender is accepted to execute the Contract Agreement for the said works and furnish the required Performance Bond, the entire sum becomes payable immediately to the Employer as liquidated damages and not as penalty for the Tenderer's failure to perform.

NOW THE CONDITIONS OF THE above written Bond are such that:

1. If the Tenderer fails to abide by his Tender for the period mentioned and if the Tender is accepted by the Employer then the Tenderer fails to sign the Contract Agreement and provide a Performance Bond within ----- days of being requested to do so in accordance with the conditions of tendering, the Guarantor hereby unconditionally and irrevocably undertakes to pay forthwith the sum of Rs.----- (Rupees----- only) to the Employer within three days after a demand is made by the Employer without any question and without any reference of any nature whatsoever to the Tenderer and irrespective of any dispute existing between the Tenderer and the Employer in respect of the acceptance or rejection of the Tender and irrespective of the pendency of any dispute before any Arbitrator or in any Court of Law.
2. In the event of the Tenderer fulfilling the aforesaid obligations as certified by the Engineer who will be the sole and exclusive judge in this respect, this Guarantee will come to an end as the purpose would have been served.
3. The certificate of the Engineer that the Tenderer has failed to comply with the conditions or any of them herein mentioned shall be final, conclusive and binding on all the parties and the Employer will be entitled to demand forthwith from the Guarantor the aforesaid sum on the issuance of the said certificate.
4. That the liability of the Guarantor shall not be discharged until such time that a release has been granted to the Guarantor in writing under the signature of the Engineer.
5. That the liability of the Guarantor shall not be affected at any time by any forbearance or indulgence being given to the Tenderer or by his death or insolvency.
6. That the payment under this Bond shall be made by the Guarantor in the name of the Employer and a receipt issued by the Employer shall discharge the Guarantor from his liability to the Employer under this Bond.

7. That any notice or demand under this Bond may be made by the Employer and may be left at the Guarantor's address mentioned herein or at any changed address as may be communicated by the Guarantor to the Employer in writing against receipt of the Employer, or the said notice of demand may be sent by registered post to the Guarantor addressed as aforesaid and shall be deemed to have been given at the time when it should have been delivered in due course of post and a certificate signed by the Employer that the envelope containing the notice was posted shall be conclusive.

8. This Bond shall remain in force upto ----- for the amount of Rs.----- (Rupees -----only).

IN WITNESS WHEREOF the Guarantor and the Tenderer have signed and sealed this Bond on this ----- day of -----.

Signed, sealed and delivered
by -----

Signed, sealed and delivered
by -----

for and on behalf of

(Guarantor)

for and on behalf of

(Tenderer)

in the presence of

(name and designation)

in the presence of

(name and designation)

03. FORM OF PERFORMANCE BOND

THIS BOND is executed at ----- on this -----day of ----- by -----(name)-----
-----having its registered Office at -----(full address)----- (hereinafter called the "Surety" which expression shall include its successors and assigns) and -----(name)-----whose registered Office is at -----
--(full address)----(hereinafter called the "Contractor" which expression shall include its successors and permitted assigns) in favour of ----- (name and address) ----- (hereinafter called the "Employer" which expression shall include its successors and assigns).

WHEREAS the Contractor by an Agreement which shall be signed between the Employer of the one part and the Contractor of the other part (hereinafter called the "contract") has agreed for the manufacture, supply, construction, assembly, installation, completion, testing, commissioning, adjusting, balancing and maintenance of certain works as therein mentioned viz.-----

(hereinafter called the "works") in conformity with the provisions of the said contract.

AND WHEREAS one of the conditions of entering into Contract Agreement is that the Contractor shall provide to the Employer a Performance Bond in the sum of Rs.----- (Rupees -----
----- only) for due fulfilment of the contract.

AND WHEREAS, the Surety has agreed to give to the Employer this Performance Bond on the terms and conditions mentioned hereinafter.

NOW THEREFORE, THIS BOND WITNESSETH:

1. That the Contractor shall duly perform and observe all the terms, provisions, conditions, stipulations and his obligations contained in the contract according to the true purport, intent and meaning thereof or as may be determined by the Employer who shall be the Sole Judge in the matter.
2. In the event of default being committed by the Contractor of which the Engineer shall be the sole exclusive judge, the Surety shall satisfy and discharge within three days after demand of all the damages sustained by the Employer on account of the default of the Contractor, as may be solely and exclusively determined by the Engineer, without any reference of any nature whatsoever to the Contractor and without any question whatsoever and whether or not the Contractor disputes his liability in respect thereof and whether or not any arbitration or Court case is pending in respect of the dispute.
3. That the liability of the Surety under this Performance Bond shall be upto the amount of Rs.-----
----- (Rupees ----- only) and this Bond shall become null and void if the Contractor has carried out the works and also performed his obligations strictly in accordance with the contract to the full satisfaction of the Engineer, who will be the sole and exclusive judge to determine whether or not the Contractor has carried out the works and fulfilled his obligations in accordance with the contract.
4. The Engineer can complete that portion of the works, which the Contractor has not commenced or not satisfactorily executed, upto the amount of the Performance Bond, at the expense of the Surety.

5. That the liability of the Surety shall not be discharged until such time that a release has been granted to the Surety in writing under the signature of the Engineer.
6. No alteration in the terms of the said contract made by agreement between the Employer and the Contractor or in the extent or nature of the works to be executed thereunder and no allowance of time by the Employer or the Engineer under the said contract nor any forbearance or forgiveness in or in respect of any matter or thing concerning the said contract on the part of the Employer or the Engineer shall in any way release the Surety from any liability under this Bond.
7. That the payment under this Bond shall be made by the Surety in the name of the Employer and a receipt issued by the Employer shall discharge the Surety from his liability to the Employer under this Bond.
8. That any notice or demand under this Bond may be made by the Employer and may be left at the Surety's address mentioned herein or at any changed address as may be communicated by the Surety to the Employer in writing against receipt of the Employer, or the said notice of demand may be sent by registered post to the Surety addressed as aforesaid and shall be deemed to have been given at the time when it should have been delivered in due course of post and a certificate signed by the Employer that the envelope containing the notice was posted shall be conclusive.
9. This Bond shall remain in force upto ----- for the amount of Rs.----- (Rupees -----
-----only).

IN WITNESS WHEREOF the Surety and the Contractor have signed and sealed this Bond on the day the month and the year mentioned above.

Signed, sealed and delivered
by -----

for and on behalf of

(Surety)

in the presence of

(name and designation)

Signed, sealed and delivered
by -----

for and on behalf of

(Contractor)

in the presence of

(name and designation)

Note:

The Surety may be a scheduled Bank or an approved Insurance Company.

04. SPECIMEN OF MOBILIZATION ADVANCE GUARANTEE

To

-----,
-----,
-----,
-----.

Dear Sirs,

WHEREAS you have entered into a contract with -----(name and address)----- (hereinafter called the "Contractor" which expression shall include its successors and permitted assigns) for ----- (hereinafter called the "works").

AND WHEREAS at our request and at the request of the Contractor you have agreed to advance to the Contractor a sum of Rs.----- (Rupees-----only) to be used by the Contractor for the procurement and transport of Plants, Equipment and materials for the said works (inclusive of any temporary works).

NOW THEREFORE we do hereby agree, undertake and guarantee:

1. That the Contractor shall use the advance amount of Rs.----- (Rupees-----only) for the purposes of procurement and transport of Plants, Equipment and materials for the works inclusive of any temporary works as defined in the Contract Agreement dated ----- entered into between you and the Contractor.
2. That the Contractor shall repay the above said advance amount to you either by getting the same deducted from his running bills as per the General Conditions of Contract or from his own resources.
3. In the event of the Contractor failing to utilize the advance for the purpose for which it has been given by you and/or the Contractor failing to make the payment of the same to you as per the General Conditions of Contract, we hereby guarantee the payment of the amount of Rs.----- (Rupees-----only) or such other amount as may be outstanding against the Contractor within three days after demand made by you on us without any question or without any reference of any nature whatsoever to the Contractor and irrespective of existence of any dispute between you and the Contractor and irrespective of pendency of any dispute with the Contractor before any Arbitrator or any Court of Law.
4. That a demand certifying that the Contractor has failed to utilize the advance for the purpose for which it has been given and/or has failed to repay the same and signed by the Engineer will be conclusive against the Contractor and against us which certified demand shall not be questioned by us for any reason whatsoever and it would be sufficient authority for us to make the payment to you.
5. That our liability under this Guarantee shall stand reduced automatically to the extent of the adjustment made from the running bills of the Contractor and a certificate signed by the Engineer to this effect shall be conclusive and binding on us.

SECTION-02

INSTRUCTIONS TO TENDERERS AND TERMS & CONDITIONS

1. The tenderers are required to furnish the following information in addition to that required in the tender notice & Evaluation Criteria with their tenders, failing which their tenders are liable to be rejected:
 - I. Organization structure of the “ Contracting Firm” (whether the firm is a partnership or Limited Company etc.
 - II. Details of works of similar nature executed during the last five years with supported by documentary evidence(Photostat copies to be attached).
 - III. Proof of financial stability.
 - IV. Programme of work to ensure that the work will be completed within the allotted time on the prescribed format.
 - V. Undertaking to the effect that the firm has never been black listed by any Government / Semi Government / Private Organization.
 - VI. The Contractor /Bidders must be the sole distributor since four Years (4Years) of the offered brand/system.
 - VII. The Contractors / Bidders must be licensed by the Pakistan Engineering Council. (PEC,s Category C-3 & ME-01).
2. Set of tender documents, duly signed on each page and official seal stamped on each page including annexure, Addendum/Corrigendum, if any and supplementary information and **Earnest Money @ 2%** of the quoted rates in shape of Pay Order / Demand Draft / Bank Guarantee in favor of Aror University Of Art & Heritage Sukkur Sindh, valid for a minimum period of twenty eight (28) days beyond the bid validity date (i.e.120 days+28 days validity) from any Schedule Bank registered in Pakistan on prescribed format (refundable to unsuccessful bidder after award of Contract) must reach the office of the Director of Engineering on or before the time and date fixed in the Tender notice for receipt of the Tenders.
3. Tender must be filled in English and all enclosed document should be in English.
4. Tenders are to be irrevocable and valid for acceptance for a period of hundred & twenty (120) calendar days from the Tender opening date.
5. Documents submitted by Tenderers in connection with the Tender for above named Works will be treated as confidential and will not be returned, except Financial Proposal of Non-responsive Bidders.
6. Incomplete and Conditional Tenders shall be rejected at the sole discretion of the Employer.
7. Tenderers will not be reimbursed for any expenses of any kind whatsoever incurred in connection with preparation and submission of their Tenders.
8. Unit rates should be mentioned both in word and figures in Pak Rupees. If there is a discrepancy between the Unit Price & Total Price i.e. obtained by multiplying the Unit Price and quantity, the Unit price shall prevail and the total price shall be corrected. If there is a discrepancy between the words and figures, the amount in the words shall prevail. If there is

a discrepancy between the total bid price enter in the Form of Bid and the total shown in the Schedule of Prices, the amount stated in the Form of Bid will be corrected by the Employer's Engineer in accordance with the corrected Schedule of Price. If the Bidder does not accept the corrected amount of Bid, his Bid will be rejected and his Bid Security will be forfeited.

9. The entire work should be completed within **24 weeks** from the date of issue of the work order.
10. The rates should be inclusive of all taxes (including GST, custom & other duties, Govt. Levy as applicable at the time of Payment), insurance, overheads, transportation, labour charges for handling, commissioning and testing at the site etc.
11. The supplier/contractor should be registered with General Sales Tax and Income tax Departments and shall submit GST invoice with the bill.
12. The exemption in Income Tax will only be allowed against the Exemption Certificate issued by the Income Tax Department.
13. The supplier /contractor will submit GST Registration Certificate, GST Invoice and paid copy of Professional Tax along with the bill. The bill will not be entertained without these documents.
14. The supplier/Contractor may visit the site on any working day to form a clear understanding of the work, before quoting the rates.
15. The contractor/supplier should provide complete information including Technical computerized selection, selection drawing, technical Submittal along with the dimensional drawings, sectional details, technical details, certificates mentioned in the specification/tender documents etc. for the quoted equipment with the Bid.
16. In case of award of work, 10% (ten percent) of the billed amount will be deducted from every bill as security deposit.
17. The **Earnest Money @ 2%** of the quoted rates in shape of Pay Order / Demand Draft / Bank Guarantee in favor of Aror University Of Art & Heritage Sukkur Sindh, valid for a minimum period of twenty eight (28) days beyond the bid validity date (i.e. **120** days + 28 days validity). The Bank Guarantee should be from any Scheduled Bank registered in Pakistan on prescribed format.
18. Conditional/incomplete tenders and tenders without earnest money will not be accepted.
19. This tender is only an invitation to offer and the Sukkur IBA University reserves the right to accept or reject any or all tenders.
20. If the tender/bid does not meet the specifications and other requirement, the same will be rejected and their Financial Bid will be returned un-opened.
21. In case of acceptance of tender, the supplier/contractor will submit a Performance Bond amounting to 10% of tender cost in shape of Bank Guarantee **within 28 days** of issuance of Acceptance Letter. Performance Bond shall be issued by any Scheduled Bank registered in Pakistan on prescribed format. Performance Bond shall be valid for following period:
(a) **24 Weeks** (for execution of works as prescribed in Schedule of Prices, Specifications etc.)

- (b) For Maintenance / Warranty Period which shall be started after completing the entire scope of works as per Contract. The same shall be valid for the whole Currency of Works including Maintenance / Warranty Period
22. If Contractor failed to provide Performance Bond, the Earnest Money will be forfeited and the client reserves the right to accept the 2nd lowest bidder and he will not be allowed to participate in future tenders with Aror University of Art & Heritage Sukkur Sindh.
23. The successful tenderers shall have to execute the Agreement with **the Aror University Of Art & Heritage Sukkur Sindh**, within 14 days after issuance of the acceptance letter, in its standard form. In case of default, the Earnest Money will be forfeited and the Bank reserves the right to accept the 2nd lowest bidder. After execution of the Agreement, the work order for commencement of the work shall be issued.
24. The contractor will submit 03 sets of operation & maintenance manuals, and spares manual As Built Drawings along with / before the Delivery of the Equipment.
25. The employer proposes to advance an amount equal to 10% of tendered cost as mobilization advance against a bank guarantee, to be obtained by the supplier/contractor at his own expenses from any Scheduled Bank registered in Pakistan as per Proforma of the agreement-cum-guarantee included in this tender document.
26. The total amount of mobilization advance will be recovered from the contractor's Running / interim bills.
27. The client reserves right to increase /decrease the quantity mentioned in BOQ up to any extent as per there requirements/budget.
28. TERMS OF PAYMENTS
- 28.1 For Terms and payments refer, refer Section-03
29. PENALTIES
- 29.1 For Penalties, refer Section 03
30. WARRANTY
- 30.1 The Equipment shall be covered under the Standard Warranty Period of 18 Months from the date of Shipment / 12 Months from the date of commissioning whichever occurs earlier. However extended Warranty Period may be offered by any Supplier
31. The consultant/ client shall disqualify a supplier or contractor if it finds, at any time, that the information submitted by contractor /supplier concerning his qualification as supplier or contractor was false and materially inaccurate or incomplete.
32. The tender shall be proceeds "SINGLE STAGE – TWO ENVELOPE PROCEDURE."

SECTION – 03**TERMS OF PAYMENT****A. TERMS OF PAYMENT**

1. ALL ADVANCE PAYMENTS SHALL BE MADE AGAINST FURNISHING THE **INSURANCE GUARANTEE** IN FAVOR OF **AROR UNIVERSITY OF ART & HERITAGE SUKKUR SINDH** IN REQUIRED FORMAT FROM ANY SCHEDULED BANK REGISTERED IN PAKISTAN.
 - i) Mobilization Advance 40%(Total amount)
 - ii) Upon delivery of the material / equipment at Site subject to confirmation of the Quantities delivered, specifications, Acceptance of Consultant & Engineer In charge. 30%
 - iii) Balance Payment shall be made against Running Bills which will be jointly scrutinized by Engineer In charge & Consultant
2. Payments against Clause (ii) and (iii) shall be subject to an adjustment/deduction of 10% Mobilization Advance (up to the complete recovery) and 10% Retention Money.
3. 10% Performance Bond shall be released after satisfactory completion of the Maintenance / Warranty Period (i.e. 12 Months after commissioning of the System)
4. Retention Money shall be released as follows:
 - (a) One Month after issuance of the Completion Certificate 50%
 - (b) After satisfactory completion of the Maintenance / Warranty Period 50%

B. PENALTIES

1. In case of delay in work the Client shall have the right to impose the Liquidated Damages as compensation @ 0.1% of the total cost of the tender per day. (Up to maximum 10% of total cost of works) after which client reserves the right at its Sole Discretion to rescind the Contract and take the action as per Contract Agreement. Performance Bond & Earnest Money shall be forfeited without reference to the Contractor. The Contractor may not be allowed to participate in future tenders with client.

2. If the delivered Material / Equipment does not comply with the specifications or have any missing item or received in damaged / defective condition, Contractor shall rectify / make the System in good condition at his own expenses whatsoever without voiding the Manufacturer's Warranty (if any) within a period of 1 Week (Period shall be accorded by client in consultation with the Consultant) after which CLIENT reserves the right in its Sole Discretion to terminate the Contract and confiscate the Supplied Equipment along with forfeiture of Performance Bond without reference to the Contractor

SECTION - 04**TENDERER'S QUALIFICATION / EVALUATION CRITERIA****I. MANDATORY REQUIREMENTS BEFORE EVALUATION OF TENDER**

- (a) Bidder must be registered with Pakistan engineering council (PEC'S Category C-3 Registered in Mechanical Engineering ME-01).
- (b) Bidder should have completed minimum eight (8) similar nature of work(s) of same / above capacity in the last 5 Years (complete detail with completion latter required)
- (c) The Contractor /Bidders must be the sole distributor of the VRF equipment since last Four Years (4Years) of the offered brand/system.
- (c) The Interested bidders should have presence / support / branch offices in Karachi.
- (d) Bank Statement for Last 3 Years, Minimum turnover of Rs. 400 Million for at least any one year
- (e) The Firms / Bidders / Suppliers blacklisted by any Government / Semi Government Organizations shall not be eligible to bid. Affidavit to be submitted.
- (f) The Firms / Bidders / Suppliers in litigation with any Government / Semi Government Organizations shall not be eligible to bid. Affidavit to be submitted.
- (g) The Firms / Bidders / Suppliers who have failed to perform as per Contract with the Government / Semi Government Organization will not be eligible to bid. Affidavit to be submitted.
- (h) Organization structure of the "Contracting Firm" (whether the firm is a partnership or Limited Company etc.
- (i) Programmer of work to ensure that the work will be completed within the stipulated time on the prescribed format.

NOTE. THE EVALUATION OF ANY THESE BIDDERS SHALL BE CARRIED OUT WHO WILL COMPLY WITH THE ABOVE PARAMETERS.

II. TECHNICAL EVALUATION OF TENDER

A It will be examined in detail whether the goods offered by the bidder comply with the technical provisions of the technical bidding documents. For this purpose, the bidder's data submitted with the bid will be compared with the specific work data prescribed by the Employer and technical, feature / criteria of the Goods detailed in the technical provisions. Other technical information submitted by the bidder regarding the scope of work will also be reviewed. In addition to this following Technical Details / Requirement must be provided / complied with the Tender Documents (Technical Bid).

B Tender shall be rejected if it is Non-submission of verifiable proofs against the mandatory as well as general documentary, qualification and eligibility related requirements.

C. Technical Evaluation:

The firm cleared from initial screening will be evaluated as per following criteria:

The total marks shall be 100. Minimum score for competing in the next stage is 75 %. The Financial Proposal of only the Audit Firm will be opened which secures 75 % or more in the Technical Evaluation.

S.NO	DETAILS	POINTS
1	Draft of Earnest Money	Mandatory
2	Bid /Quotation (As per pattern)	Mandatory
3	Certificate of Registration In Pakistan Engineering Council PEC'S Category C-3 Registered in Mechanical Engineering ME-01).	Mandatory
4	Income Tax Registration	Mandatory
5	General Sales Tax Registration	Mandatory
6	Proof of Non-Blacklisting: Affidavit on legal paper of appropriate value (duly attested from notary public)/letterhead that the Firms / Bidders / Suppliers blacklisted by any Government / Semi Government Organizations shall not be eligible to bid.	Mandatory
7	Proof of Non-Blacklisting: Affidavit on legal paper of appropriate value (duly attested from notary public)/letterhead that The Firms / Bidders / Suppliers in litigation with any Government / Semi Government Organizations shall not be eligible to bid. Affidavit to be submitted.	Mandatory
8	The Contractor /Bidders must be the sole distributor of the VRF equipment since last Four Years (4Years) of the offered brand/system.	Mandatory
9	Bidder should have completed minimum eight (8) similar nature of work(s) of same / above capacity in the last 5 Years (complete detail with completion latter required	Mandatory
10	Bank Statement for Last 3 Years, Minimum turnover of Rs. 200 Million for at least any one year	Mandatory
11	The Interested bidders should have presence / support / branch offices in Karachi.	Mandatory
12	Technical Compliance Sheet Provide Technical Compliance Sheet in Tabulated Form specifying the compliance of each and every quoted item with minimum specification of required items mentioned in Bill of Quantity (BOQ) of this document.	Mandatory
13	Annual turnover (Max Points 10) a. 200 to 300 Millions (6 Points) b. 350 to 500 Millions (8 Points) c. Above 500 Millions (10 Points)	
15	Sole distribution of the VRF Equipment in Years (Max Points 10) a. 4 Year (6 Points) b. 5 to 6 Year (8 Points) c. 7 to 10 Year (10 Points)	

S.NO	DETAILS	POINTS
16	No of similar nature of same or above capacity project in 5 Years. (Max Points 15) a. 8 Project (1 Points) b. 9 to 11 Year (8 Points) c. 12 to 15 Year (10 Points)	
17	Total No of employees (Max Points 10) a. 40 Employees (6 Points) b. 50 to 60 Year (8 Points) c. 70 to 100 Year (10 Points)	
19	Warranty/Guarantee Terms. (Max Points 30) a. 2 Years' service & Repair Warranty (20 Points) b. 3 Years' service & Repair Warranty (25 Points) c. 4 Years' service & Repair t Warranty (30 Points)	
	No of similar nature of project in 10 Years with Government & Public sector. (Max Points 15) a. 5 Project (10 Points) b. 6 to 7 Project (12 Points) c. 8 to 10 Project (15 Points)	
20	Bidder already work with Aror University Of Art & Heritage Sukkur Sindh (10Points)	

- a. Bids will be evaluated in fair, transparent and non-discriminatory manner. For the purpose of determining the Most Advantageous bid, following above mandatory scales of evaluation shall be taken into consideration for technical and financial bids.
- b. Failing to fulfill ANY of the Mandatory Requirement will disqualify the bidder from the process.
- c. After evaluation/marking of bidders in technical evaluation process, financial bids of technically qualified bidders only will be opened later on prior notice.
- d. For final grading of bidders towards contract award, Most Advantageous bid prices will be calculated to ascertain lowest bid for placement of procurement contract.

S.No.	Items	Approved Make
1	VRF System	1. L.G – Korea 2. Daikin-Thailand 3. General- Thailand 4. York- Japan Approved Equal
2	Refrigerant pipes	1. Mueller (USA) Approved Equal
3	Pipe/Duct Insulation	1. Aeroflex (Thailand) 2. Aerofoam-UAE Approved Equal
4	UPVC Pipe	1. Dadex 2. AGM 3. Steelex Approved Equal
5	Electric Cables & Wires	1. Pakistan Cables Approved Equal
6	Ventilation/Air Curtains Fan	1. GreenHeck 2. S&P Fans Approved Equal
7	G.I Sheet	1. Pakistan Steel 2. Imported Approved Equal
8	Air Devices	1. Steel Craft 2. Mehran 3. Thermec Approved Equal
9	Concrete Fasteners & anchors	1. Hilti (UK/Germany) 2. Fischers (Germany) Approved Equal
10	Paints	1. ICI (Pakistan) 2. Berger (Pakistan) Approved Equal
11	Motors	1- Siemens 2- ABB Approved equal
12	AHUS	1- Daikin -Malaysia 2- Boreas-Turkey 3- York- Turkey 4- VTS-Italy

S.No.	Items	Approved Make
		Approved equal
12	M.C.C & CABLE TRAY	1- Karimi Electric 2- Sunbeam 3- Husain & co. Approved equal
13	Refrigerant Isolation Valve	1- Danfoss 2- Mueller 3- Emersion Approved equal
14	Control wire	1- Belden Approved equal
15	Aluminum Tape	1-Abro industries (USA) Approved Equal
16	FILTER	1- CAMFIL 2- AMERICAN air filter Approved Equal
17	Vapor Barrier Coating	1. Foster (USA) Approved Equal

NOTE:

EQUIPMENT & MATERIAL SHALL BE SUPPLIED ONLY FROM THE AUTHORIZED DISTRIBUTER. THE CONTRACTOR SHALL SUBMIT COMPLETE TECHNICAL DETAILS OF THE EQUIPMENT, MATERIAL AND OBTAIN CONSULTANTS APPROVAL PRIOR TO DELIVERY ON SITE. IN CASE OF "APPROVED EQUIVALENT", IT SHALL BE AT THE DISCRETION OF THE CONSULTANT TO ACCEPT THE ALTERNATE PROPOSAL SUBMITTED BY THE CONTRACTOR.

SECTION - 05

SPECIAL CONDITIONS OF CONTRACT01. GENERAL CONDITIONS OF CONTRACT

1.1 The General Conditions of Contract shall be carefully studied by each tenderer before submitting his tender. Nothing stated herein shall waive any part of the General Conditions of Contract unless specifically stated herein. Where clauses of General Conditions of Contract are repeated in this section, it shall be only for calling special attention to them and/or as a further qualification, and it shall not mean as omitting any other clause or clauses of the General Conditions of Contract.

02. SCOPE OF WORK

2.1 The accompanying specifications and drawings are intended to provide complete Airconditioning systems and ancillary works for the Building referred in the specifications and drawings, and the contract on lump sum cost basis is intended to provide all materials and labour necessary for manufacture, supply, construction, assembly, installation, completion, testing, commissioning, balancing and adjusting and maintenance of the complete Airconditioning systems and ancillary works, making them ready for operation in all respects and training of the Employer's personnel.

2.2 (a) The general scope of work is detailed and shown in the specifications and drawings. Furthermore included are all interconnecting piping, valves and fittings and electric wiring between and for various items of plant, equipment, controls and accessories.

(b) Owner shall supply to the contractor, free of charge at site, certain equipment and materials as listed in the Schedule of Quantities. The contractor shall take delivery of these items, arrange careful storage and carry out assembly, installation of these items alongwith other items to be supplied by the Contractor so as to complete whole of the works in all respects as detailed in the specifications, drawings, schedules carefully study the specifications, manufacturers technical bulletins and drawings for the Employer supplied items so as to become fully familiar with the same for carrying out the works.

2.3 Within the general scope of work the following items are specifically included without limitation:

- a. VRF system and Ahus
- b. Refrigerant & Air distribution system
- c. System automatic controls
- d. Water drain system for all equipment
- e. All cutting, chases and making of opening and subsequent repairs except beam and slab openings.
- f. Motor Control Centers and complete electric wiring and earthing for all the plants, equipment, automatic controls and safety devices from electric supply and earthing points provided by the Employer as shown in the drawings. The Contractor shall also supply starters etc. for all Owner supplied equipment.
- g. Painting of equipment and system components and all other incidentals to

- make the exhaust air systems and ancillary works installation complete and perfect and ready for operation in every respect.
- h. Commissioning, testing, balancing, adjusting, painting and all other incidentals to make the Airconditioning, Ventilation and other systems and all ancillary works installation complete and perfect and ready for operation in every respect.
- I Adjusting and balancing of the complete air and water systems and automatic controls. The Contractor shall arrange the services of approved Specialist(s) for final balancing of the air exhaust system. The Contractor shall be responsible to provide the services of Engineers, technicians and skilled helpers as required by the Specialist(s) for carrying out the work.
- J Test runs of the complete plant and systems after the completion of installation, commissioning, balancing and adjusting of equipment and systems.
- K Servicing and maintenance of the complete plants during the period of maintenance (12 operating months).
- 2.4 The Contractor shall give written guarantee that all the equipment and materials supplied under the contract shall be brand new, of robust construction and standard manufacture, and that the materials and workmanship will be of best class, will be installed in a practical and first class manner, that the plants and systems will be complete for satisfactory operation, nothing being omitted by way of labour and material required to make them so although not specifically shown or mentioned in the drawings or specifications, and that these will be delivered to the Employer in well working order, complete and perfect in every respect.
- 2.5 The Contractor shall furnish all the required equipment, plants, devices, controls, etc. required to complete the works under applicable local codes or regulations required to complete the works.
- 2.6 The specifications are to be read in conjunction with the latest relevant British/American Standard Specifications and British/American Standard Codes of Practice. It shall be inherent in the interpretation of the contract documents that wherever British Specifications or Codes are referred to, they shall be deemed to be the British or American Standard Specifications or Codes and vice versa. Where differences or contradictions appear to arise between the British and American Standard Specifications or Codes, these differences or contradictions shall be referred to the Engineer for a decision.
- 2.7 In case any item or material offered deviates from the above standards, the tenderer shall clearly draw attention to all such deviations and no such item or material shall be supplied by the Contractor without prior written approval of the Engineer.
- 2.8 The Contractor shall execute the works with materials in accordance with the specifications. All materials which in the opinion of the Engineer are not sound and/or do not meet with the above conditions, shall be immediately dismantled and/or removed from site by the Contractor at the request of the Engineer and replaced by appropriate approved materials without claim by or extra payment to the Contractor.
- 2.9 The tenderer shall carefully check the sizes of the plant rooms, the pipe and duct passages and trenches, the pipe and duct shafts as shown in the drawings and

confirm that his equipment, piping, ducting, wiring, etc. can be installed within the respective spaces allocated for the same.

03. RESPONSIBILITIES OF THE EMPLOYER AND CONTRACTOR

- 3.1 The Employer shall not provide any equipment, stores, materials, etc. to the Contractor for the purpose of completing the works or temporary works except where otherwise specified in the contract.
The respective responsibilities of the Employer and the Contractor for the ancillary works shall be as detailed below.
- 3.2 Builders Work.
- (a) The Employer shall arrange all slab, beam and structural openings.
 - (b) All wall openings, cutting, chases, patching and making good shall be done by the Contractor. Only finishing and painting shall be arranged by the Employer after the Contractor had completed his work.
 - (c) All foundations for equipment mounting, MS Channels etc. will be constructed arranged by the Contractor who will also provide vibration isolators for isolation from the Building structure as required (and/or specified).
 - (d) The Contractor will supply and fix all necessary foundation and anchor bolts, concrete inserts, sleeves, brackets, clips, supports, stays, hangers, and hardware required for the complete installation. The Contractor shall supply and fix foundation and anchor bolts, concrete inserts and pipe sleeves before concreting. The Contractor will also be responsible for plugging of slab, wall and ceiling openings for all items and fittings where plugging has to be done by special plugs, screws or materials.
 - (e) The Contractor shall arrange for lifting of all equipment and materials (including Owner supplied equipment) to their respective plant rooms and locations. The Contractor will be responsible for any damage to the Building finishing. He shall ensure that no damage is caused to the structure.
- 3.3 Electrical Work.
- (a) The Contractor will be provided electric supply points, 400 volts, 3 phase, 4 wire alongwith two earthing points, or 220 volts, 1 phase with one earthing point, in the plant room as shown in the drawing.
 - (b) The Contractor shall be responsible for supply and installation of the Motor Control Centres and complete electric wiring and earthing work for all system, equipment and automatic control. He shall also check and confirm that the specified ratings of the supply point meet the requirements of his plant and equipment.
 - (c) The responsibility of the Employer would be limited to provide the electric supply point and earthing points as detailed above and shown in the drawings.

3.4 Decorating Work.

The Contractor shall not be responsible for the decoration of the Building including false ceiling/boxing and any special decorative painting to the plant components visible in the occupied areas unless otherwise specified. The Contractor will be responsible otherwise for painting of all equipment, plants, components, piping and ducting as specified.

3.5 The Employer will arrange without charge to the Contractor, the supply of electricity, water and fuel during the commissioning, starting, testing and adjusting of the complete plant and during the Test Run. The Contractor shall be responsible for the supply of all other materials and labor required in this connection.

3.6 It will be the responsibility of the tenderer to clearly mention in detail any other particular work excluded by him in his tender but necessary to complete the works in all respects for satisfactory, efficient and trouble free operation.

04. **COORDINATION**

4.1 The Contractor shall acquaint himself fully with the requirements of the program of Building construction and the requirements of the Main Contractor, Electrical Contractor, Plumbing Contractor and any other Contractor carrying out the work in the Building. It would be necessary due to the nature of the air-conditioning works to arrange a proper sequence of installation with respect to the work of the other contractors. It shall be the responsibility of the Contractor to schedule his work so as to complete the air-conditioning installation work within the required time and without causing delay in the completion of the entire project.

05. **GUARANTEES**

5.1 The Contractor shall guarantee the performance (including specified capacities), fuel and electricity consumption of the plant and equipment offered by him. He shall state in his tender the natural gas/fuel oil consumption in cubic feet/litres per hour per horse power of the boilers, KW consumption of electric motor operated compressors/chillers/airconditioners and other equipment offered by him. The Contractor shall establish the performance, fuel and electricity consumption of the plant and equipment during the summer and winter test runs and will make all necessary adjustments to ensure that the performance and consumption is within the limits guaranteed by him.

5.2 The Contractor shall give to the Employer a written guarantee for the complete works against defective materials and faulty workmanship for the period of maintenance as specified in the Memorandum from the date of issue of Certificate of Substantial Completion by the Engineer. The guarantee shall also cover the maintenance of inside temperature and humidity conditions as specified. All defects of material or workmanship found in the work during the period of maintenance shall be removed and defective items replaced or repaired by the Contractor to the satisfaction of the Engineer without any additional cost to the Employer.

5.3 The Engineer shall inform the Contractor in writing in what respect any portion of the works, plant or equipment is defective. If any defect be not remedied within

reasonable time by the Contractor, the Employer may proceed to do the defect rectification work at the Contractor's risk and expense but without prejudice to any other rights which the Employer may have against the Contractor in respect of such defects.

- 5.4 In case the replacements, repairs or renewals are of such a character as may affect the efficiency of the plant or equipment, the Engineer shall have the right to give to the Contractor within one month from such replacements, repairs or renewals notice in writing that a test be carried out to check the efficiency and performance of the plant or equipment and it shall be the duty of the Contractor to ensure that the efficiency and performance of the plant or equipment conform with the specified requirements.
- 5.5 In the event of any defect of material or workmanship occurring or being discovered during the period of maintenance, the period of maintenance shall continue until the cause of the defect has been discovered and remedied to the satisfaction of the Engineer.

06. **MANUFACTURERS/SUPPLIERS' GUARANTEES/WARRANTIES**

- 6.1 Manufacturer/Supplier's Guarantee/Warranty, specimen given below, for each equipment is an essential document to be supplied to the Employer before claiming payment for that equipment. The Guarantee/Warranty shall be duly sealed and signed by an authorised Executive of the Manufacturer/Supplier.
- 6.2 (a) The Contractor may obtain the Guarantee/Warranty from the Manufacturer/Supplier and submit the same to the Engineer/Consultant before claiming payment for the equipment in his bill, or
- (b) The Manufacturer/Supplier shall furnish the Guarantee/Warranty as an essential part of the documents submitted to the Bank to claim payment against the letter of credit established by the Employer.
- 6.3 The form of Guarantee/Warranty shall be:
"We hereby guarantee that the stores supplied are produced new in accordance with the contract specifications and that the materials used whether or not of our manufacture are in accordance with the latest appropriate standard specifications, the contract specifications and of good workmanship throughout. We shall replace free of cost FOB Factory or repair any part of the equipment for either a period not exceeding 12 calendar months after it has been taken over on completion of installation as certified in the Completion Certificate issued by the Employer or a period of 24 calendar months from the date of despatch from our Factory, whichever is shorter, which would be found defective due to material or faulty workmanship or in any way not in accordance with the contract specifications.

Our responsibility shall be limited to replace/ repair any part or parts of the stores found to be defective in workmanship or material provided the equipment is operated and maintained by the Employer in accordance with the generally approved practices and provided the Employer informs us in writing as soon as such defect becomes apparent.

Our obligation shall be to replace or repair any part or parts found defective FOB Factory and we shall not be responsible for any consequential damage or liability. We shall also not be responsible for any work done, equipment or part(s) supplied or repaired by others or for any loss, damages or expenses arising from such work, equipment, part(s) or repairs.

Signature and Seal _____
Manufacturer/Supplier's Name and
Address _____
Date _____ "

- 6.4 Wherever guarantees of operating capacity and efficiency, proper functioning, durability and the like are called for and/or wherever it is specified that the manufacturer shall furnish necessary technical manuals, drawings, performance data, test certificates, etc. and shall supervise the starting up of the equipment and adjustments after installation and starting up, and etc., and maintain it for the required period and perform similar other duties and services, the Contractor shall be held responsible for performance of the specified services for the actual conditions of the installation and he shall be held responsible for any default on the part of his suppliers/manufacturers/principals.

07. **DRAWINGS, TECHNICAL DATA AND MANUALS TO BE SUPPLIED**

- 7.1 The Contractor when preparing any detailed shop drawings shall carefully check for all clearances, field conditions, avoidance of any hindrance with architectural features and proper coordination with all other services of the Building. Each shop drawing submitted by the Contractor shall include a certificate by the Contractor that all related conditions on the site relevant to that particular installation have been checked and that no conflict exists. The Engineer/Consultant shall not approve any shop drawing submitted by the Contractor without such a certificate.
- 7.2 Manufacturers' performance data, performance and other test certificates and shop drawings for all main equipment giving complete information regarding dimensions, materials and other details confirming the adequacy of the equipment to be supplied shall be submitted to the Engineer/Consultant for approval.
- 7.3 All shop drawings etc. correct and conforming with the contract requirements, shall be submitted to the Engineer/Consultant sufficiently in advance of actual requirements to allow ample time for checking and approval and no claim for extension of the contract time will be considered by reasons of the Contractor's failure to submit the correct drawings etc. in time. The Contractor will submit eight copies of final corrected shop drawing for approval out of which 3 duly approved copies would be returned to him.

- 7.4 The Contractor shall clearly point out the differences, if any, between the details submitted and the requirements of the contract in covering letters sent with the submitted documents and drawings. He should also give reasons for his request for substitution so that if substitution is approved by the Engineer, necessary action may be taken for price adjustment. The Contractor will not otherwise be relieved of his responsibility for executing the works in accordance with the contract.
- 7.5 After completion of the installation work, the Contractor is to provide reproducible transparencies (quality to be approved by the Consultant) and 3 copies each of as-installed drawings showing runs and location of all the plant, equipment, controls, piping, ducting, electric wiring, burried work, etc. giving all necessary details of the works as actually installed.
- 7.6 Technical Manuals.
- The Contractor shall supply seven sets of printed manufacturers' installation, commissioning, operation, servicing and maintenance manuals, technical catalogues and detail spare parts manuals in English language for all items for the guidance of the Employer's operators in operation, servicing and maintenance of the plants and equipment.
- One set shall be supplied to the Consultant for scrutiny and approval well before shipment of the items by the manufacturers/suppliers.
- Each set shall be hard bound in volumes as directed by the Consultant.
- After approval by the Consultant, balance six hard bound sets shall be supplied to the Engineer simultaneously with or before the arrival of the items at site.
- 7.7 In case of any question regarding the Contractor's responsibility for preparation and supply of any detail shop drawings, data, as-installed drawings, technical manuals, etc., the Engineer's decision shall be final and binding as to the requirements of the shop drawings,data, as-installed drawings, technical manuals, etc. for the works.
- 7.8 The approval by the Engineer/Consultant of any submitted data, shop drawings, performance curves, test certificates for any item, arrangement and or layout shall not relieve the Contractor from any responsibility regarding the performance of the contract. Such approval shall not also relieve the Contractor from responsibility of error of any sort in the submitted data and shop drawings, etc.

01 GENERAL REQUIREMENTS FOR MEP WORKS**1.1 General**

- 1.1.1. This specification forms an integral part of each section of MEP specifications.
- 1.1.2. These specifications covers Labour, materials, equipment and services to complete the MEP work as further specified and as shown on the Drawings.
- 1.1.3. All of the material to provide a complete and operational installation to the satisfaction of the Engineer. All incidental components and appurtenance necessary for the proper operation of the system shall be provided and installed as required whether or not they were specifically mentioned in the Contract Documents.

1.2. Definitions

- 1.2.1. Reviewed: Reviewed by the Engineer; normally a design or piece of equipment must be shown to have operated successfully for not less than two years under conditions generally similar to those required by this Contract. Facilities shall be given at the tender stage, if required by the Engineer, to enable him to evaluate the equipment's features and performance. The review of a design or piece of equipment shall be without prejudice to the acceptance tests required after installation.
- 1.2.2. Size: When related to pipe work means nominal size which generally approximates to the bore of steel tubes and the outside diameter of plastic tubes.
- 1.2.3. "Complete installation" shall mean not only the major items of plant and equipment conveyed by this specificatio, but all the incidental sundry components necessary for the complete execution of the works and for the proper operation of the installation, with their labour charges, whether or not these sundry components are mentioned in detail in the tender documents issued in connection with the contract.
- 1.2.4. "As indicated", "where indicated", and "unless otherwise indicated", refer to items or requirements which are, or may be given elsewhere in the tender documents issued in connection with the contract, (e.g. on a drawing, in a supplementary specification or in a schedule to this specification).
- 1.2.5. Provide: Supply, install and test.
- 1.2.6. Remove: Remove complete with all ancillary devices and equipment. Dispose of off- site in an environmentally safe manner. Ensure that equipment is completely isolated from any energy sources prior to removal. All piping and wiring shall be removed back to the nearest isolating point.

1.3. Regulations

- 1.3.1. The Work shall accord strictly with all rules, regulations, By-laws and requirements of all authorities having jurisdiction.
- 1.3.2. Drawings and specifications should not conflict with the above regulations but where there are apparent discrepancies the Contractor shall notify the Engineer in writing and obtain clarification before proceeding with the Work.

1.4. Governing Standards

- 1.4.1 The installation shall comply with all relevant statutory instruments and regulations & in particular with the following:

1.4.1.1	The IEE regulations for electrical equipment in buildings.
1.4.1.2	Any Regulations under Electricity.
1.4.1.3	The Fire Safety regulations of the Local Civil Defense Authorities. Local Health and Safety at Work Regulations.
1.4.1.4	Local Control of Pollution Regulations.
1.4.1.5	ASHRAE standards.
1.4.1.6	SMACNA standards for ductwork installation.
1.4.1.7	NFPA standards. British Standards.

- 1.4.2. The Tender shall be based on regulations and standards current on the date of return of tenders. If these regulations are amended or new regulations are enacted after that date, the Engineer shall be notified immediately.
- 1.4.3. The materials, equipment and installations detailed in this specification are based on the standards and codes of practice indicated in the Contract Documents. In the event of a contradiction between this specification and any applicable standard or Code of Practice, this specification shall govern and the Engineer shall be notified immediately.
- 1.4.4. Where material and equipment are specified under a particular standard and supplied under an equivalent standard, a certificate of compliance shall be provided to the Engineer at his request.

1.5 Permits, Fees Inspection (if applicable)

- 1.5.1 Obtain all required permits from the Municipality and/or Utility to complete your work. Make all submissions in a timely fashion with due regard for the requirements of the construction schedule.
- 1.5.2 Pay all fees and charges levied by the authorities having jurisdiction. Arrange for any permits, inspections and certificates and work carried out by the Municipality or Utilities in connection with your work.
Perform all tests required by the governing authorities, including those tests specified under this Division, and submit a copy of the final approved inspection certificate for the approval of the Engineer before taking
- 1.5.3 over Certificate. All costs for testing to be borne by the Contractor including all consumables required for testing, commissioning, training and running of the facility until TOC is issued.
- 1.5.4 It is the contractor's responsibility to provide a comprehensive list of standards applicable to each municipality and / or utility company approval after soliciting this information from the concerned authority, and to provide compliance statements with standards before making submittals to authorities. Any calculations, sketches, drawings or information required shall be produced and provided by the contractor at no extra cost.

2.1 General as to MEP Works

- 2.1.1 The work throughout shall be executed in the best and most thorough manner, under the direction of and to the satisfaction of the Employer and the MEP Consultant, who will interpret the meaning of the drawings and specifications, and shall have the power to reject any works and materials which, in their judgment, are not in full accordance therewith.

- 2.1.2 The Contractor shall be responsible for his work until its completion and final acceptance and shall replace any of the same which may be damaged, lost or stolen, without additional cost to the Employer.
- 2.1.3 The Contractor shall put his work in place as fast as reasonably possible. He shall, at all times, keep competent engineers in charge of the work and shall facilitate its inspection by the Employer and Consulting Engineers. He shall also remove any rubbish caused by his work as expeditiously as possible.
- 2.1.4 Except for such changes as may be specifically approved by the Employer and Consulting Engineer, in accordance with alternates or options stated hereinafter, all work must be in full accordance with the intent of the plans and specifications, complete in every way and ready for satisfactory and efficient operation when delivered to the Employer.
- 2.1.5 The Contractor must guarantee that the materials and workmanship supplied under these specifications will be of the best grade, that the apparatus will be erected in a practical and first-class manner, that it will be complete in operation, nothing being omitted in the way of labour and materials required to make it so, although not specifically shown or mentioned herein, and that it will be delivered in well-working order, complete and perfect in every respect.
- 2.1.6 The Contractor shall thoroughly acquaint himself with the work involved, and must verify at the building all measurements necessary for the proper installation of his work, obtaining the same when necessary from the Employer. He shall also be prepared to promptly furnish, to other Contractors or Employer, any information relating to his own work necessary for the proper installation of other work and shall co-operate to secure the best progress of and harmony between, the works of the different trades, in the interests of the building as whole.
- 2.1.7 It is specifically intended, in this specification, that anything (whether material or labour) which is usually furnished as a part of such equipment as is hereinafter called for (and which is necessary for its proper completion and best operation), shall be furnished as a part of this contract without additional cost whether or not shown in details on the drawings or described in detail in the specification. This provision is in consideration of the fact that in many cases the use of apparatus of different makes may be considered which differs in detail from that described, although intended to fulfil the same functions.
- 2.1.8 The Employer will arrange, without charges to the Contractor, the supply of electricity, water and fuel during the commissioning starting, testing and adjusting of the complete plant, and summer and winter test runs. The Contractor shall be responsible for the supply of all other materials and labour required in this connection.

2.2 Co-Ordination of Work Done By Others

- 2.2.1 Due to the type of the installation, a fixed sequence of operations is required to properly install the complete system. It shall be the responsibility of the Contractor to closely schedule his work so that his work will be installed at the proper time and without delaying the completion of the entire project.

2.3 Cutting and Patching

- 2.3.1 In general cutting and patching will be done by the Contractor.

2.3.2 No structural opening shall be made by he Contractor without prior written approval of the competent authority (Structural consultant)

2.4 Approvals, Substitutions, etc.

2.4.1 Wherever hereinafter the words "FOR APPROVAL" or "APPROVED" are used in regard to manufactured specialties, or wherever it is desired to substitute a different make or type of apparatus for that specified, all information pertinent to the adequacy and adaptability of the proposed apparatus shall be submitted to the Architect and Consulting Engineer, and their approval secured before the apparatus is ordered.

2.4.2 Wherever operating results (such as quantity delivered, pressure obtained, or the like) are specified or a definite make and size of apparatus is specified, for which such quantities are readily determinable, the make and size of apparatus that is proposed to be used must conform substantially (in regard to such operating results) to the quantities specified or implied. The same shall apply to important dimensions relating to the installation and operation of the apparatus in co-ordination with the rest of the system, or to properly fitting it into the available space conditions.

2.5 Permits

2.5.1 All work specified herein shall be installed in full accordance with the requirements of all Governmental agencies having jurisdiction. The Contractor shall secure and pay for any necessary approvals, permits, inspections, etc., and he shall turn over the official records of the granting of permits to the Employer.

2.5.2 The Contractor shall obtain all necessary allowances, pay any royalties, etc., in connection with the use of any patented devices or systems and software shall hold the Employer harmless and immune from any claims or law-suits arising from such use.

2.6 Drawings, Changes and Installation

2.6.1 The drawings shall be considered to show the general character and scope of the work and not the exact details of the installation. The installation shall be complete with all accessories required for a complete and operative installation.

2.6.2. The location, arrangement and connection of equipment and material as shown on the drawings represent a close approximation to the intent and requirements of the Contract. The right is reserved by the Engineer to make reasonable changes required to accommodate conditions arising during the progress of the work, at no extra cost to the Contract.

2.6.3. All Electrical piping and duct work in finished areas shall be concealed in ceiling spaces and shafts or chased into walls. No exposed work shall be installed in such areas unless specifically accepted by the Engineer.

2.6.4. Vent pipes, exhaust hoods or other mechanical & electrical equipment mounted on roof, or housing for such equipment, shall not be close to the edge of roof than a distance equal to the height of the pipe, hood or equipment; unless specifically accepted by the Engineer.

- 2.6.5. The actual location of thermostats, switches, etc., shall be reviewed by the Engineer before installation.
- 2.6.6. The location and size of existing services shown on the drawings are based on the best available information. The actual location of existing services shall be verified in the field before work is commenced.
- 2.6.7. Changes and modifications necessary to ensure coordination and to avoid interference and conflicts with other trades, or to accommodate existing conditions, shall be made at no extra cost to the Contract.
- 2.6.8. The Contractor shall ensure that all plant to be supplied by him can be installed in the available space and that there is adequate access to admit all plant to its position and enable maintenance to be carried out on the plant without difficulty.
- 2.6.9. Special care shall be taken in areas where pour-gaps take place.

2.7 Shop Drawings

- 2.7.1. Shop Drawings shall indicate clearly all services and the materials and/or equipment actually being supplied, all details of construction, accurate dimensions, capacity operating characteristics and performance. Each material submission shall give the identifying number of the specific pump, fan, etc. for which it was prepared (e. g. Fan F-7).
- 2.7.2. Each shop drawings for non-catalogue items shall be prepared specifically for this project. Material submissions and brochures for catalogue items shall be marked clearly to show the Items being supplied.
- 2.7.3. This contractor shall prepare all shop drawings related to the particular material submittal and shall submit both the shop drawings and the material submittal simultaneously.
- 2.7.4. Ensure that electrical, structural, reflected ceiling coordination with all applicable trades is complete before submitting drawings for review.
- 2.7.5. Installation of any equipment shall not be commenced until after the shop drawings have been approved by the Engineer.
- 2.7.6. When requested, shop drawings shall be supplemented by data explaining the theory of operation. The Engineer may also request that this information be added to the maintenance and operating manual.
- 2.7.7. Shop drawings shall be in compliance with the requirements of "General Notes" drawing for each MEP trade. All piping (plumbing, drainage, chilled water cable trays etc.) and duct work under this contract shall be shown in double line at a scale to be advised by the Consultant.
- 2.7.8. A coordinated plan and section (running the entire length) for each shaft shall be prepared and submitted as part of shop drawings for approval.
- 2.7.9. The Consultants may call for additional drawing as required for the proper execution of the woks.

2.8 Record Drawings

- 2.8.1. During construction, the Contractor shall keep an accurate record of all deviations, between the work as shown on the drawings and that which is actually installed.

2.8.2 After completion of the installation work, the Contractor is to provide 3 sets of "as installed" drawings showing runs and location of all the equipment, controls, piping, ducting, electric wiring etc., giving all necessary details of the works as actually installed. The Contractor shall also supply electronic copies of drawings on AutoCAD 14 or later on CD.

2.9 Drawing Submissions

2.9.1 Unless otherwise indicated, the Contractor shall provide the following drawings:

2.9.1 Seven (7) sets of prints, and one electronic copy in CAD format on disk of builder's work drawings, (to a scale of 1:50).

2.9.2. Three sets of prints, and one electronic copy in CAD format on disk of detailed services and plant room layout drawings (to a scale of 1:50).

2.9.3. Three sets of prints, and one electronic copy in CAD format on disk of purpose-made diagrams detailing separately all the composite electrical circuit and wiring layouts.

2.9.4 Three sets of prints, and one electronic copy in CAD format on disk of drawings or any variations to the design suggested by or agreed with the Engineer.

2.9.5 Three sets of prints, and one electronic copy in CAD format on disk of "as installed" drawings, upon completion of the work and as a condition precedent to the certification by the Engineer that the work is complete.

2.9.6 Builder's work drawings shall show fully dimensioned, foundation, bases plinths, sumps, holes and sleeves details required and the overall size and weights of the plant concerned.

2.9.7 With the agreement of the Engineer, smaller holes, built-in fixings, etc., other than in plant rooms, may be marked out on site instead of on drawings.

2.9.8 Fully dimensioned plant room drawings shall detail for each plant room the location of each unit, pipe routes and connections with valves and fittings, duct routes and connection with accessories, drain connections, electrical connections and controls. All drawings shall include explanatory notes and shall show the required sizes of pipes and ducts with and without insulation as applicable.

2.9.9 If abbreviations are employed for the designation of components, an integral schedule shall be provided on the drawings to explain the meanings of the abbreviations.

2.9.10 Individual equipment drawings from the various manufacturers will not be accepted in lieu of these composite plant room drawings.

2.9.11 All drawings shall be produced on the latest version of AutoCAD available.

2.10 Coordination, Installation, Interference and Setting Drawings

2.10.1. Coordination, Installation, interference and setting drawings dimensioned and to scale, shall be submitted for the Engineer's review to make clear the work intended and to, show its relation to adjacent work and to the work of other trades. Three copies of such drawings shall be submitted for review, of which one will be retained by the Engineer.

- 2.10.2. The drawings must be comprehensive showing all details, dimensions, equipment, supports for services and sections through critical areas to properly coordinate all services and work of other trades. All drawings must be to 1:50 scale.
- 2.10.3. Site services drawings shall be prepared to show all existing services, modification to existing services and all new services within the entire construction area. Drawings must show all connections of new or existing services to Municipal services and must be approved by the relevant authorities. Location of all existing services shall be carefully detailed and dimensioned on the drawings showing all sizes and invert elevations.
- 2.10.4. Drawings shall be prepared with due regard to the construction schedule and shall be submitted to the Engineer, allowing reasonable time for examination and review.
- 2.10.5. Work shall not proceed in areas involved until after final approval of all such drawings has been obtained.
- 2.10.6 These drawings shall include all existing information.

2.11 Contractor's Technical Responsibilities

- 2.11.1. The Contractor shall provide detailed calculations for flow and head and electrical noise abatement and vibration control for all equipment whether these are supplied by him or the owner. These calculations shall be done prior to ordering the equipment and shall be submitted to the Engineers for review prior to ordering such equipment. This Contractor shall bear full responsibility for the final equipment sizing and selection. The Consultants may specify the details to be provided by the Contractor.
- 2.11.2 The contractor shall provide seismic restraints and supports for all equipment piping, duct work, etc. The supply and installation of all seismic restraints supports and hangars is part of this contractors scope of work. The Contractor shall submit technical details as to now the requirements for seismic restraints and supports was worked.
- 2.11.3 In case of any question regarding the Contractor's responsibility for preparation and supply of any detail shop drawings, data, etc., the Engineer's decision shall be final and binding as to the requirements of the shop drawings, technical manuals, data etc., for any particular part of the work.
- 2.11.4 The approval by the Engineer / Consultants of any submitted data, shop drawing, performance curves, test certificates for any item, arrangement and / or layout shall not relieve the Contractor from any responsibility regarding the performance of the contract. Such approval shall not also relieve the Contractor from responsibility of error of any sort in the submitted data and shop drawing.

2.12 Commissioning

- 2.12.1 Commissioning shall be planned and implemented as per International standards and known best practices. The Contractor submit for approval by the Consultants the methodology and commissioning procedure for each item of equipment and for the system as a whole.
- 2.12.2 The intent of these specifications is to:
- Determine the specific requirement of parts and whole (integrated systems).
 - The commissioning process shall be documented and record compliance and

acceptance as per approved procedure.

- 2.12.3 As a general rule the ASH RAE definition of commissioning process shall govern “a quality-oriented process for achieving, verifying, and documenting that the performance of facilities, system, and assemblies meets defined objectives and criteria”. A total process based on the ASHRAE commissioning guidelines shall be followed as directed.
- 2.12.4 In general commissioning shall follow National Environmental Balancing Bureau (NEBB) procedures.
- 2.12.5 The testing and commissioning shall as a minimum include but not be limited to the following areas:
- a. All HVAC Systems
 - b. Air quality and air tightness of the building
 - c. All plumbing systems
 - d. All mechanical systems
 - e. All Fire Protection and life safety systems
 - f. All water systems & STP installation
 - g. All Food Service Systems
 - h. All Electrical Systems
- 2.12.6 The intention of the commissioning process is to demonstrate compliance with design intent and achievement of design parameters.
- 2.12.7 The Contractor shall notify the Engineer at least seven days in advance of any intended commissioning. He shall submit the Methodology and procedure for approval by the Consultants. On confirmation of the data and time by the Consultant the commissioning shall be carried out and witnessed by the Engineer/Consultants or such other persons/entities what the Employer may nominate.
- 2.12.8 Any Commissioning or testing carried out without being witnessed and approved shall not be considered as complying with the contract’s requirements.
- 2.12.9 Details relating to commissioning, testing, balancing/ adjusting are included in the specifications for the various trades.

2.13 Tests on completion

2.13.1 Contractors Obligations

The Contractor shall carry out the Tests on Completion after providing the documents required.

The contractor shall give to the Engineer not less than 21 days notice of the date after which the Contractor will be ready to carry out each of the tests on Completion. Unless otherwise agreed, Tests on Completion shall be carried out within 14 days after this date, on such day or days as the Engineer shall instruct.

In considering the results of the Tests on Completion, the Engineer shall make allowances for the effect of any use of the works by the Employer on the performance or other characteristics of the works. As soon as the Works or a section have passed any Tests on Completion, the Contractor shall submit a certified report of the results of these Tests to the Engineer.

2.13.2 Delayed test

If the Test on Completion are being unduly delayed by the Contractor, the Engineer may be notice require the Contractor to carry out the Tests within 21 days after receiving the notice. The Contractor shall carry out the Tests on such day or days within that period as the Contractor may fix and of which he shall give notice to the Engineer.

2.13.3 Retesting

If the Works, or a Section, fail to pass the Tests on Completion, and the Engineer or the Contractor may require the failed Tests, and Tests on Completion on any related work, to be repeated under the same terms and conditions.

If the Contractor fails to carry out the Tests on Completion within the period of 21 days, the Employer's Personnel may proceed with the Tests at the risk and cost of the Contractor. The Tests on Completion shall then be deemed to have been carried out in the presence of the Contractor and the results of the Tests shall be accepted as accurate.

2.13.4 Failure to Pass Tests on Completion

If the Works, or a section, fail to pass the Tests on Completion repeated, the Engineer shall be entitled to:

- a) Order further repetition of Tests on Completion.
- b) If the failure deprives the Employer of substantially the whole benefit of the Works or Section, reject the Works or Section (as the case may be), in which event the Employer shall have the right to claims cost of replacement rectification from the Contracts and have the work executed by other.
- c) Issue a Taking-Over Certificate, if the Employer so requests.

2.13.5 Operating and Maintenance Instructions

2.13.5.1 Eight (08) sets of operating and maintenance instructions, covering completely the operation and maintenance of the MEP works systems and equipment shall be furnished to the Employer. The O&M manuals shall include:

- a) Complete submitting of the equipment including catalogues.
- b) Operation and maintenance procedures.
- c) Fault trouble shooting
- d) Manufacturers Contact
- e) Spare Parts list
- f) Maintenance Schedules.

2.14 Guarantees

2.14.1 The Contractor shall give to the Employer, a written guarantee for the complete installation of all the works against defective materials and faulty workmanship, for the period of maintenance, from the date of issue of certificate of substantial completion by the Engineer. The guarantee shall also cover the maintenance of operating conditions as specified. All defects of materials or workmanship found in the installation during the period of maintenance shall be removed and defective items replaced or repaired by the Contractor without any additional cost to the Employer.

2.14.2 The Engineer shall inform the Contractor, in writing, in what respect any portion is defective. If any defect be not remedied within reasonable time by the Contractor, the Employer may proceed to do the work at the Contractor's

risk and expense, but without prejudice to any other rights which the Employer may have against the Contractor in respect of such defects.

- 2.14.3 In case the replacements, repairs or renewals are of such a character as may affect the efficiency, the Engineer shall have the right to give to the Contractor, within one (01) month from such replacements, repairs or renewals, notice in writing that a test be carried out to test the efficiency and performance, and it shall be the duty of the Contractor to ensure that the efficiency and performance conform with the specified requirements.
- 2.14.4 In the event of any defect of material or workmanship occurring or being discovered during the period of maintenance, the period of maintenance shall continue until the cause of the defect has been discovered and remedied to the satisfaction of the Engineer.

2.15 Manufacturer's Guarantees

- 2.15.1 Each manufacturer shall give guarantee for all items and this guarantee by the manufacturer, shall be an essential part of the documents to be submitted by the Contractor to the Employer to claim payment against the equipment the guarantee shall state that the stores supplied are produced new, in accordance with the contract specifications and drawings, and that the materials used, manufactured, are in accordance with the latest appropriate standard specifications, the contract specifications and of good workmanship throughout. (The manufacturer will replace, free of cost F.O.B. factory, any part of the equipment for either a period not exceeding 12 calendar months after it has been taken over on completion of installation, as certified in the completion certificate issued by the Employer, or a period of 24 calendar months after the date of dispatch from the factory, whichever is shorter, which would be found defective due to unsound material or faulty workmanship, or in any way not in accordance with the contract specifications and drawings.)
- 2.15.2 The manufacturers responsibility shall be limited to replace any part or parts of the stores found to be defective in workmanship or material, provided the equipment is operated and maintained by the Employer in accordance with the generally approved practices, and provided the Employer informs in writing as soon as such defect becomes apparent.
- 2.15.3 The manufacturers' obligation shall be to replace or repair any part or parts found defective F.O.B. The factory and the manufacturer shall not be responsible for any consequential damage or liability.
- 2.15.4 Wherever guarantees of operating capacity and efficiency, proper functioning, durability and the like are called for and / or wherever it is specified that the manufacturer shall furnish necessary drawings, performance data, test certificates etc., and shall supervise the starting up of the equipment and adjustments after installation and starting up etc., and maintain it for the required period and perform similar other duties and services, the Contractor shall be held responsible for performance of the specified services for the actual conditions of the installation and he shall be held responsible for any default on the part of his suppliers / manufacturers.

2.16 Training

- 2.16.1 The Contractor shall arrange the training of the Employers dedicated O&M Staff. The training shall cover all major equipment and systems.

- 2.16.2 The trainings shall based on the Operation and Maintenance manuals and the equipment and systems themselves.
- 2.16.3 The Contractor shall arrange suitably qualified personnel approved by the Consultants for providing the necessary training.
- 2.16.4 The training shall consist of training in the class room type environment followed by practical demonstration of operating procedures.
- 2.16.5 Training shall continue until O&M personnel are able to operate the equipment.
- 2.16.6 Training shall be carried out prior to commissioning of the systems.

2.17 Spare Parts

- 2.17.1 The Contractor shall provide spare parts for the various equipment's and systems as called for in the specification for each trade.

2.19 Painting

Painting works shall be carried out as per Specifications No. 09 90 00 which is made part of these General requirements.

2.20 Vibration, Noise and Seismic Controls

Vibration, noise and seismic controls works shall be carried out as per Specifications No. 13 48 00 which is made part of these General requirements.

3-VRF SYSTEMS**SPECIFICATION FOR VRF SYSTEMS****BASIC DESIGN**

The mechanical services shall maintain the following conditions at the stated external parameters:

Internal design conditions

Summer 23^o C db, 50% RH
Winter 21^o C, 40% RH

External design conditions

Summer 48^o C db, 27.0^o C wb

Noise criteria

External noise criteria
At 1 m in front of the plant NR60

Design noise criteria
To the offices NR40

3.1 GENERAL DESCRIPTION

The building shall be air conditioned via Variable Refrigerant Flow System with R410A refrigerant based VRF Split Unit.

The systems shall comprise of one or a number of outdoor units connected via interconnecting refrigeration pipe work to multiple indoor units using simple Y, T or Header type branch pipe connectors. The systems shall be complete with all the necessary electronic controls board and control wiring to maintain the design room conditions without external controller.

Installation

The equipment must be installed in line with the manufacturer's specification and design standard as listed below:

Piping, Y, T or header distributor size and wiring sizes to be carried out as per manufacturers standard. However, given sizes in drawings are tentative and will be in the range of $\pm 10\%$ up or down. Supplier to submit computerized selection with schematics and system layout complete with the "Y" connector size, pipe size and the piping lengths as per the actual site.

Replacement Warranty of shall be ONE YEAR after submission of satisfactory commissioning report and evidence of a satisfactory test run of 30 days test/ maintenance period.

3.2 REFRIGERATION PIPE WORK

The pipe work shall be of refrigerant quality copper ASTM B88,B306,B819, DIN1754/8905 half hard tempered. Soft tempered pipe (Type-L)work may be used where the pipe diameter is 1/4" or 3/8". Above 3/8" all pipe shall be type-K.

Long radius bends shall be formed using pipe bender. The use of short radius pre formed bends and elbows should be avoided to minimize pressure drop and possibility of leaks.

Oxygen free nitrogen must be passed through the pipe work during all brazing of joints to prevent the formation of oxidization scale on the inside surface of the pipes.

All pipe work shall be clean, de-hydrated and sealed. Pipe work shall be stored under dry conditions. Any pipe work found to be stored without the end caps should be rejected. Where sections are cut from a new coil any remaining lengths must be re-sealed. During the installation if the system has to be left unattended for any purpose whatsoever, the openings in the systems must be securely sealed.

Pipe work fittings for branching off to indoor units must be Y, T or header type Branch joints as supplied by manufacture. No other fittings are acceptable like expansion Valve or devices . The positioning and installation of these joints shall be strictly in accordance to the manufacturer's specification.

All pipe work shall be insulated with foam insulation Class-0 type insulation, Minimum 19 mm thick. Joints and headers shall be insulated with the pre formed insulation supplied with these fittings. Insulation exposed to atmospheric conditions shall be externally protected with Fiber glass insulation complete with plastic paint and jacketing. All insulation joints shall be made using adhesive and care should be taken that the every part of insulation is sealed to maintain a vapour barrier.

The pipe work must be supported through its entire length according to good refrigeration practice. However the brackets must not be positioned directly on the joints or headers. On horizontal pipe work the bracketing should be over the insulation to allow pipe movement due to contraction and expansions. The vertical pipe work shall be bracketed at no more than 1000 mm centres. The horizontal pipe work shall be bracketed at no more than 1500 mm centres.

The pipe work layout and the pipe sizing shall be approved and according to the manufacturer standard.

All installed pipe work lengths are to be accurately measured and recorded on the commissioning form. This information is required for accurate calculation of the additional refrigerant charge for the system. The weight of the additional refrigerant must also be recorded for future reference.

3.3 PRESSURE TESTING, EVACUATION AND COMMISSIONING

After Installation of pipe work, and prior to sealing of insulation joints, pipe work should be pressure tested to 38 bar, held for 24 hours and checked for leaks, vacuumed/dehydrated to -752 mm Hg and held at that setting for 1 to 4 hours depending on the pipe length. Supplier to submit detailed information for installation and commissioning procedures for approval after completion of installation.

A representative from manufacture or any other nominated factory trained engineer shall carry out the final refrigerant charging and the commissioning of the system, a copy must be sent to Consultant inline with manufacturer required parameter/figures to qualify for warranty.

3.4 WIRING

3 PHASE UNITS

A fused 415 V - 3 Phase, N + E power supply with external isolator shall be made available for each outdoor unit. The fuse rating for the 5 hp outdoor unit shall be 20 Amps, the 8 and 10 hp outdoor units shall be 32 amps and the 12, 14 and 16 hp units shall be 40 Amp. All fuses / circuit breakers (MCCB not MCB) should be motor rated.

SINGLE PHASE UNIT

A fused 220 V - 1 Phase, N + E power supply with external isolator shall be made available for each outdoor unit. The fuse rating for the 4 and 5 hp outdoor unit shall be 20 Amps, the 6 hp outdoor units shall be 25 amps. All fuses / circuit breakers should be motor rated.

A fused 240 V - 1 Phase, N + E Power supply shall be made available for each indoor unit, the HR box and the centralized control system. Maximum 15 amps ring main for the indoor units and HR boxes and a 5 Amp fused spur shall be provided locally to each item.

Control cable to the following specification shall be used:

2 core PVC shielded cable sized between 0.75 mm² and 1.25 mm².

Control and power cables must not be installed along side each other as interference in the signal wiring caused by electrostatic and electromagnetic coupling can occur.

The table below indicates recommendation as to the appropriate spacing of control and power cables where these run side by side:

Current capacity of the power cables	Spacing	
	10 amp or less	300 mm
100 v or more	10 - 50 amps	500 mm
	50 -100 amps	1000 mm
	100 amp +	1500 mm

The control cables shall be installed on conduits. Care must be taken to ensure that they are not tied together or packed tightly.

3.5 OUTDOOR UNITS

All outdoor units are to be permanently marked with an identification number. The removable access panels are also to be marked with the same number.

The outdoor units are to be Variable Refrigerant Volume (VRV) inverter based centralized combination of multiple outdoor units up to Nominal capacity of 50 TR.

The units shall be air-cooled type incorporating heat exchanger coils manufactured from copper tubes and aluminum fins, factory treated to reduce the effect of atmospheric corrosion. The unit casing shall be manufactured from (70μ) polyester powder coated baked enamel finish sheet steel in order to have a high corrosion resistance and to protect against salt laden environment close to where the units may be installed. The color shall be manufacturer's standard 'off white'. The air outlet grilles shall have plastic coated guards.

The outdoor units shall have at least all dc inverter driven compressor electronically controlled and capable of changing speed linearly to follow the variation in cooling and heating requirements.

The capacity control of the outdoor units will be inverter controlled and shall be determined electronically by sensing operational temperatures, pressures and ambient temperature and monitoring requirements for the indoor units.

The units shall be complete with electronic expansion valve(s), oil separator(s), high pressure switches, fan motor safety devices, over current relay, inverter overload protection, fuses, necessary solenoid valves, refrigerant shutoff valves, re-cycling guard timer and all necessary sensors for a safe and trouble free operation.

The access to the internal components for maintenance purposes shall be by removable panels.

It shall be possible to connect up to 64 indoor units, capacity permitting, to one modular outdoor unit.

The outdoor unit shall have full capacity control to meet the load fluctuation up to 140% and indoor unit individual control.

One compressor shall be inverter driven capable of 'Soft start'. The other compressor/s shall be on/ off type. These units will incorporate one inverter driven variable speed propeller type fan.

The fan will be capable of overcoming a minimum of 58 Pascal of external static pressure. The control PCB, the power and control wiring terminals shall be provided in an electrical box attached to the front of the unit.

3RD Party Salt test report/performance test report must be submit for the VRF units.

3.6 CONTROLS (OUTDOOR UNIT)

The units shall be equipped with Auto Restart function, which allows the unit to start in the same mode prior to the power failure.

Digital thermostat: Units shall be controlled with user friendly, wall mounted microprocessor based LCD, wired remote controller. The wired remote controller shall be slim having the following features.

- a) 24 hour ON / OFF timer in 1 hour interval.
- b) Test run mode.
- c) Self-diagnosis function.
- d) Operation indication.
- e) Room temperature display.
- f) Weekly programming.
- g) Child lock function.
- h) 3 speed fan control.
- i) Linear control of E.S.P/Airflow.

The wireless remote control should be available as an option, if required.

Computerized control shall be used to maintain a correct room temperature either at the fan coil or from a sensor in the remote controller. The system shall be equipped with a self-diagnostic feature for easy service and maintenance. The LCD remote controller shall be able to control up to 16 indoor units as a group. It shall also be possible to select cooling, heating, fan only or automatic change over mode for heat recovery systems.

3.7 PC BASED CENTRAL CONTROLLER

A multi-functional centralized Controller shall be supplied.

It will provide the following features:

- Start/stop operation, set point control, cool/heat mode selection, air volume setting, air flow direction setting and enabling/disabling operation of the remote.
- Monitoring of operation status of the indoor units and error code of the group or the zone.
- Comprehensive timer function to start/stop the air conditioning systems. This can be set for year, month, day of week, hour and minute. This will enable normal day-to-day time clock functions as well as yearly holiday set up..
- Power proportional distribution with optional memory card DCS002A1 and external kW hour meters, shall be provided for each and every outdoor unit.
- CO² motoring with CO² sensor for each area.

The controller shall be installed on single PC and shall be compatible with bac-net or remote control through internet and can be wired by a non-polar 2-wire transmission cable to a distance of 200m away from the outdoor with capability to control units up to group of 16 Outdoor and 4200 indoor.

3.8 INDOOR UNITS**3.8.1 Four-way discharge ceiling Cassette**

The unit casing shall be manufactured from galvanized steel plate and shall be fully insulated. Facility shall be provided for duct connection for introduction of the fresh air in the unit and branch ductwork from the unit.

The fan shall be of the propeller type, statically and dynamically balanced to ensure low noise and vibration free operation.

The heat exchanger coils will be manufactured from copper tubes and aluminum fins. It shall have electronic expansion valve to control refrigerant flow rate in response to the load variation in the conditioned space. The expansion valve shall be controlled by an integral computerized control system to maintain correct room temperature.

The low profile dedicated decoration panel shall be provided for each unit. The decoration panel shall incorporate the return air grille and supply air louvers. A facility shall be provided to automatically swing the supply air louvers or lock them at a desired angle to ensure even distribution of the airflow.

A condensate lift pump shall be provided within the unit and shall be capable of discharging at a height of at least 500 mm above the drain outlet.

The condensate shall be drained from the unit using thermally insulated copper tube and run directly to the foul water drain as indicated.

The air filters shall be incorporated within the unit and shall be mould resistant washable resin net type.

3.8.6 CONTROLS (INDOOR UNITS)

Digital thermostat: Units shall be controlled with user friendly, wall mounted microprocessor based LCD, wired remote controller. The wired remote controller shall be slim having the following features.

- j) 24 hour ON / OFF timer in 1 hour interval.
- k) Test run mode.
- l) Self-diagnosis function.
- m) Operation indication.
- n) Room temperature display.
- o) Weekly programming.
- p) Child lock function.
- q) 3 speed fan control.
- r) Linear control of E.S.P/Airflow.
- s) Auto swing
- t) Clean filter indication

The wireless remote control should be available as an option, if required.

3.9 -SPARE PARTS

- 1.0 The tenderer shall include the price of complete set of spare parts for all items supplied by him required for two years operation for the specified operating hours as recommended by manufacturer and specified elsewhere. In particular, spares shall be provided for electrical equipment, fuses, controls, instruments, bearings, flexible couplings, belts, gaskets, O-rings, etc. without which the equipment would become non-operative.
- 2.0 The following spares shall be supplied for V.R.F system (For each Typical model)
 - i. 1 Nos Spare Compressor for (Each Compressor Model)
 - ii. 1 Nos Spare Condenser Motors & Fan
 - iii. 1 Nos Spare Fan Motors for Each indoor Model. (
 - iv. 02 Nos Spare of Cards for all type of indoors
 - v. 02 Nos Spare of Main PCB Cards for out Doors
 - vi. 02 No.s of each expansion valve
- 3.0 The tenderer shall give a complete List of all the spare parts included in his tender.

3.10 EQUIPMENT WARRANTY

The supplier shall be responsible for **1 YEAR** complete replacement warranty of the complete system.

5- PIPING

- 01. Where screwed joints are used, the screw threads shall be cut clean and true, screwed joints made tight with Teflon thread seal tape, approved thread seal compound or litharge. Jute thread, red or white lead, pipe dope, caulking or filling compounds shall not be used. Reducing fittings shall be used to change pipe sizes and no bushings shall be used. All necessary unions shall be provided for easy dismantling.

02. All pipes shall be properly supported on clamps, hangers etc. of approved design. Supports shall be designed to permit free expansion and contraction to minimize vibrations. All hangers, clamps etc. for piping in the plant rooms, basements, inspection passages and vertical risers shall be provided with rubber in shear or spring or combination anti vibration supports to prevent transmission of vibrations to the building structure. No pipe shall be suspended from other pipes.
03. Expansion joints shall be installed in the piping at building expansion joints and where required at other locations to prevent undue stresses in the piping. The expansion joints may be installed with tie bars as recommended by the manufacturer for the required duty. Where space is available, expansion loop shall be used instead of an expansion joint.
05. All pipes passing through floors or walls shall have 20 gauge G I sleeves for the full depth of the finished floor construction or thickness of the finished wall and extending 6mm beyond the finished face of the structure on both sides.
06. All elbows shall be long radius type except where space limitations necessitate use of short radius type.
07. The Contractor shall provide all stop valves, balancing valves, check valves, drain cocks, steam traps, dirt traps, automatic vents, manual vents, thermometers, pressure gauges, strainers and other specialities as are required for proper operation of the whole system. Generally necessary valves etc are shown in the drawings. All valves, strainers and specialities shall be selected for 7 bar rating or 125% of working pressure of the system whichever is higher.
08. The Contractor shall provide strainers where necessary to protect all equipment, automatic control valves etc. where proper functioning would be affected by the dirt on the seat or by scoring of the seat.
09. At the time complete plant is operated and tested and any of the coils etc. do not have rapid and noiseless circulation due to trapped or air bound connections or any other reason of defective installation and workmanship, the Contractor shall be responsible to make proper alterations in these defective connections.
10. The piping installation shall not be accepted until it is free from foreign matters to the satisfaction of the Engineer.
11. The piping for fluorocarbon refrigerant circuits shall be hard drawn copper tubing with silver soldered joints. Equipment, valves, strainers, etc. shall have flanged joints as required for easy dismantling and servicing. In case of size 5/8" OD and below.
12. Fluorocarbon refrigerant piping shall be hard drawn seamless copper piping of refrigeration service quality.

6-SHEET METAL DUCTING

1. All sheet metal duct work shall be fabricated from commercial quality prime finish galvanized steel sheets. The specifications for USA and Canadian sources shall be base steel sheets according to ASTM designation A366:62T and zinc coating according to 525-64T, 1.25 oz./sq.ft. and for all other sources base steel sheets cold rolled B.S. 1449:Part 1B:1962 and zinc coating according to B.S. 2989:1958 Class D, 1.25 oz./sq.ft. The zinc coating should

be applied uniformly by continuous hot dip method to both sides of the base metal so that the sheet metal can be drawn, formed, lock-seamed and spun without danger of flaking or peeling off the zinc coating.

2. All uninsulated ducts shall be cross broken. Insulated ducts not to be cross broken.
3. All ducting shall be substantially built with approved joints and seams shall be made smooth on the inside and neat on the outside. The duct joints shall be made as air tight as possible. The laps shall be made in the direction of air flow and no flanges shall project inside the ducting.
4. Ducts, the width of the greater dimension of which exceeds 30 inches shall be constructed of not more than four feet sections. Ducts, the width of the greater dimension of which is 30" or less shall be constructed of not more than eight feet sections.
5. All elbows shall preferably be full radius type. If space does not permit, square elbows may be used with double thickness shop fabricated turning vanes riveted with the ducting. Due to space limitations curved elbows with less than a full radius bend may also be used provided single thickness turning vanes are installed in the elbow. Full radius elbows of widths 40"-60" shall have one and over 60" shall have two single thickness turning vanes. Minimum throat radius of any curved or square elbow shall be 3 inches.
6. Wherever necessary in duct work, casings or sheet metal partitions, suitable access doors and frames shall be provided to permit inspection, operation and maintenance of valves, controls, fire dampers, filters, bearings, traps or other apparatus concealed behind the sheet metal work. Access doors shall also be provided at distance not exceeding 23m for duct cleaning. All such doors shall be of double construction, of not less than 20 gauge G.I. sheet metal and shall have sponge rubber gasket around the entire perimeter to make the joint airtight. They shall be hung on heavy flat hinges and shall be secured in the closed position by means of wing type catches. In no case shall access to any of the items of equipment requiring inspection, adjustment or servicing require the removal of nuts, bolts, screws, wedges or any other screwed or loose device.
7. The supply and return air duct connections with the fans and equipment shall be made through heavy duty air tight pre-fabricated flexible duct connector to prevent transmission of vibrations. The flexible duct connector will have 75mm 24g G.I. sheet, 150mm of fabric and 75mm 24g G.I. sheet. The fabric shall be fixed with G.I. sheets with double-lock grip. The fabric shall be non-combustible heavy glass fabric double coated with fire retardant neoprene to become fully water proof and air tight of approx. 30oz weight per sq.yd. The flexible connector shall be Duro-Dyne Super Metal Fab or approved equal.
8. The ducts shall be adequately supported from hangers firmly fixed and generally suspended from the building structure with the help of concrete inserts, rawl bolts or shooting bolts. The hangers and supports shall not pierce the insulation which shall be suitably protected and reinforced at that location. The bottom support shall be 30x6mm M.S. flat or 25x3mm angle for ducts up to 12" width, 30x3mm angle up to 30" width, 40x3mm angle upto 72" width and 50x5mm angle upto 96" width. Hangers shall be spaced on average 3 meter centers with a hanger no further than 300mm on each side of any changes of direction. Ducting passing through building expansion joints shall be supported on either side of joint. The hangers for horizontal ducts shall be 9mm round rods for ducts upto 30" width, 12mm round rods or 40x3mm M.S. flat upto 72" width and 40x5mm M.S. flat upto 96" width. The vertical ducts shall be supported at each floor with M.S. angle or channel supports resting on slab and bolted with the duct bracing or MS flat straps riveted

with the duct. Perforated band or wire shall not be used in any case for supporting the ducts.

9. The low pressure ducting with static pressures upto 50mm wg and velocities upto 10mps, shall be fabricated 22 Gauge, standing seam joint and with 25x25x3mm bracing.
10. Dampers less than 200mm wide (90 degrees to damper rod) may have through damper rod with bent handle and position indicator. Dampers wider than 200mm shall have through damper rod with quadrant and lever with lock screw with position indicator at one end damper lever shall be fastened to rod with set screws. On insulated duct work, quadrants shall be mounted on metal saddles finishing flush with insulated surface. The quadrant and lever unit shall be factory fabricated, made of heavy gauge steel electro galvanized, Thermec model UNXLD or as approved. Bearing at handle end shall be of cast iron or brass with set screws, bearing at opposite end shall be of brass with close fitting rod hole; bearings shall be riveted to duct.

7-INSULATION

- 1.0 The thermal conductivity at 40°C for fiberglass insulation minimum density 64 kg/cum. shall be not over 0.032, for flexible foamed plastic insulation average minimum density 80 Kg/cum. not over .040, and that for fire retardant self-extinguishing type expanded polystyrene insulation minimum density 24 Kg/cum. not over .030 W/m °C.
- 2.0 The insulation shall be fully fixed to the piping with approved adhesive compound recommended by the manufacturer. Special P.V.C. or resin based adhesive compound shall be used for polystyrene insulation and mineral oil based adhesive shall not be used. Adhesive to be Mayasol, Dollar Industries HV-275 Hoechst 270 Mowilith, Zahabia Sealing Gum ZCL-12 or approved equal.
- 3.0 Each pipe shall be insulated separately with pre molded pipe insulation and gaps, if any, shall be filled with the same insulation material. All circumferential and longitudinal joints shall be sealed with at least 50mm wide self-adhesive tape of approved quality. In case of chilled water piping, PVC impregnated canvas vapor seal type tape or Polyethylene coated cloth high moisture resistance type tape shall be used. The tape shall be pressed down firmly to ensure an efficient seal and smoothed out to avoid any gaps and wrinkles.
- 4.0 The insulated piping in the plant rooms and near the equipment at levels 2m and below shall be further protected with a jacket of 28g G.I. or aluminum sheet.
- 5.0 External and weather exposed insulated piping shall be further protected with an external jacket as specified in the Schedule of Materials. The external jacket may be of 28g G.I. or aluminum sheet or Zahabia 1mm thick Polymeric canvas felt or approved equal. A full coat of Zahabia Sealing Adhesive Coat, Type ZSAC-10 or approved equal, shall be given on the canvas jacket and internal side of canvas felt. When the adhesive is nearly dry, the canvas felt shall be wrapped on the piping ensuring that the wrapping is smooth and free from wrinkles and bubbles. All joints overlapped atleast 40mm and fully sealed with the adhesive. The canvas felt jacketing shall be fixed and finished as recommended by the manufacturer.
- 6.0 Insulated piping buried in ground shall be further protected with a jacket of Zahabia 1mm thick Polymeric canvas felt, or approved equal. The canvas felt shall be fixed with adhesive and finished as specified above.

8-INSTALLATION

- 1.0 The Contractor shall be responsible for the supply, manufacture, fabrication, assembly and installation of all the above items and all other items, accessories and materials required to complete the installation and make the plant ready for operation in all respects.
- 2.0 The installation work shall include all rigging, setting, assembling, aligning and grouting necessary to prepare each of equipment and its integral parts for normal continuous operation in locations shown on drawings and special attention shall be paid to all installation notes on the drawings and instructions in the manufacturers' technical bulletins.
- 3.0 The Contractor shall arrange for progressive shipment of equipment/materials with emphasis on early delivery for the items to be installed in the occupied areas. The shipments should commence and be completed within the periods specified in the Memorandum.
- 4.0 The Contractor shall be required to complete the work in all respects on floor wise basis. All work in an occupied floor will be completed and tested in all respects and then the Contractor will not be allowed to do any other work in that floor or interfere with the building finishing work of the Main Contractor except for the final testing and adjustment when the complete plant is commissioned and operated.
- 5.0 The Contractor shall be required to complete the installation in the occupied areas progressively and the entire installation within the times stipulated in the Memorandum.
- 6.0 The Contractor shall follow the procedures outlined in manufacturers' instruction books for handling, setting, assembling, installing, aligning, grouting etc. of equipment. For equipment not supplied with instruction books, the Contractor shall follow standard practices that are acceptable to the Engineer/ manufacturer taking all precautions to prevent damage to the equipment. The Contractor shall advise the Engineer of the installation procedure to be followed for each equipment and shall keep the Engineer informed as to the progress of the installation.
- 7.0 Equipment which is not weather proofed or which may be designated by the Engineer as subject to damage if exposed to the elements shall be covered and protected with tarpaulins or other approved means.
- 8.0 All equipment such as pumps, motors, refrigeration machines, air compressors, etc. shall be set carefully to the proper line and elevation and aligned, then bolted down and grouted in place.
- 9.0 After the piping has been installed, the coupling halves connecting driving and driven portions of equipment shall be checked for alignment. Wherever misalignment is found, the coupling halves shall be disconnected and the equipment shall be realigned. Piping or duct work which is connected to any equipment shall be supported by adequate hangers or other supports and shall be entirely free of any supporting assistance by the equipment. When the alignment is correct, the equipment shall be drilled and dowelled to the base plate. Accurate records shall be kept for the aligning of all rotating equipment.
- 10.0 Coupling bolts shall not be installed permanently until the correct direction of rotation has been established for the equipment. Wherever the manufacturer has not provided a directional arrow or marker, the Contractor shall provide the same.

- 12.0 All uncrating, unpacking, cleaning, degreasing, removal of skids, protective covering and inspection prior to installation shall be performed by the Contractor. Due diligence and extreme care shall be exercised to prevent distortion and damage when unloading and moving equipment to its proper location. Ropes or slings shall be attached to the equipment as recommended by the manufacturer and in such a manner that the weight is properly distributed without abnormal strain on the equipment.
- 13.0 All equipment shall be inspected prior to start-up by the Contractor. All work required to satisfy the inspection at the time of start-up such as but not limited to unbolting of covers, access doors, special scaffolding for inspection, removal of foreign matter, removal of belt guards, tightening of hold down bolts and flanges, etc. shall be performed by the Contractor.
- 14.0 All required protection of shafts, flanges and similar parts of the equipment by grease coating or otherwise shall be provided.
- 15.0 The Contractor shall furnish and install extension handles, extension oil cups or such similar fittings or appliances for lubrication, etc. of all equipment where same is not easily accessible, unless otherwise specified or shown on the drawings.
- 16.0 Interferences. The Contractor shall coordinate the work of the different trades in order that interference between mechanical, electrical, architectural and structural work will be avoided. Piping, ducts, etc. shall be kept as close as possible to ceilings, walls, columns etc. in order to take up minimum space and all off-sets, fittings etc. required shall be furnished and installed by the Contractor without additional expense to the Employer. In case interference develops, the Engineer will decide which equipment, piping, etc. shall be relocated, regardless of which was first installed

9-CLEANING, TESTING AND ADJUSTING

- 1.0 All air ducting sections shall be given a pressure test before fixing insulation and cutting openings for air devices. Any opening made shall be sealed off with air tight metal caps or any other convenient device for giving the pressure test.

The ducts shall be pressurized with a rotary blower or nitrogen cylinder:

- (a) Low pressure ducts upto 50mm wg.

All seams and joints shall be checked and all audible and noticeable leaks repaired in a good workmanlike manner by filling with a sealant, Zahabiya Duct Sealant or approved equal, from to the inside of the joint so that the air pressure tends to force the sealant into the joint.

The Contractor shall follow SMACNA procedure to carry out final measured leakage test for medium or high pressure ducting. A cfm leakage upto 10% of the volume of the duct section under test shall be permissible.

- 2.0 All refrigerant piping shall be tested with dry nitrogen at a pressure 1-1/2 time the operating pressure or at the test pressure limits fixed by the manufacturer. Refrigerant 12 and 22 systems shall be tested at 10/20 bar on the low/high sides respectively but air cooled Refrigerant 22 high side at 27 bar. The pressure shall be maintained for sufficient time to detect leaks and defects. All leaks and defects shall be made good in proper workman like approved manner. If necessary the piping shall be taken down and re-erected and any make shift or temporary repair of leaks will not be permitted. The

pressure shall be maintained for atleast 24 hours in the final test. The system shall subsequently be given 975 mbar vacuum test for sufficient time to detect leaks and defects. Final vacuum shall be maintained for atleast 24 hours.

- 3.0 The Contractor shall test all electric motors, electric wiring and earthing and furnish test records to the Engineer.
- 4.0 After the entire installation has been completed, the Contractor shall operate the equipment under normal working conditions making all necessary adjustments in the equipment, plants, balancing valves, automatic controls, air vents, pressure reducing valves, air dampers, air devices, etc. until all requirements of performance are met.
- 5.0 Air Balancing.

All air systems shall be adjusted and operated for as long a time as necessary to test air flow in all parts of a system and the Contractor shall make all necessary adjustments to obtain proper and uniform air distribution throughout the Building, meeting the specified design requirements. The Contractor shall arrange for this purpose high quality instruments and meters duly calibrated and certified by the manufacturer and having all necessary probes, jets, scoops and collectors for measuring supply, return, fresh and exhaust air velocities and cfm, static pressure and total pressure in the ducts, plenums, fans, air handling equipment, supply, return, fresh and exhaust air devices (grilles, registers, diffusers and louvers). The suggested instruments are Alnor Series 6000-P Velometer or Alnor Compu Flow Electro Manometer with Micro Printer, Cambridge-Alnor PMS Meter and Dwyer combination Manometer-Air Velocity Meter. The Contractor shall inform the Consultant about the instruments he proposes to use.

Air balancing and testing shall not begin until the system has been completed and is in full working order.

10-ELECTRIC WIRING

- 1.0 The Contractor will be responsible for complete electric wiring and earthing of the plant, equipment and controls. The Employer shall only provide 3 phase and neutral, 4 wire electric supply point(s) with two earthing points, and 1 phase, neutral and earth, 3 wire electric supply point(s) at locations shown in the drawings and detailed elsewhere in the documents.
- 2.0 The electrical work shall be carried out by licensed workmen authorized to undertake such works under the provisions of the Electricity rules.
- 4.0 The climatic conditions shall be temperatures between 2°C (min) and 45°C (max) with max. relative humidity 90%, unless lower min. and higher max. temperatures are specified elsewhere in the documents.
- 5.0 The electric wiring shall be carried out in MS or G.I. conduits as specified, 18g G.I. sheet metal trunking or cable trays, or G.I. (medium weight) piping as specified and/or shown in drawings. All wiring buried in floor or exposed to weather to be in G.I. piping (mw). MS conduit to be of 16g, given anti rust coating and then painted with black enamel paint. Conduits buried in slabs or walls may be PVC conduits or PVC Class D pipes as specified in the drawings. Sheet metal trunking or cable trays installed indoor shall have ventilation slots; those installed in Building shafts shall have removable covers and installed outside shall be of weather proof construction with removable covers. The wire sizes shall be selected for satisfactory operation at least 45°C ambient temperature derated according to installation method and grouping as envisaged.

- 6.0 The terminal connections for motors and where required for starters, shall be made in flexible conduit. The terminal wiring for 230 volt, 1 phase below 0.5 HP motors (such as for fan-coil units, small ventilation-exhaust fans) and their starter control switches can be exposed PVC insulated and sheathed wiring, connections protected within the terminal box so that no live lead is exposed.
- 7.0 The wiring for electric/electronic automatic controls shall preferably be with single conductor wire which may be PVC insulated within metal conduits, exposed shielded or exposed PVC insulated and sheathed wiring in accordance with the recommendations of the control manufacturer. The live connections shall be protected by the cover plates to avoid any hazard. The wiring outside the plant rooms or fan-coil unit enclosures must be in conduit to avoid any mechanical damage.
- 8.0 All Motor Control Centres(MCCs) or Control Boards shall be Factory fabricated of an approved listed manufacturer.
- 9.0 On each Motor Control Centre (MCC), the incoming supply shall have a circuit breaker for 20 amps and above rating and circuit breaker or disconnect switch with fuses for lower rating.
The circuit breaker shall be of high rupture capacity, heavy continuous duty, moulded case type (MCCB) for 1000amps and below rating and air-breaker (ACB) type for rating above 1000 amps. The circuit breaker shall have adjustable magnetic short circuit trip and adjustable thermal overload trip. In MCCs with multi circuit outgoings, the incoming MCCB of 100amp and above or ACB shall have high and low voltage release, rated 415 volt $\pm 20\%$ adjustable range. The MCCB or ACB to be manually reset after trip. The minimum rupture capacities (IEC 157-1 P-1 rating or IEC 947-2 Icu rating) at 415 volt of MCCBs shall be as follows:

RATING	RUPTURE CAPACITY
Up to 30 amp rating	10 KA
40 to 225 amp rating	25 KA
250 to 400 amp rating	30 KA
500 to 600 amp rating	35 KA
800 amp rating	50 KA
1000 amp rating	65 KA

Miniture Circuit Breakers (MCB) shall have minimum rupture capacity of 5KA and to have off-on-reset switch with handle. The 3-phase MCB shall make or break all 3 circuits simultaneously. MCB may be used for single phase circuits up to 30amp rating. 3-phase MCB may be used for motors 4HP and below or for general power supply circuit 30amp and below.

The disconnect switch shall be rotary type. The fuses shall be HRC time lag link type according to BS 88:1952 and ASTA-20 certified. Two sets of replacement HRC fuses shall be supplied as spare for each disconnect switch.

Each outgoing individual circuit shall have a ACB or MCCB or MCB or disconnect switch with fuses according to rating limits specified above. The outgoing for each motor circuit shall be provided with:

1-phase MCB	for single phase motors up to 1HP
3-phase MCB	for 3-phase motors 4HP and below.
MCCB	for 3-phase motors above 4HP.

- 10.0 Single phasing preventer relay shall be provided for each 3 phase circuit of 1 HP and above rating as part of motor starter.
- 11.0 The Contractor shall supply and install necessary Motor Control Centres (MCCs), Control Boards, circuit breakers, disconnect switches, fuses, MCBs, earthing, etc. to complete the work. It is required, where possible, to mount all circuit breakers, disconnect switches, fuses, starters, contactors and relays, etc. in one machine room on one MCC for ease of operation.
- 13.0 The Contractor shall submit schematic electric wiring diagrams, manufacturer's construction drawings, component selection lists with manufacturers' technical literature for all components proposed to be used to the Consultant for checking and approval before the fabrication of MCCs and Control Boards is commenced. The work will be carried out only in accordance with the approved drawings and components.
- 14.0 All components and wires shall be selected/sized with required derating for site ambient and altitude as specified and close grouping within the enclosed space of a MCC or Control Board.
- 15.0 Each Motor Control Centre shall have three phase indicating lights, incoming supply voltmeter with phase selector switch, three ammeters one for each phase if more than one outgoing and total load 30 KW (40 HP) and above, an incoming ACB or MCCB according to load, a MCCB or MCB for each outgoing according to circuit rating, motor starters, ammeters, indicator lights, etc.
All starters/contactors for motors and equipment operation control shall have rotary type hand/off/auto switch. With HOA switch in "auto" position the motor/equipment shall be remote operated from the MCC so designated or Building DDC System as specified, "hand" position would permit local operation and testing, while the "off" position would ensure that all circuits are deenergised for servicing and checking.
- 16.0 Each out going shall circuit shall have a MCCB according to circuit rating and indicating lights. Each out going for motors shall have rotary type hand/off/auto switches, star-delta motor starters, contactors, ammeters, etc.
- 17.0 Contractor shall provide three set of fuses, indicating lamps, one manometer and one voltmeter as spares.
- 18.0 List of approved manufacturer

S.NO.	DESCRPTION	MANUFACTURER
A	MCCBs, ACBs	ABB, Fuji, Hitachi, LS (LG) , Merlin Gerin or Terasaki
B	Contactors and Starters	ABB,Fuji, Hitachi, LS (LG) , National, Siemens, Square D or Telemecanique
C	MCBs	ABB, Emzed-Kopp, Hitachi, LS (LG) or Merlin Gerin, manufacture
D	Wires and Cables	AGE Industries Ltd./ Newage Cables Ltd./Pakistan Cables Ltd./Pioneer Cables Ltd. manufacturer or approved equal.
E	Steel conduits	Hilal or IIL manufacturer
F	PVC conduits	Shavyl or Galco manufacturer
g	PVC class D	Dadex-Eternit or Shavyl manufacturer

ACBs, MCCBs, MCBs, Contactors and Starters shall be of listed Manufacturer's country of origin and not substitutes.

11- SPECIAL TOOLS AND INSTRUMENTS FOR MAINTENANCE

- 1.0 The Contractor shall supply to the Employer all necessary special tools and instruments required for proper operation, servicing and maintenance of the complete plant.
- 2.0 The tenderer shall give a complete List of special tools and instruments included in his tender.
- 3.0 Amongst others, following shall be included without limitation:
 - 3.1 Tong Tester of suitable range with Amp, Volt and ohm scales.
 - 3.2 One set each of open end, ring and adjustable spanners.
 - 3.3 One set each of flat and Philips head screw drivers.
 - 3.4 Set of hammers.
 - 3.5 Two pliers with flat and pointed nose.
 - 3.6 Set of Adjustable wrenches (Make: Force)
 - 3.7 Offset Box Wrenches (all Standard Sizes) (Make: Force)
 - 3.8 Electric Air Blower, Industrial Type (Make: Hyundai)
 - 3.9 Bench vice (6" Size) = 01 No.
 - 3.10 Karcher Machine (Make: Karcher)

12-MAINTENANCE

01. The Contractor shall be responsible without additional charge to the Employer for maintenance and servicing of the complete plant during the period of maintenance named in the Memorandum after the issue of the Certificate of Substantial Completion by the Engineer.

02. The Contractor shall be responsible for arranging all tools, instruments and Technical Staff including Specialist Technicians/Engineers required for the work. The Employer shall be responsible to supply all materials and spare parts required for the work excluding parts defective due to manufacturing defect which shall be replaced by the Contractor under the terms of the contract.
03. The Contractor shall service the complete plant regularly according to the Schedule of Servicing and Maintenance as approved or amended by the Consultant but not less than once a month during the operational seasons. The servicing and maintenance shall be carried out by competent skilled labor under supervision of a qualified Engineer. The Contractor shall take a certificate of satisfactory completion of monthly servicing from the Employer's Representative.
04. The Contractor shall carry out annual servicing, maintenance and overhauling of the complete plant at the end of the operational season and make the plant ready for operation in all respects well before the commencement of the next operational season. On receiving notification from the Contractor that annual servicing, etc. is nearing completion, the Consultant shall check the work carried out and give directions to the Contractor for completion of outstanding work, if any.
05. On satisfactory completion of annual servicing, maintenance and overhauling of the complete plant, the Engineer shall issue a Certificate of satisfactory completion to the Contractor.

14- THERMAL AND ACCOUSTIC INSULATION

PART ONE GENERAL

1.1 REFERENCE

- 1.1.1 Conform to General Requirements and Conditions for MEP Works, Division 1 Section 01 00 00.
- 1.1.2 Conform to Special Requirements for Mechanical Works Section 23 05 01.
- 1.1.3 Refer to detail sheet in the drawing package.

PART TWO PRODUCTS

2.1 ACOUSTIC DUCT LINER

- 2.1.1 Fibre glass duct liner with fabric on air side, to ASTM C1071 type 2 rigid board type, 48kg / m³ density; 121°C maximum service temperature: maximum face velocity on fabri side 20.3m/s; non combustible; 25mm thick.
- 2.1.2 Application: 25mm thick where shown on drawings.

2.2 INSULATION SCHEDULE

2.2.1 Insulation shall be as per following schedule:

CONDENSATE PIPING	Elastomeric Foam Insulation 25mm thickness
SHEET METAL DUCTWOR	
Indoor	¾" Close Cell Foam Insulation

Outdoor	1" Close Cell Foam Insulation
Five Ducts	Rockwool Blanket with GI wire mesh 96 Kg / m3 density finished with insulating cement and painted.
Kitchen Hood Ducts	Calcium silicate block insulation wire mesh and finished with insulating cement and painted.

2.2.2 All insulation required for the work shall be new, of first-class quality and shall be furnished, delivered, erected and finished in every detail, and shall be so selected and arranged as to fit properly into the building spaces. Where no specific kind or quality is specified, a first-class standard article as approved by the Architect shall be provided.

2.2.3 Jackets and Facings

Vapor barrier jackets and facings shall have a permeance rating not to exceed 0.02, puncture resistance not less than 50 Beach units, and tensile strength no less than 241 .33 kPa in width.

Jackets and facings on insulation in exposed areas shall have a white finish suitable for painting without sizing.

All exterior ductwork shall be clad with 26 gauge Aluminum cladding

PART THREE EXECUTION

3.1 EXECUTION

3.1.1 No installation shall be applied to any surface, until all foreign matter has been removed from the surface to be installed. All insulations shall be applied in a manner consistent with good practice and method.

3.1.2 Insulation shall be continuous through floors, walls, partitions, etc. except when otherwise indicated or specified. Where space will not permit application of insulation in wall or slab chase, the chase shall be packed full of 85% magnesium mineral wool asbestos rope, or fiber glass and protected with covers plates as approved by the consultants.

3.1.3 For cold air ducts, fiberglass insulation shall have vapour barrier of aluminum foil with internal fibreglass yarn reinforcement at maximum 5mm centers fixed with approved quality adhesive. Care shall be taken such that vapour barrier is not damage / pierced during installation, and any damage will be repaired with the same quality of vapour barrier. The installation shall be firmly fixed on the ducting / plenums with approved quality adhesive compound recommended by the installation manufacturer's Adhesive to approve by Consultant. The adhesive shall cover at least 25% duct area on the side and top, and 50% area at the bottom. All circumferential and longitudinal joints shall be lapped at least 50 mm and fully sealed with adhesives. Where rectangular ducts are 600 mm in width or greater, the insulation shall further mechanically secured to the ducts, and at least 25 mm wide metal bands shall be applied at the corners so that the mechanical fastener does not pierce the insulation and vapour barrier.

3.1.4 The insulation shall be applied to the full length of the ducts, including portions where internal sound absorber liner etc is fixed.

- 3.1.5 All access doors and removable panels shall be insulated and jacketed separately. The insulation jacket ends on the duct and door or panel shall be sealed with 50 mm wide PVC vapour seal self-adhesive type tape to prevent damage to the insulation due to use and servicing. Exposed cold air ducts in unconditioned spaces shall be insulated with 50 mm thick, 32 kg/m³ dense Fiberglass insulation vapour sealed as specified above.
- 3.1.6 External and weather exposed insulated ducting shall be insulated as specified and then protected with a jacket of 20 kg roofing felt, all joints sealed with hot bitumen PBS PB4 or approved equal. The jacket shall be further mechanically secured to the duct with 6 mm wide soft aluminum bands, generally spaced at 450 mm. Indigenous coarse cloth, canvas roofing felt and asphalt impregnated kraft paper of approved quality are to be used.
- 3.1.7 25mm thick rigid fiberglass duct insulation with a thermal conductivity of 0.041 W/m.°C at 23.8°C and a density of 48 kg/m³. Insulation shall be complete with a vapor barrier: jacket consisting of aluminum foil reinforced with fiberglass yarn and laminated with Kraft paper.
- 3.1.8 Insulation shall not be applied, unless the piping or apparatus to be covered has been tested according to specification.
- 3.1.9 All cements and adhesives shall be as recommended by the manufacturer of the insulation. Insulation, insulation jacket, canvas and adhesive shall be fire retardant with a flame spread not larger than 25 and a smoke developed rating not larger than 50 11 when tested in accordance with standard E 84-61 of the ASTM.
- 3.1.10 Insulation shall be installed in accordance with the manufacturer's printed installation instructions.
- 3.1.11 Valves and fittings shall be insulated with the same material as the pipe.
- 3.1.12 At each hanger or support for chilled water piping, the contractor shall install a section of high-density insulation between the pipe protection saddle and the pipe. Only the lower half of insulation, at hanger, will be replaced by an insert of high-density material so the top of pipe insulation and vapour barrier can be continuous. The high-density insulation shall be calcium silicate and extend 25mm beyond each end of shield. Seal with vapour barrier mastic.
- 3.1.12 Insulation for diesel or gas engine exhaust pipe and muffler shall be 50mm (2") thick calcium silicate. Do not insulate expansion bellows. Insulation shall be protected with 1.0mm aluminum cladding.
- 3.1.13 Where pipes are exposed to outside or unconditioned exposed spaces, they shall be covered with 0.8 mm thick Aluminium cladding.
- 3.1.14 Insulation for pipes, duct and other equipment in mechanical rooms and where exposed to weather; shall be enclosed in 0.8mm thick aluminum cladding with all joints sealed and arranged to shed water.
- 3.1.15 Where thermal insulation is applied to the outside, equipment and plant used to convey, store or generate fluids or gases at temperatures lower than the design

ambient dew point temperature a water vapour barrier shall be provided. The vapour barrier shall be applied such that it is continuous and gives protection to the whole surface of the insulation which it protects. It shall not be pierced or otherwise, damaged by supports or by the application of external cladding. At points of support, means of load distribution shall be provided as necessary.

3.1.16 Apply insulation in strict accordance with manufacturer's recommendation including all seals and adhesive taking care of compatibility of such adhesives with the insulation. Submit manufacturer's data and compatibility recommendations for review.

3.1.17 Duct Insulation:

The Contractor shall supply and fix thermal insulation in accordance with BS 5970 and as detailed below:

3.1.17.1 All sheet metal fresh air, supply and return air rectangular metal ducts inside the building shall be thermally insulated with 25mm thick rigid glass fiber insulation. All external ducts shall be insulated with 50mm thick insulation slabs. Extract and transfer air ducts shall be insulated unless they carry cooled air and are located in non air conditioned space such as roof, basement, masonry shafts, etc. or where any possibility exists of condensation within or on the outside of the duct.

3.1.17.2 The insulation shall be faced with class 0 fire spread glass reinforced aluminum foil on one side of the mat. Insulation density shall be 48kg/m^3 and the "K" value shall be $0.031\text{ W/m}^2\text{C}$. The insulation shall be fixed to the duct with a suitable fire resistance adhesive. Where duct sides or bottoms are greater than 1 m, the insulation shall be additionally supported by Nylon handles and washers bonded to the duct surface at 300mm centres with approved adhesive.

3.1.17.3 All ductwork insulation will be wrapped with canvas sealed with approved paint and vapor barrier.

3.1.17.4 The thermal insulation will be installed by skilled labor and will be applied in accordance with the requirements of the BS 5970. The thermal insulation of ductwork will not commence until satisfactory completion of the ductwork, is achieved to the Engineer's approval. All surfaces to be installed will be thoroughly cleaned and de-greased before the application of adhesives or fixatives. Sample lengths or insulated ductwork incorporating stiffening angles and standing steam 3.1.17.5 All insulated ductwork outside the building (i.e. on the roof) and insulated ductwork within the plant rooms, shall be clad in 0.8mm thick aluminum sheet.

3.1.17.6 Rivets and screws shall not be used to fix the cladding unless means are incorporated to ensure that the duct vapour barrier is not punctured and the method is approved by the Engineer in writing

3.1.17.7 Insulation for fittings, valves, flanges, and accessories, same thickness as adjacent pipe insulation.

- 3.1.17.8 Strainers, expansion joints and other specialties requiring periodic servicing or inspection shall be provided with insulation covers, removable and replaceable without damaging insulation, vapor barriers or finishes.
- 3.1.17.9 Insulation on hot pipes shall be protected from hangers, guides and rollers by pipe protection saddles welded to the pipe, and filled with pipe insulation or insulating cement. Saddles shall not be welded to the pipe hanger or support.
- 3.1.17.10 Insulation on cold pipes shall be protected from hangers, guides and rollers by a 180° galvanized steel shield on the outside of the insulation and vapor barrier. A half-section of waterproof, calcium silicate, high-density insulation of the same thickness as the pipe insulation, and full length of the shield, shall be used to support the weight of the pipe at the shield. Shields shall be of sufficient length to allow for the maximum pipe movement and hanger load at the specified hanger spacing.
- 3.1.17.11 All vapor barriers shall be completely sealed against moisture penetration.
- 3.1.17.12 Wherever external duct insulation is specified and internal acoustic treatment of equivalent insulating effect is also required for the same location, the external insulation may be omitted.
- 3.1.17.13 All duct sleeves and openings penetrating floor slabs, partitions, walls, etc., shall be packed with approved fire resistive material and sealed with non-hardening mastic.

AIR HANDLING UNITS

PART ONE GENERAL

All air handling units shall be ARI, AMCA or Eurovent certified. Proof of certification required with the bid submission.

PART TWO PRODUCTS**A. MATERIALS****i. QUALITY ASSURANCE**

Furnish Double skin Central Station Modular Air Handling Units of type, size and capacity as set in the equipment schedules. Units shall be constructed to comply with the requirements of material and workmanship according to the latest ASME Codes or equivalent. Units shall be tested before dispatch and ready for installation, and their performance certified in accordance with ARI standard 430 or equivalent.

ii. COMPONENTS

The units shall be complete with insulated casings, water proof insulated drain pan(s), coil(s), fan(s), motor and starter, adjustable motor and fan drives, V-belts, belt guards, filters, dampers as required, access doors, mixing box(es), vibration isolators and all other items necessary for satisfactory operation. For components required for each unit refer to drawings and schedules.

iii. COORDINATION

The Supplier shall verify and confirm that the dimensions of the units offered by The Supplier are suitable for installation in the space available and he shall be responsible for ensuring that the units are capable of being installed in the available space. The owner shall only place an order with The Supplier based on The Contractor written confirmation.

iv. DELIVERY, STORAGE AND HANDLING

Units shall be delivered factory assembled with protective crating and covering and their delivery coordinated in sufficient time to allow movement into building. The unit base shall be supplied with painted lifting lugs located to suit optimum hoisting stability. Units are to be handled as per manufacturer's written rigging and installation instructions for unloading and moving to final location. Units shall be shipped fully assembled (within freight limitations) on a minimum 10-gauge galvanized steel base rail/ housekeeping pad.

v. WARRANTY

The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor/Supplier under requirements of the Contract Documents.

vi. SPECIAL WARRANTY

A written warranty, executed by the manufacturer and signed by the Supplier, agreeing to replace components (parts + labour) that fail in workmanship, within the specified warranty period, provided manufacturer's written instructions for installation, operation, and maintenance have been followed. Warranty Period, Fans: Manufacturer's standard but not less than 3 years after date of shipment

Warranty Period, Coils: Manufacturer’s standard but not less than 5 years after date of shipment
 Warranty Period, All other Components: Manufacturers’ standard but not less than 2 years after date of shipment

vii. SPARES PARTS

Furnish extra materials described below that match products offered/installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 Manufacture recommended Spear parts for one year operation.

B. COMPONENT FEATURES

1. UNIT CASING

I) GENERAL CONSTRUCTION:

Unit shall be constructed of a complete frame with removable panels. Removal of side panels must not affect the structural integrity of each module. The casing must be able to withstand up to 152mm (6”) positive or 102mm (4”) negative static pressure. All exterior wall panels shall be made of minimum 18 gauge G90 galvanized steel. Closed-cell foam gasket shall be provided where modules are joined, to ensure that no thermal bridge occurs.

II) BASE AND FRAME:

The unit base and upper frame shall be hot dipped galvanized.

III) WALL CONSTRUCTION:

Units shall be double-wall constructed to prevent fiberglass erosion into the airstream and to allow cleaning of the unit interior. Interior wall shall be a minimum of 25mm (1”) thick of either 20-gauge solid plate galvanized steel. Double-wall units shall be factory insulated with minimum insulation density of 32 kg/m³. The insulation thickness and density is to be selected by the manufacturer for indoor and outdoor (weather exposed) type AHU to ensure that the following minimum criteria are met: Heat Transfer Coefficient: 1.15 W/m² K Noise Attenuation Characteristics: As per table below

Frequency (Hz)	63	125	250	500	1 k	2 k	4 k	8 k	Overall
SPL (dB)	11	11	15	25	26	27	27	27	<30

No condensation to occur on unit exterior when air around unit is at: 40°C and 65% RH

All connecting channels shall be so designed and to insulated create thermal bridge to prevent sweating.

IV) DRAIN PAN:

Units shall have an insulated, double wall stainless steel pan under cooling coil section(s) for drainage of condensate. Minimum insulation requirements for the drain pan are as detailed in the section on >Wall Construction=. Drain connections are to be provided on both sides of the unit.

V) ACCESS DOORS AND PANELS:

Full sized hinged removable double-wall access doors with two step safety handles shall be provided for quick access to the interior of the unit casing. Doors attached by screws or doors not continuously gasketed are not acceptable. All doors/panels shall be sealed with closed-cell foam gasketing.

VI) PAINT: Units shall be finished with two coats of baked enamel/powder coating.

2. AHU.S FANS

I) GENERAL:

Fan(s) shall be rated in accordance with AMCA Standard 210. Fan(s) shall be indirectly connected with V-belt drive and selected to produce the capacity required at the static pressure indicated.

II) TYPE:

Fan(s) shall be of fully enclosed centrifugal type, double width, double inlet, forward curved, Class I; or backward inclined, Class I or II; or airfoil, Class I or II. Fan(s) shall be statically and dynamically balanced.

III) HOUSING:

Fan housing shall be constructed of heavy gauge steel equipped with intake cones designed for smooth air flow. Fan discharge shall be connected to cabinet through a 152mm (6") deep canvas flexible connection. Housed fan performance shall be certified as complying with ARI Standard 430-89. Centrifugal fans shall be dynamically balanced at the factory as a complete fan assembly (fan wheel, motor, drive and belts). Fan shafts shall not exceed 75 percent of their first critical speed at any cataloged rpm.

IV) DRIVE:

Drive assembly shall consist of a solid steel turned, ground, polished and greased shaft with heavy duty, self-aligning, re-lubricatable ball bearings. Bearing grease zerks shall be extended to fan drive side. V-belt drives shall be designed for not less than 150 percent of the connected driving capacity. Sheaves shall have at least two grooves, selected to drive the fan(s) at the specified RPM. Motor sheave shall be of the fixed (or adjustable) type.

V) BEARINGS:

Fans shall be equipped with self-aligning, anti-friction pillow block bearings with a minimum life of L-50 200,000 hours. Bearings shall be equipped with grease lines allowing for lubrication from one side of the fan.

VI) MOTORS:

All Fan motors shall be E.C Type.

VII) ACOUSTIC PERFORMANCE:

Minimum acceptable fan/AHU acoustic performance shall be as indicated in table below:

Frequency (Hz)	63	125	250	500	1000	2000	4000	8000	Overall
Fan Lw (dBA)	55	67	75	80	80	78	74	67	85
AHU Lw (dBA)	54	65	69	72	71	65	54	44	76
SPL* (dBA)	43	54	58	61	60	54	43	33	65

Sound Pressure computed at 1.0 m, in free field space

3. AHU'S COILS

I) GENERAL:

Coils shall be designed with aluminum plate fins and copper tubes. Fins shall have collars drawn, belled and firmly bonded to the tubes by means of mechanical expansion of the tubes. No soldering or tinning shall be used in the bonding process. Coils shall be mounted in the unit casing to be accessible for service and can be removed from the unit either through the side or top. Capacities, pressure drops and selection procedure shall be certified in accordance with ARI Standard 410.

II) WATER COOLING COILS:

Water Cooling Coils shall be supplied where scheduled and shall conform to the following minimum specifications: Coils shall be designed to operate at 17.5 bar design working pressure and up to 149°C. Coils shall be tested with 22.75 bar compressed air underwater. Coil circuiting shall provide free draining and venting when installed, counter flow of air and water, with water velocities not to exceed 2.13m/s and without exceeding the water pressure drops scheduled.

All coils shall be enclosed in a coil section. Coil headers and U-bends shall not be exposed. All coils must have same end connections regardless of the number of rows deep. Coils shall have a supply header to ensure distribution of cold water to each tube of coil. Headers shall be either round copper or cast iron. Steel pipe headers are not acceptable. Tubes shall be 51mm (2") or 16mm (5/8") OD.

4. AHU'S FILTERS

I) GENERAL:

Air handling units are to be supplied complete with filters as scheduled, and having the following minimum specifications:

II) PERMANENT FILTERS:

These filters shall be 51mm (2") thick, efficiency up to 35% all metal viscous imprisonment type; capable of operating up to 3.05m/s face velocity without loss of filter efficiency and holding capacity. Filter media shall be layers of cleanable wire maze. Filter frame shall be constructed of galvanized steel.

III) BAG FILTERS (IN FRESH AIR UNITS ONLY)

These filters shall be fine fiber, all glass media with spun backing to keep glass fibers from eroding downstream. Stitching method shall permit bag to retain pleat shape without the use of wire basket support. Bag filters to be furnished with pre-filter to extend life of bag filter. Manufacturer shall supply side access filter rack, capable of holding bag filters and 51mm (2") pre-filters. Bag Filters are to be provided of 85% efficiency. Efficiency of filters shall be determined by ASHRAE Standard 52-76. Filters shall be rated UL Class 2.

5. DAMPERS, MIXING BOXES AND PLENUMS

I) OUTSIDE AIR/RETURN AIR DAMPERS:

Outside air/return air dampers shall be provided to modulate the volume of outside and return air. Dampers shall be of airfoil design and shall be either parallel or opposed blade type with metal compressible jamb seals and extruded vinyl blade edge seals on all blades. Blades shall rotate on stainless steel sleeve bearings. Maximum damper blade length shall be 1524mm (60"). Leakage rate shall not exceed 2.36 l/s at 0.25 bar and 4.25 l/s at 1 bar.

6. COMMISSIONING & TESTING

The unit shall be commissioned and tested as per the Manufacturer's recommendations. Drives shall be adjusted to provide the required air flow rate and valves shall be adjusted for the proper water flows, etc. The Contractor shall be required to carry out tests on forms to be supplied later by the Consultants, and obtain the Consultant's approval. Suppliers' representative shall be present during commissioning and testing to certify that units are commissioned as per manufacturers' recommendations.

S.NO	DESCRIPTION	OFFERED VALVE
1	Make	
2	Country Of Origin	
3	Delivery Time	
4	Warranty Period	
5	Air flow (cfm)	
6	Coil capacity Total (MBH)	
7	Coil capacity Sensible (MBH)	
8	Coil Entering. DB/WB (° F)	
9	Coil Leavening. DB/WB (° F)	
10	Coil face velocity (fpm)	
11	Fan Motor Hp. / make	
12	fan Blower make / Origin	
13	Unit Height	
14	Unit Dimensions	
15	Operating weight	
16	VFD Make	

S.No.	Items	Approved Make
1	VRF System	<ol style="list-style-type: none"> 1. L.G – Korea 2. Daikin-Belgium 3. General-Japan 4. York- Japan Approved Equal
2	Refrigerant pipes	<ol style="list-style-type: none"> 1. Mueller (USA) Approved Equal
3	Pipe/Duct Insulation	<ol style="list-style-type: none"> 1. Aeroflex (Thailand) 2. Aerofoam-UAE Approved Equal
4	UPVC Pipe	<ol style="list-style-type: none"> 1. Dadex 2. AGM 3. Steelex Approved Equal
5	Electric Cables & Wires	<ol style="list-style-type: none"> 1. Pakistan Cables Approved Equal
6	Ventilation/Air Curtains Fan	<ol style="list-style-type: none"> 1. GreenHeck 2. S&P Fans 3. VTS Approved Equal
7	G.I Sheet	<ol style="list-style-type: none"> 1. Pakistan Steel 2. Imported Approved Equal
8	Air Devices	<ol style="list-style-type: none"> 1. Steel Craft 2. Mehran 3. Thermec Approved Equal
9	Concrete Fasteners & anchors	<ol style="list-style-type: none"> 1. Hilti (UK/Germany) 2. Fischers (Germany) Approved Equal
10	Paints	<ol style="list-style-type: none"> 1. ICI (Pakistan) 2. Berger (Pakistan) Approved Equal
11	Motors	<ol style="list-style-type: none"> 1- Siemens 2- ABB Approved equal

S.No.	Items	Approved Make
12	M.C.C & CABLE TRAY	1- Karimi Electric 2- Sunbeam 3- Husain & co. Approved equal
13	Refrigerant Isolation Valve	1- Danfoss 2- Mueller 3- Emersion Approved equal
14	Control wire	1- Belden Approved equal
15	Aluminum Tape	1-Abro industries (USA) Approved Equal
16	FILTER	1- CAMFIL 2- AMERICAN air filter Approved Equal
17	Vapor Barrier Coating	1. Foster (USA) Approved Equal
18	AHUS	1- Daikin -Malaysia 2- Boreas-Turkey 3- York- Turkey 4- VTS-Italy

NOTE:

EQUIPMENT & MATERIAL SHALL BE SUPPLIED ONLY FROM THE AUTHORIZED DISTRIBUTER. THE CONTRACTOR SHALL SUBMIT COMPLETE TECHNICAL DETAILS OF THE EQUIPMENT, MATERIAL AND OBTAIN CONSULTANTS APPROVAL PRIOR TO DELIVERY ON SITE. IN CASE OF "APPROVED EQUIVALENT", IT SHALL BE AT THE DISCRETION OF THE CONSULTANT TO ACCEPT THE ALTERNATE PROPOSAL SUBMITTED BY THE CONTRACTOR.

AROR UNIVERSITY

REVISED BOQ FOR HVAC SYSTEM FOR AUDITORIUM ARE AROR UNIVERSITY, SULLUR, SINDH

S.No	DESCRIPTION	QTY		UNIT RATE (RS)		AMOUNT(RS)		
				COST OF SUPPLY	COST OF INSTALLATION	COST OF SUPPLY	COST OF INSTALLATION	TOTAL COST
1	2	3		4	5	6	7	8
1	Supply, Installation, shifting, Testing & Commissioning of Air-cooled electric operated, condensing outdoor units, High efficiency, High C.O.P, Latest Series inverter base compressors(Reversible) with ACRA-CLAD factory coated condenser fins, , vibration isolators, factory wired weather proof cabinet type control center, Integrated Centralized Remote Controller, Hot dip G.I Drain Tray, atmosphere friendly refrigerant (CFC free refrigerants)etc. Complete with safety controls and accessories as per specification and drawings.(Note: each out-door unit shall have minimum two modular units and each modular unit shall be minimum 2separate refrigerant circuits with separate refrigerant & separate isolation valve.)							
i.	OCU-01 -FOR INDOORS (Connected Load-34 TR)	1	No					
ii.	OCU-02 -FOR DX-AHU-01 (Connected Load. -36.6 TR)	1	No					
iii.	OCU-03 -FOR DX-AHU-02 (Connected Load. -36.6 TR)	1	No					
2	Supply,Installation,shifting, Testing & Commissioning of Indoor units complete with automatic and safety controls, thermostat (wired & remote) and accessories as per drawing and specification.							
A	Cassette Unit							
i	3.0 TR	2	Nos					

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S.No	DESCRIPTION	QTY		UNIT RATE (RS)		AMOUNT(RS)		
				COST OF SUPPLY	COST OF INSTALLATION	COST OF SUPPLY	COST OF INSTALLATION	TOTAL COST
1	2	3		4	5	6	7	8
ii	4.0 TR	7	Nos					
3	Supply, Installation, Testing & Commissioning of DX-Type double skin type Air handling Unit with centrifugal plug fans VFD Driven motor with VFD complete with system BACnet protocol automatic control, VRF Outdoor connection Kit as per drawings and specification	2	Nos					
4	Supply, Installation, Testing & Commissioning of Centralized BMS system for HVAC system, including Integrated Centralized Remote Controller with Software for Remotely Operation, Complete wiring , energy meters/energy management for all indoor/ outdoors,other equipment and other parameters as per specification and drawings.	1	Job					
5	Supply & installation of "Y" joints complete in all respects as per specification. (Note. The piping sizes and Qty shall be as per the equipment's selection from the manufacturer/suppliers)	1	Job					
6	Supply & installation of Copper Piping (ASTM-B-88,B306,819) for VRF System (Liquid + Gas) with 3/4" thick closed cell form insulation on each indoor Units , Hangers with all respects as per specification. (Note. The piping sizes and Qty shall be as per equipment's selection from manufacturer/suppliers)	1	Job					
7	Supply & installation of Copper Isolation Valve complete with all respects as per specification	26	Nos					
8	Supply, Installation, Testing & Commissioning of Hot dip Galvanized Cable try 16 Gauge with cover for copper piping with galvanized hanger supports as per specification and drawings.							

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REVISED BOQ FOR HVAC SYSTEM FOR AUDITORIUM ARE AROR UNIVERSITY, SULLUR, SINDH

S.No	DESCRIPTION	QTY		UNIT RATE (RS)		AMOUNT(RS)		
				COST OF SUPPLY	COST OF INSTALLATION	COST OF SUPPLY	COST OF INSTALLATION	TOTAL COST
1	2	3		4	5	6	7	8
i.	24"x3"	120	Rft.					
ii.	10"x3"	80	Rft.					
9	Supply, Installation, Testing & Commissioning of UPVC Class-D Piping for AC units drain complete with Specialties, closed cell form Insulation, cladding, fitting, hanger supports all other patch work as per the building standards. etc. as per specification and drawings.							
i.	1 1/4" dia (3/4" Insulation)	200	Rft.					
ii.	1 1/2" dia (3/4" Insulation)	100	Rft.					
iii	2" dia (3/4" Insulation)	140	Rft.					
10	Supply, Installation, Testing & Commissioning of Medium pressure G.I. Sheet Metal ducting (Machine Made) as per SMACNA & ASHRAE Standards for air ducting, plenums and other sheet fabrications including splitter dampers, take off, vanes elbows and other necessary fittings with galvanized hanger supports as per specification and drawings.							
i	20 Gauge	2400	Sq.ft.					
i	22 Gauge	3500	Sq.ft.					

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S.No	DESCRIPTION	QTY		UNIT RATE (RS)		AMOUNT(RS)		
				COST OF SUPPLY	COST OF INSTALLATION	COST OF SUPPLY	COST OF INSTALLATION	TOTAL COST
1	2	3		4	5	6	7	8
11	Supply & Installation of flexible closed cell foam thermal insulation 1" thick & 26 gauge G.I sheet Jacketing on air ducts complete with all respect as per specification and drawings.	6000	Sq.ft.					
12	Supply & Installation of 1/2" Foam insulation for Sound liner for supply air ducts complete with all respect as per specification and drawings.	4000	Sq.ft.					
13	Supply & Installation of Air Devices with damper Complete with all respect as per specification and drawings.							
i.	Access door 24" x 24"	10	Nos.					
ii.	Supply Air Multi-Core Jet Panel Diffusers-10" dia	20	Nos.					
iii.	Return Air Grill 36"x36"	10	Nos.					
iv.	Supply Air Grill 32"x10"	8	Nos.					
v	24"x24" Fresh Air Louvers with (GI Filter,V.C.D)	2	Nos.					
14	Supply & Installation of Fire Damper with fusible links Complete with all respect as per specification and drawings.	20	Sq.ft.					
15	Supply & Installation of volume control Damper Complete with all respect as per specification and drawings.	40	Sq.ft.					
16	Additional system atmosphere friendly refrigerant charge as per site requirement Complete with all respect as per specification and drawings.	1	Job					

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S.No	DESCRIPTION	QTY		UNIT RATE (RS)		AMOUNT(RS)		
				COST OF SUPPLY	COST OF INSTALLATION	COST OF SUPPLY	COST OF INSTALLATION	TOTAL COST
1	2	3		4	5	6	7	8
17	Wall cutting for air diffusers and 6" Core cutting and sealing with fire resistance material for refrigerant piping and drain piping complete with all respects.	1	Job					
18	Supply, Installation, Testing, and Commissioning of Electric air curtain Complete with switch as per Specification and drawings							
i	7'-0"	4	Nos					
ii	6'-0"	2	Nos					
19	Supply, Installation, Testing, and Commissioning of Complete Electric power & control wiring complete with PVC conduit & hanger supports, etc. for Equipment as per Specification and drawings. (All the power supply for indoor units/Fans shall be by an electrical contractor with ESP.)							
20	Supply, installation, testing & commissioning of MCC with circuit Breakers, Disconnect switches, phase reversal, phase sequence, fuses, starters etc. for all equipment as per specification & drawing.(Isolation breakers shall be finalized as per manufacturer specifications.)							
a	MCC-01 AT ROOF TOP	1	No					
b	FLOOR HVAC DB	1	No					
21	All Equipment foundation, vibration isolator and equipment lifting, shifting charges from Ground floor to foundation pads as per specification and drawings.	1	Job					

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S.No	DESCRIPTION	QTY		UNIT RATE (RS)		AMOUNT(RS)		
				COST OF SUPPLY	COST OF INSTALLATION	COST OF SUPPLY	COST OF INSTALLATION	TOTAL COST
1	2	3		4	5	6	7	8
22	M&P Services Shop drawings & As Built Drawings Color Copies. (Minimum scale 1-1/8") Hard Copy and Soft Copy in Autocad format in CD	4	Sets.					
23	Cost of System operation training of the client site operational team for 2 month with 1 operators.	1	Job					
24	COST OF ANY OTHER ITEM WHICH IS MISSING AND NECESSARY TO COMPLETE THE JOB. (DETAIL MUST BE ATTACH)							
TOTAL COST OF HVAC SYSTEM. (RS.)								

NOTES:

- 1 THE CONTRACTORS ARE RESPONSIBLE FOR VISITING THE SITE AND DETERMINING THE EXISTING CONDITION AND STATE FOR THEMSELVES BEFORE SUBMITTING THE TENDER.
- 2 The Contractor shall be responsible for the supply, procurement and delivery of all the material and shifting of the equipment to their respective location, installation, testing, commissioning of the systems in all respects.
- 3 The quoted cost should include all overheads, profits, income tax and all other Taxes which are applicable, import duty (if any), insurance, packing, unpacking, transportation charges etc.
- 4 The work at site shall be executed in accordance with the consultant approved shop drawings which will be prepared by the Contractor.
- 5 The work at site shall be executed in accordance with the approved shop drawings which will be prepared by the Contractor within 1 week after award of works and Manufacturers drawings, Contract Specifications etc.
- 6 The work shall be awarded on item Rate cost basis.
- 7 The Owner reserves the right to delete any item before award of works. The cost of such items shall be reduced.
- 8 Abbreviation used in the BOQ are as follows: (a) Sq. Ft Square Foot (b) R. Ft. Running Foot, (c) Ton Ton weight, (d) TR Ton of refrigeration, (e) No. Number, (f) Lot Complete package/lump sum.