OFFICE OF THE DIRECTOR
GAMBAT INSTITUTE OF MEDICAL SCIENCES, GAMBAT

TENDER DOCUMENT FOR HVAC AT GAMBAT INSTITUTE OF MEDICAL SCIENCES (LABORATORY, ACADEMIC BLOCK OT AND ICU BLOCK)

for Financial Year 2015-16

M/S _____

Due on: 03-11-2015 at 12:30pm

1(a) INVITATION FOR BIDS

Date:_____

ADP No: _____

Bid reference No:_____

1. The Director Gambat Institute of Medical Sciences invites sealed bids (the **financial envelop** should be separated with earnest money of 2.5% for each item), from eligible firms a foreign Bidders is entitled to bid only in joint venture with a Pakistani contractor having manufacturing facility in Pakistan.
2. Bidders may obtain further information from, inspect at and acquire the bidding documents from the office of the Director Gambat Institute of Medical Sciences.
3. A complete set of Bidding Documents may be purchased by an interested Bidder s on submission of a writing application to the above office and upon payment of a non-refundable fee of **Rs.3000/-**
4. All bids (Technical must be accompanied by a Bid Security in the amount of **2.5% of Bid Amount** in the form of Security deposit, Bank Draft / Pay order on bid security from or in the form of deposit at call or from a foreign bank duly counter guaranteed by a schedule bank of Pakistan in favor of Director Gambat Institute of Medical Sciences and must be delivered to office of the Director Gambat Institute of Medical Sciences, Gambat District Khairpur (Mir's) Sindh at or before 12:00noon on dated 03-11-2015 Bids will be open at 12:30pm on the same day, in the presence of Bidders representatives who choose to attend at same address.

Address:-

OFFICE OF THE DIRECTOR
GAMBAT INSTITUTE OF MEDICAL SCIENCES,
GAMBAT, DISTRICT KHAIRPR (MIR'S) SINDH.

Director
Gambat Institute of Medical Sciences,
Gambat

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1(b) CHECK LIST

The provision of this checklist is essential prerequisite along with submission of tenders.

S/NO	DETAILS	YES / NO	PAGE# ANNEX.
	KNOCK OUT CLAUSES		
1	Original receipt for purchase of tender Original receipt for purchases of tender for each alternate		
2	The financial envelops should be separated of each item, clearly marked company name and quoted serial item number and name		
3	Copy of earnest money without amount in technical bid		
4	Acceptance of terms and condition, tender documents duly signed and stamped		
5	Sole agency certificates [as per annex: A]		
6	Proof of past import of quoted items from manufacturers (copy of bill of entry & etc)		
7	Original Literature/ Brochure of product showing complete contact details of the manufacturer (as per annex. B)		
8	Copy of previous installation reports in reputable Govt./Private teaching hospitals		
9	Copy of GST Certificate		
10	Copy of NTN Certificate		
11	Copy of Last three years paid income tax challan		
12	Copy of registration with chamber of commerce		
13	Copy of registration with PNRA in case of X-Ray, Ultrasound.		
14	Bank certificate showing financial capability		
15	Bidders questioner proforma for bid evaluation		
16	Price should not be mentioned son technical bid		
17	Certificate / documentary proof of the effect that the Principal is the original manufacturer of the required goods (major components, mainframe, etc)		
18	Certificate regarding quality of production for conformity with international Standards (Copy of certificate FDA, CE, JIS [as per annex.C]		

Signature & seal (bidder):_____

Annexure "A"

Tender item No.	Name of Equipment	Name of Manufacturer

Signature & seal (bidder):_____

Annexure "B"

Tender item No.	Name of Equipment	Name of Manufacturer

Signature & seal (bidder):_____

Annexure "C"

Tender item No.	Name of Equipment	Name of Manufacturer

Signature & seal (bidder):_____

3. TERMS AND CONDITIONS:

3.1 Bid should remain valid for 90 days from the date of financial opening.

3.2 Bidders shall quote their price on C.I.F for Gambat Basis. FOR Offer should be inclusive of all duties/Taxes/Octroi/Transportation etc. and all other expenses on free delivery to consignees end at Gambat Institute of Medical Sciences.

3.3 Price should be quoted for both C.I.F and FOR basis in Figure and words failing which the offer will be ignored.

3.4 Free installation along with all accessories including labor charges/Demonstration at consignees end must be borne by the bidder.

3.5 03 years free service from the date of installation and undertaking regarding availability of spare parts for at least 08-10 years may also be confirmed by the bidder.

3.6 Sole agent certificate for the quoted items from the Manufacturer must be attached by the bidder. Certificate should valid for three years from the date of issue which should be verifiable by concern authority.

3.7 Bidders are required to submit proof of past import of quoted items from Manufacturer by submitting copy of bill of entry (Custom Clearance documents). Bill of landing / Airway bill and etc.. along with their bid.

3.8 The supplier will be bound to train nominated technical personnel to operate / repair and maintain the supplied equipment.

3.9 Bidders should confirm the presence of Manufacturers trained service/installation Engineers/Technicians and provide the detail of their working experience, Manufacturer training Certificate, list of tools and test equipment, approximate area of workshop in the premises of their office and address along with the bid.

3.10 List of hospitals, name of department, contact numbers of the end users, in which the quoted equipment are working must be attached. Copy of previous installation report in a reputed Govt./Private |Teaching Hospitals/ repair certificate if any, of the similar quoted items from the end user should be attached along with the bid.

3.11 In case of purchase of C.I.F, the bidder will bear the charges of clearing agent. Godown Rent, Airline D/O charges and all other charges including Transportation to consignees end excluding custom duty and tax. Certificate will be issued by this office to clarify that the import has been made for the hospital in question so as to avail the facility of exemption of duties/taxes as per Government Rules.

3.12 In this tender envelops procedure as per SPPRA 2010 rules will be followed i.e. Technical and Financial proposal separately, i.e. single stage two envelops system. The envelope must contain tender enquiry no. on the top and TECHNICAL/FINANCIAL PROPOSAL clearly in order to avoid any confusion. The tenders shall be submitted with all documents, drawing literature & catalogue (in equipment) in Technical proposal, with sealing wax. The name of manufacturer or supplier should be affixed on the face of envelop at the left side, moreover, financial envelops should contain financial bid each item separately.

3.13 tenders must be filled in with blue or black ink in the column provided and on separate letter head duly signed.

3.14 The tenders must be free from erasing, cutting and overwriting. in case of erasing, cutting and overwriting, authorized person should initial it.

3.15 The rates of each item should be written in figures as well as in words. In case of discrepancy the price in words will be taken as authenticate and final.

3.16 Conditional tenders will be ignored and will not be considered / entertained / accepted.

3.17 tender shall be accompanied by Earnest Money @ 2.5% of the value of stores quoted by them in form of call deposit / pay order/demand draft in the name of Project Director Strengthening of Gambat Institute of Medical Sciences, Gambat.

3.18 Copy of earnest money (without amount) must be attached along with the technical bid and the original along with financial bid in case of disclosure of price or amount of Earnest Money in the technical bid, the bid will be rejected.

3.19 Original purchase receipt must be enclosed with their technical offer.

3.20 The tender rate (FOR) price should be inclusive of all taxes. Income and sales tax etc payable to Federal and Provincial Government or local bodies and no claims on these accounts shall be entertained.

3.21 The bidder shall furnish General Sales Tax (GST) Registration Certificate of the firm failing which the offer will be ignored. In case the item is exempted from GST either documentary evidence or certificate from competent authority shall be attached with the offer.

3.22 The bidder shall furnish copy of valid Professional Tax Certificate, Income Tax Certificate; Last three years paid income tax Challan, proof of registration with Chamber of Commerce.

3.23 For the X-ray Equipments, bidders must submit a valid copy of Registration with PNRA (Pakistan Nuclear Regulatory Authority).

3.24 Bidder should submit a fresh ban certificate showing strong financial capability of firm.

3.25 the original printed catalogue / technical brochure showing detail technical specification, clear photo/picture of the quoted item, Manufacturers address, Phone number , e-mail address and website must accompany with offer.

3.26 The equipment to be imported comply/certificate at CE / FDA standards certificate should be attached along with the offer.

3.27 Store is required immediately. The tenderer, may however give their short guaranteed delivery period by which the supply will be completed positively.

3.28 If the Contractor fails to attain completion of the supply or installation within the time for completion, he shall pay to the purchaser liquidated damages at the rate of 2% per month (0.5% per week) of the Contract Price, or the relevant part thereof. The aggregate amount of such liquidated damages shall in no event exceed 10% of the bid amount. Once the "Maximum Limit" is reached, the purchaser may consider termination of the Contract.

3.29 Tenderers are required to furnish a detail technical quotation on their letter head and specify the standard and optional items / accessories as required in the tender specification. Bidder should clearly mention make, model and country of origin of the quoted items.

3.30 Choice to select /ignore any alternate offers shall rest with the purchaser.

3.31 tenders shall purchase separate tender documents and furnish purchases receipt for each alternate offer in case they want to submit alternate offers without separate purchase receipt (original) are supposed to be rejected.

3.32 No manufacturer shall authorize their distributor/ agent/ any firm or person to quote the same item which manufacturer quoted it-self in any tender. Failing that offer of both the manufacturer as well as other bidder shall be ignored.

3.33 The bidder shall comprise a single package containing two separate envelops. Each envelops shall contain separately the financial proposal and the technical proposal.

3.34 The envelops shall be marked as **"FINANCIAL PROPOSAL"** and **"TECHNICAL PROPOSAL"** in bold and legible letters to avoid confusion.

3.35 Initially only envelops marked as **"TECHNICAL PROPOSAL"** shall be retained in the custody of the procuring agency without being opened.

4. PURCHASER'S RIGHT TO VARY QUANTITIES AT TIME OF AWARD.

The purchaser reserve the right to increase/decrease or delete the quantities of goods etc at the time of award of contract and also reserve the right to enhance the quantity goods and services originally specified in the schedule of requirements without any change in unit price of other terms and conditions of goods at any time during contract period.

5. NOTIFICATION OF AWARD/ADVANCE CONTRACT:

5.1 Prior to the expiration of the period of the bid validity, the purchaser will notify the successful bidder in writing, delivery by hand or by register by cable to be confirmed that their bid has been accepted.

5.2 The notification of award will constitute the formation of the contract.

6. AWARD OF CONTRACT AND CONTRACT AGREEMENT.

Subject to the fulfillment of all codal formalities, the purchaser will award the contract to the successful bidder whose bid has been determined to be qualified to perform the contract satisfactory.

7. PERFORMANCE SECURITY.

The successful tenderers will have to deposit with the purchase security depots as under in shape of call deposit / bank guarantee at the rate of 2.5% of the value of the contract.

8. PAYMENT TERM:

8.1 in case of purchase on CIF, this office will establish Letter of credit for 80% of contract value in favor of Manufacturer, remaining 20% payment will be release in the equivalent Pak. Rupees of CIF amount after successful completion of delivery of equipment at consignee end. Insurance charges for opening L/C and the difference in currency fluctuation will be borne by bidder.

8.2 Terms of payment for F.O.R purchase 100% after supply of equipment at consignee end.

9 FEE FOR AWARD OF CONTRACT:

9.1 Stamp duty @0.3% shall be borne by the suppliers.

10. UNDERTAKING

10.1 That I/We agree whether our tender accepted for total partial or enhanced quantity for all or any single item. I/We also agreed to supply and accept the said item at the rates for the suppy of contracted quantity within the stipulated period shown in the contract.

10.2 I/We understand and confirm the refund of cost different if the same good is/was supplied at lower rates to any other Government / Semi Government Institution in the Province in same fiscal year.

10.3 I/we undertake that: that I any of the information submitted in accordance to this tender enquiry found incorrect our contract may be cancelled at any stage on our cost and risk.

11. CERTIFICATE

We guarantee to supply the sores exactly in accordance with the requirement specified in the invitation to this tender

Signature of Tenderer: _____

Name & Designation _____

Address _____

_____

_____

12. CRITERIA FOR EVALUATION OF BIDS

Quality and the following evaluation factors criteria will be employed on technical proposals. The number of points allocated to each factor shall be specified in the evaluation report. Only bids securing minimum of 70% marks would be considered for further process.

EVALUATION CRITERIA (ELECTRO-MEDICAL EQUIPMENTS0

S/NO	13. ASSESSMENT PARAMETER	Marks
13.1	**Availability of technical staff of the company / firm in reference to the product.**	**15**
Following two companies shall be considered ascertain the availability / expertise of technical staff:		
A.	Number of technical staff	
i)	At least two technical staff members	05
ii)	01 additional number for every additional technical member shall be granted with maximum up to	05
B.	Technical staffs academic qualification	05
	B.Sc degree in (Bio-medical / Electronic) Engineering from recognized institution shall be granted one additional mark. How ever. B. Tech shall not be considered for additional mark. M.Sc / Master degree holder from recognized institution shall be 2 additional marks.	
13.2	**Manufacturer's local agent capacity for technical services with reference to the product.**	**15**
1.	Repair workshop facility with the diagnostic tools and test equipment as submitted along with the quotation	03
2.	Physical size and facility of workshop attached photo.	03
3.	Test and diagnostic tools list.	03
4.	Service manual and other technical documentation list.	03
5.	Availability of spare parts and accessories at workshop list	03
13.3	**FINANCIAL SOUNDNESS**	**12**
1.	Income tax paid challan for last three years	04
	Balance sheet, audited for the last financial year	08
	OR Bank statement for the last financial year	06
If balance sheet and bank statement both are deposited then only marks of balance sheet (8 Marks) would be counted. Tapering down phenomenon regarding rating of marks shall be applied on competitive firms		
13.4	**Overall reputation in reference to the product (cliental)**	**10**
Overall reputation of the product shall be envisaged by following criteria: A. References / certificates provided regarding performance of the product from head of the concern institute / hospital. B. References/ Certificates of the product shall be verified by the department independently C. Attestation of being Category "A" D. Purchaser have right to exercise Market Survey / Internet Exploring Survey give indicator marks.		

13.5	**General overall sale turnover of the organization**	**10**
A. 60% or more sales proportion of medical equipment (quoted items)		08
B. 40% or more sales proportion of scientific equipment		02
13.6	**International Sales and country of origin of quoted item**	**15**
A. Sale of product in two or more continents		10
B. Sales of production in single continent		05
13.7	**Product Certification**	**10**
Certificate FDA /CE (MDD)/JIS		
A. Any two certificates		10
B. Any one certificate		05
13.8	**Exclusive Agency Certificate , Attested by Embassy, & Chamber of Commerce from native Country of Manufacturer**	**08**
A. 10 years or more for each products or		08
B. 5 years or more for each products		05
C. Less than 3 years		03
13.9	**Other**	**05**
Submission of original brochures and required certificates as per tender terms and Conditions.		05

Assessment parameter: 13.1.1

Availability of technical staff of the company/firm in reference to the product:

1. Total Number of Technical Staff:_____
2. No. of B.Sc. degree in Bio-Medical Engineering holder_____
3. No. of B.Tech / Diploma holder_____
4. No. of MSc / Master Degree holder _____
5. Details of Engineers _____

S/NO	Name of Engineer	Qualification	Experience No of Years	Manufacturer's training with name of equipment and duration

Signature: _____ **Seal:** _____

ASSESSMENT PARAMETER: 13.2.1

Manufacturer's local agent capacity for technical services in reference to the product.

Physical size and facility of workshop_____
(Please attach photograph or picture of your workshop)

Details of test and diagnostic tools:_____
(Please attach a separate sheet describing the test and diagnostic tools)

Details of service manual and other technical documentation:_____
(Please attach a separate sheet describing the detail of manuals and other supporting documents)

Detail of separate parts and accessories available at workshop:_____
(Please attach a separate sheet mentioning the list of spare parts and accessories)

Assessment Parameter: 13.3.1

Financial Soundness

Copy of Income Tax Paid Challan for last three years:_____

Copy audited balance sheet by a recognized audit firm:_____

OR

Copy of Bank statement for the last financial year:_____

Assessment Parameter: 13.4.1

Overall reputation in reference to the product (Cliental)

No of References_____

(Reference will be verified)

No of Certificates, regarding performance of the product from head of concerned institute/hospital_____

Signature:_____ **Seal:**_____

Assessment Parameter:13.5.1

Overall sale turnover of the Organization _____

For quoted Medical Equipment:_____

For other scientific equipment:_____

Assessment Parameter:8.6

International sales and country of origin of quoted item

Tender Item No	Name of Quoted Equipment	Manufacturer's declaration mentioning name of continent where the equipments are soled	Country of Origin

Signature:_____ **Seal:**_____

Assessment Parameter:13.9.1

Submission of documents:
Original Brochure

Tender Item No	Name of Equipment	Manufacturer / Origin

Copy of NTN Certificate:_____

Copy of Sales Tax Certificate:_____

Copy of Professional Tax Certificate:_____

Copy of Chamber of Commerce Registration Certificate:_____

Copy of PNRA Registration Certificate: _____

Note:

Bidders can provide details information on extra sheets by separating them with the uses of annexure.

Name:_____

Designation:_____

Signature:_____

Name of Firm:_____

Stamp of Firm_____

14. Bidders Questionnaire for Bid Evaluation

Name of Firm:_____

Address:_____

Ph:_____ Fax:_____

Email:_____ Website_____

Details of Quoted Equipment:

Tender Item No	Name of Equipment	Model	Make	Country/ Origin

Signature:_____ Seal:_____

15. BID FORM AND PRICE SCIIEDULE

Dated:_____

Tender No._____

To:

[name and address of Procuring agency]

Gentlemen and/or Ladies;

Having examined the Bidding Documents including addenda nos: [insert number's], the receipt of which is hereby duly acknowledged, we, the under signed, offer the supply and deliver [description of goods and service] in conformity with the said Bidding Documents for the sum of [total Bid Amount in words and figures], or such other sums as may be ascertained in accordance with the schedule of Price attached herewith and made part of this bid.

We undertake, if our bid is accepted, to deliver the goods in accordance with delivery schedule specified in the schedule of requirements.

If our bid is accepted, we will obtain a guarantee of a bank in the sum of equivalent to_____ percent of the Contract Price for the due performance of the Contract, in the form prescribed by the Procuring Agency.

We agree to abide by for a period of [number] days from the date fixed for bid opening as per bid terms and condition, and it shall remain binging upon us and may be accepted at any time before the expiration that period.

Until a formal contract is prepared and executed, this bid, together with your written acceptance thereof and your notification of award shall constitute a binding Contract between us.

Commissions of gratuities, if any, paid or to be paid by us to agents relating to this Bid, and to contract execution if we are awarded to contract, are listed below;

Name and address of agent	Amount and Currency	Purpose of commission or gratuity
_____	_____	_____
_____	_____	_____

We understand that you are not bound to accept the lowest or any bid you may receive.

Dated this day of, 2015

Signature: _____

In the capacity of: _____

Duly authorized to sign bid for and on behalf of_____

16. BID SECURITY FORM

Where as [name of bidder] (hereinafter called the Bidder) has submitted its bid dated [date of submission of bid] for the supply of [name /or description of goods] (hereinafter called the bid).

KNOW ALL PEOPLE by these presents that we [name of bank] of [name of country], having our registered office at [address of bank] (hereinafter called the bank) are bound up to [name of procuring agency] (hereinafter called "The procuring Agency") in the sum of for which payment well and truly to be made to said procuring agency, the bank binds itself, its successors and assigns by these presents. Sealed with the common seal of the said bank this_____ day of _____, 20_____

The conditions of this obligation are:

1. If the bidder withdraws its bid during the period of bid validity specified by the bidder on the bid for:

   Or
2. If the bidder, having been notified of the acceptance of its bid by the procuring agency during the period of bid validity:
3. Fails or refuses to excuse the contract form, if required; or
4. Fails or refuses to furnish the performance security, in accordance with the instruction to bidders.

We undertake to pay to the procuring agency up to the above amount upon receipt of its first written demand, without the procuring agency having to substantiate its demand, provided that in its demand the procuring agency will note that the amount claimed by it, owing to the occurrence of one or both of the two conditions, specifying the occurred condition or conditions.

This guarantee will remain in force up to and including twenty eight (28)days after the period of bid validity, and any demand in respect thereof should reach the bank later than the above date.

_____

[Signature of Bank]

17. CONTRACT AGREEMENT

THIS AGREEMENT made at _____ day of 20_____ between [name of procuring agency] of [country of procuring agency] (herein after referred to as the "Procuring Agency") of the on Part; and [name of supplier] of [city and country of supplier] (herein after called the "Supplier") of the other Part.

WIIERE AS the Procuring Agency invite bids for certain goods and ancillary services, viz [brief description of goods and service] and has accepted the bid by the Supplier for the supply of those goods and service in the sum of [contract price in words and figures] (hereinafter called "the contract price)

Now this Contract Witness As Follows:

1. In this agreement words and expressions shall have the same meanings as are respectively assigned to them in the General Conditions of this Contract hereinafter referred to:
2. The following documents shall be deemed to form and be read and construed as part of this agreement, viz:-
   a. The Bid form and Price Schedule submitted by the Bidder;
   b. The Schedule of requirements;
   c. The technical Specification;
   d. The General Conditions of Contract;
   e. The Special Conditions of Contract;
   f. The Procuring Agency's Notification of award;
3. In consideration of the payments to be made by the Procuring Agency to the Supplier as hereinafter mentioned, the supplier hereby covenants with the Procuring Agency to provide the Goods and Services and to remedy defects therein in conformity in all respects with the provisions of this Contract.
4. The Procuring Agency hereby covenants to pay the Supplier in consideration of the provision of the Goods and Services and the remedying of defects therein, the Contract Price or such other sum as may become payable under the provisions of this contract at the time and the manner prescribed by this Contract.
   IN WITNESS whereof the parties here to have caused this agreement to be executed in accordance with their respective laws the day and year first above written.

Signed, sealed, delivered by _____ the _____

(For the procuring agency)

Signed, sealed, delivered by _____ the _____

(For the supplier).

18. PERFORMANCE SECURITY FORM

To,

[Name of the Procuring Agency]

[Whereas name of Supplier] (hereinafter called "the Supplier") has undertaken in pursuance of Contract No. [Number] dated [date] to supply [description of goods] (hereinafter called "the Contract").

And whereas it has been stipulated by you in the said Contract that the Supplier shall furnish you with a Bank Guarantee by a reputable bank fore the sum specified therein as security for compliance with the Suppliers performance obligations in accordance with the Contract.

And whereas we have agreed to give the Supplier a Guarantee.

Therefore we hereby affirm that we are Guarantors and responsible to you on behalf of the Supplier up to a total of [amount of the Guarantee in words and figures] and we undertake to pay upon your first written demand declaring the Supplier to be in default under the Contract and without cavil or argument, any sum or sums within limits of [Amount of Guarantee] as aforesaid, without your needing to prove or to show grounds or reasons for your demand or the sum specified therein.

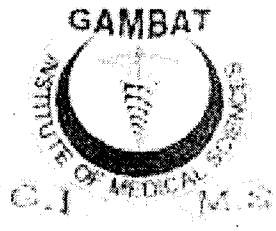
This guarantee is valid until the _____ day of _____ 20_____

Signature and seal of the Guarantors / Bank: _____

[Name of Bank or Financial Institution] _____

[Address] _____

[Date] _____



HVAC WORKS AT

LABORATORY BUILDING

GAMBAT INSTITUTE OF MEDICAL SCIENCES

TENDER DOCUMENTS

VOLUME-I

TECHNICAL SPECIFICATIONS

Table of Contents

GENERAL PROVISIONS
HVAC WORKS

1.1 HVAC SYSTEM CONCEPT

The building shall be air-conditioned by Variable Refrigerant Flow system (with R410A refrigerant), comprising of All DC Inverter air-conditioning units.

The system shall comprise of one or more outdoor units connected via inter-connecting refrigeration pipe work to multiple indoor units using branch pipe connecters. The system shall be complete with all the necessary electronic controls and associated control wiring to maintain the space design conditions.

1.2 DESIGN CONDITIONS

HVAC System has been designed for the conditions listed hereunder. These conditions are being given for the information of the Contractor to enable him to perform specified tests under these conditions.

Summer Outside Design Conditions

a)	Summer Dry Bulb Temp:	125° F
	Wet Bulb Temp:	82° F

Inside Design Conditions

a)	All air-conditioned areas	75°F ± 3° F 50% ± 10% RH

1.3 MATERIALS

All materials shall be of the highest grade, free from defects and imperfections; of recent manufacture and unused, and the classification and grades designated, conforming to the requirements of the latest issue of the appropriate specifications cited herein. All materials, supplies, and articles forming part of major equipment and not fabricated by the manufacturer of the equipment shall be the products of the recognized reputable manufacturers.

1.4 WORKMANSHIP

Workmanship and general finish shall be of the highest grade, in accordance with the requirements specified herein, and the latest standard practice.

1.5 EQUIPMENT

a) All equipment shall be manufactured by companies which have had at least ten years of previous experience in the design and manufacture of equipment of comparable type, capacity and operating conditions, unless otherwise approved by the Consultant.

b) All equipment and materials supplied shall be from approved manufacturers who are adequately represented in Pakistan by an Agent capable of providing installation, commissioning and after sales service. All major equipment shall be imported directly from the manufacturers through their local agents. Import of this equipment through warehouses/Export Houses will not be accepted.

c) All equipment shall be of latest manufacture, not older than the year in which this contract is awarded and shall bear year of manufacture stamped on the manufacturer's name plate duly certified by the manufacturer.

d) When a manufacturer's product is specified by name, or equivalent, it shall be in the sole judgment of the Consultant as to acceptability of any product which is offered as equal to that specified.

e) Where two or more units of the same class of equipment are furnished, product of the same manufacturer shall be used; component parts of entire system need not be product of same manufacturer.

1.6 CHASES AND OPENINGS

The contractor shall provide templates or details for chases and openings to be left in walls and partitions to accommodate work under HVAC scope of works.

1.7 PROTECTION

The contractor shall keep pipe, duct and other openings closed to prevent entry of foreign matter. All fixtures, equipment and apparatus shall be covered and protected against dirt, water, chemical or mechanical damage, before and during the construction period. All fixtures, apparatus, or equipment damaged including damaged shop coats of paint shall be restored to original conditions prior to Commissioning and also again prior to Final Acceptance. All bright finished shafts, bearing housings and similar items shall be protected until in service. No rust will be permitted.

1.8 CUTTING, PATCHING AND REPAIRING

Required for proper installation and completion of HVAC works, including masonry work, concrete work, and carpentry work, painting and re-painting shall be performed by skilled craftsmen in respective trades, at expense of the Contractor. Construction shall be cut only after obtaining written permission from the Consultant.

1.9 LINES, LEVELS AND SPACES

The Contractor shall check dimensions at the building site and establish lines and levels for work specified in Specifications. The Contractor shall check with work of other trades to ensure proper clearance of piping, ductwork, conduit and other items. Any deviations observed between drawings and actual construction shall be brought to the notice of the Consultant. The erection supervisor shall regularly inspect, during progress of civil works, the areas allocated for installation of HVAC equipment and any conflict observed shall immediately be reported to the Consultant.

1.10 ACOUSTIC TREATMENT

Sound measurements will be made at 5 feet above floor level in the area served and not more than 5 feet from the grilles, diffusers or other air devices being tested. Instruments for sound measurement shall be provided by the Contractor.

Provision is to be made to minimize noise and vibration. However, different manufacturers' equipment have varying sound and vibration characteristics and it is, therefore, the responsibility of the Contractor to ensure that the requirements in these specifications are fully met by the equipment he is offering. If the Contractor has any requirements for additional vibration or sound isolation, these must be incorporated into the price quoted.

All equipment installed should not be audible inside the occupied areas and the Contractor must ensure that the equipment he is offering is quiet and supplied with all necessary silencers to ensure satisfactory sound levels. Where silencers are required, these must be incorporated into the price quoted for such equipment, if these are not specified separately.

1.11 SAMPLES

Contractor shall provide at his cost, samples of materials, instruments, gauges and electrical items, for approval by the Consultant before order is placed for the same. Consultant may waive this requirement, if detailed published catalogues

submitted by the contractor provide sufficient information for approval. These samples shall include, but not limited to

1. G.I. sheet
2. Pipes and fittings. (Refrigerant)
3. Duct insulation and covering.
4. Pipe insulation and covering
5. Insulation adhesive and tapes
6. Diffusers, grilles and registers
7. OA/EA louvers
8. All types of dampers.
9. Power and control cables
10. Pipe hangers etc

1.12 APPROVAL OF MATERIAL AND EQUIPMENT

As soon as practicable after the award of contact, the contractor shall submit for approval of the Consultant specifications, drawing, catalogue diagrams and other descriptive data for all materials components and equipment which the contractor proposes for use under this contract. For certain materials and equipment, data may be required to be submitted in accordance with a detailed form furnished by the Consultant. Items submitted shall be properly labeled to indicate item number, and other data required by the Specifications. All items shall be submitted time to permit proper consideration and action thereon **without delaying the construction schedule.**

1.13 TIME FOR DELIVERY

All equipment plant and machinery **shall be delivered at site on such dates so as to** ensure adherence to scheduled dates stated in programs of works submitted by the contractor and the Consultant informed of the progress of the shipment and notify them in advance, in writing, as to when the equipment will be ready for inspection at site by the Consultant and shall supply lists covering each consignment in sufficient detail to enable Consultant to check the contents of the package, if he so desires.

1.14 STANDARDS AND CODE REQUIREMENTS

All equipment and materials under HVAC Scope of works shall be furnished in conformity with the latest edition of applicable standards of ASME, ASHRAE, ARI, SMACNA, AMCA and applicable \Government and local Codes governing

the same. In case of conflict, the stricter requirements shown/ specified shall govern.

Abbreviations for Codes and Standards referred in the Contract are as under:

1. ASME – American Society of Mechanical Engineers.
2. ASTM – American Society for Testing & Materials.
3. ASHRAE – American Society of heating, Refrigeration and Air conditioning Engineers.
4. NFPA—National Fire Protection Association, USA
5. ARI - Air-conditioning and Refrigeration Institute, USA.
6. SMACNA — Sheet Metal and Air-conditioning Contractors National Association.
7. GOVERNMENT - Government of Pakistan
8. LOCAL-Local authorities of the city where the Project is located
9. AMCA — Air Moving and Control Association inc. USA
10. P.S. - Pakistan Standards.
11. B.S. - British Standards.

1.15 ERECTION SUPERVISORS AND OPERATING STAFF

General

The Contractor shall provide the services of Erection Supervisors and Operating Staff in accordance with the requirements of the Conditions of Contract as specified here in.

Work by Erection Supervisors

a) The Erection Supervisor shall direct the activities of Contractor's employees as they concern the installation, commissioning balancing and testing of the Equipment furnished under this contract. The Contractor through his Erection Supervisors shall cooperate with other Contractors to whatever extent is necessary to produce an installation satisfactory to the Consultant in accordance with the requirements of the time schedule, the Drawings and the Specifications.

b) Erection Supervisor shall be present from the Commencement of Work and remain on Site until the substantial completion.

c) Should a disagreement arise between other Contractors and the Erection Supervisor, the matter shall be submitted without delay to the Consultant for his decision. Upon such decision, the Erection Supervisor shall proceed with the work in accordance therewith, immediately.

d) Erection Supervisor shall be a qualified HVAC/ Mechanical Associate Engineer, having at least 8-10 years experience in HVAC installation works of similar nature.

e) If the Contractor fails to fulfill his obligations and also fails to provide the services of the erection supervisor having the minimum qualifications as stated in sub. Clause (d) of this Clause then the Contractor would be obligated to pay to the Employer an agreed penalty amount per day for the number of days when the services of such erection supervisor are not provided. The Employer would be entitled to deduct the amount due from the Contractor in this regard for his running bill/any payable sums.

f) Provision of (e) above shall not apply when the Erection Supervisor is on authorized legal leave (casual), sick leave and official holidays only. His absence up to a period of ten (10) days will also be allowed when the contractor intends to replace the Erection Supervisor with the consent of the Consultant.

Operating Staff

The Contractor shall provide staff to operate the HVAC system continuously for twelve (12) hours a day during the Defect Liability period and whenever the HVAC facilities required.

Operating supervisor shall be a 3 (three) years Diploma holder HVAC or Mechanical from Government College of Technology etc. And having 4 (Four) years experience of similar plants with automatic controls.

The Contractor shall also arrange to provide proper training to Employer's staff to operate the HVAC system to the entire satisfaction of the Employer. All costs incidental to providing operating staff including staff salaries shall be deemed to be included in relevant item of schedule of Prices. No separate payment shall be made to the Contractor for fulfillment of his obligations under this clause.

1.16 AS BUILT DRAWINGS

The Contractor shall supply to the Consultant a set of "As-Built" drawings showing the contract works as installed, together with any other information necessary for operation and maintenance. Three copies or each drawing and other information shall be supplied, along with a reproducible copy.

1.17 MANUFACTURER'S DATA

Manufacturer's performance data, certified factory drawings and/or curves of apparatus giving full information as to capacity, performance at different operating and ambient conditions, dimensions, materials electrical data and all

information pertinent to the adequacy of the submitted equipment shall be submitted for approval. One original and 3 copies of catalogues and other information shall be submitted.

Manufacturer's names, sizes, catalogue numbers and/or samples or all materials shall also be submitted for approval.

manufacture of the air conditioning units, for which the consultant shall be the sole judge, the contractor shall be required to replace or repaired all defective parts, except compressors (burnt or otherwise) which shall be replaced with new compressors, all repairs and replacement shall be as desired by the consultant.

All equipment shall be of such overall dimensions, operating weights, service area requirements and configuration that it can be located where shown on the plans without any adverse effect on its performance and clearance requirements.

Provision for clearance and service spaces shall be made around all mechanical equipment as recommended by equipment manufacturers.

All equipment supplied under this section shall be brand new factory manufactured and factory assembled (unless otherwise specified) and complete in all respects. The type, characteristics, capacity ratings, component sections of all equipment shall be as specified /scheduled. All equipment shall be tested at factory for performance before shipment.

All equipment furnished by the Contractor shall include vibration isolation mounting pads, anchor bolts, frames or any other mounting or supporting accessories.

All equipment shall be complete with all accessories necessary to serve the intended purpose, whether specified or not.

2.2 MULTI SPLIT AIR-CONDITIONING UNITS (R410A):

2.2.1 Overview

All DC Inverter VRF System:

All equipment shall be brand new products from certified and approved manufacturers.

VRF system shall comprise refrigerant, outdoor unit (air-cooled), indoor DX fan coil device, liquid, air suction and pressure relief pipes, condensate pipe, branch-joints, connection tool kit, and a separate micro-processor control system.
Indoor/outdoor units, and other key parts shall be manufactured and assembled by the same manufacturer.
In case of fittings other than the standard ones from the manufacturer, approval shall be obtained before use.
The refrigerant for the VRF system shall be R-410a
The refrigerant for the VRF system shall comply with local regulations and ensure a higher COP value for the A/C equipment.
The VRF system shall satisfy the requirement for design indoor temperature.
Nameplate shall be attached to each product at a notable position, indicating the following, as a minimum:

a) Product name, model and specification;
b) Name and trademark of manufacturer;
c) Date of production, product No. or batch number; and
d) Output power, noise and other main parameters.

2.2.2 Features

The All DC Inverter VRF system shall have the following features:
Variable-capacity compressors:
All compressors should be DC Inverter type compressor controlling the cooling and heating capacity automatically according to the load.
Only DC inverter compressor shall be used in this system and it can directly intake gas to reduce loss of overheat and improve efficiency.
High-efficient permasyn motors are required, to get better performance than traditional D.C. inverter compressors.
Compressors shall have180°Sine Wave DC Speed Varying Technology to satisfy various places' demands for different temperature and shall be able to save a great deal of electricity and provide users with utmost comfort at the same time.

The condenser fan motors shall be DC Inverter type and shall have Stepless speed regulation ranges from 5Hz to 65Hz.Compared with traditional inverter motors, it shall be more efficient. It shall have Sensor less control technology to guarantee lower noise, less vibration and steadier operation.

In auto energy saving mode, system shall be able to self-adjust parameters according to the operation status, thus to lower the cost of electricity with up to 15% of energy saving. In compulsory energy saving mode, system shall limit power output forcibly with up to 20% of energy saving.

System shall have automatic energy auto-allocation technology.

System shall be able to remember the highest temperature outdoors. When night comes, system shall automatically turn to quiet mode. There shall be option of

quiet modes which can be set according to actual needs.

System shall also be able set in this mode to ensure low noise as long as unit is operating. The minimum of low noise degree shall be 45dB(A).

The indoor units of all inverter system shall have DC Inverter motors to realize stepless regulation. According to indoor temperature or people's actual needs, users shall set this mode through the indoor wire control. The minimum of low noise degree shall be 25dB(A).

The all DC inverter system shall have its working voltage range from 320V-460V, and in the places with unsteady voltage, this system shall be able to run satisfactorily.

The cooling or heating mode shall have option to be deactivated during a certain season to avoid the mode conflict in case of miss operation.

The outdoor unit shall be able to be linked with a fire alarm signal. In case of emergency, unit shall automatically turn off to avoid risk or further loss.

The outdoor unit shall be able to receive a power signal of electricity shortage. In some places like fist-class hotels, diesel generator may sometimes be used to provide electricity. In this case, this signal will be received and only VIP rooms can be provided with air conditioning service.

When a certain indoor unit needs to be repaired, it shall be powered off without any interruption to the system's operation.

First-grade oil separator shall have a filtered expansion valve with a 98% of separation efficiency; Second-grade oil separation will separate the remained 2% refrigerant oil with 95% of separation efficiency. General Efficiency shall be 99.9%.

The operating priority sequence of the outdoor unit modules shall be changed without restart when the system accumulatively operates for 12 hours, to maximize the service life of the system

Each module shall be an independent sub-system, and the whole system won't fail down even if partial malfunction occurs. Upon malfunction of any one of the modules, there shall be option of emergency operation after simply manual setup on the outdoor PCB switches.

The all DC inverter system shall be without liquid receiver and the excess refrigerant will be stored in the piping, which would minimize the refrigerant charging volume and enhance the control accuracy of the refrigerant.

Based on the actual status of each unit and compressor, system shall regulate compressor's operation and realize oil balance.

Refrigerant shall be taken into a compressor by an intake pipe and then runs through the cooling system. It shall control oil level and the minimum oil each compressor need and therefore realize oil balance.

Dual electronic expansion valve with its 960 grades of regulation shall precisely regulate refrigerant's flow between outdoor unit and indoor unit.

The best heating or cooling performance shall be realized in the most energy-saving way. DC inverter compressor and D.C. inverter fan will also be operating in this way to ensure high efficiency.

The all DC inverter system shall realize a combination of 4 outdoor unit modules. When error is occurred to one of the modules, the others shall perform the emergency operation to sustain the air conditioning. All the compressors in each single module shall be DC Inverter based, when one compressor has error, others shall perform the emergency operation. Double-fan design shall ensure that one fan can still work even if the other one has error.

Outdoor unit fan shall have 4 levels of static pressure that can be set, up to 80Pa, when an outdoor unit needs to be placed indoors. The all DC inverter system shall realize a combination of 4 models and connect as many as 80 indoor units.

The cooling capacity of the outdoor units should adjust automatically, according to the number of operating indoor unit(s).

The maximum total pipe length should not be greater than 1000 m.
The maximum actual pipe length between indoor unit and outdoor unit should not be greater than 175 m.
The maximum height difference between indoor unit and outdoor unit should not be greater than 90m.
The maximum distance between the first branch to the farthest indoor unit should not be greater than 40m.
The maximum height difference between indoor units should not be greater than 15m.
The system should offer at least 5 basic modules, which could be freely assembled in 2, 3 and 4 units modular combinations as per requirement.
The system should offer 2HP increments of capacity range, which should meet customer needs accurately and the maximum capacity combination should be up to 64HP.

The system should have an inner-screw copper heat-exchanger, which can create higher heat exchange efficiency and powerful heating capacity especially in low

ambient temperature. Outdoor heat-exchange area should be adjusted by running load. The system should have dual EXV, which should achieve up to 960 steps refrigerant adjusting precision to insure precise control of refrigerant and raise system circulation efficiency.

The combination of one main and one auxiliary four way valve should control the outdoor heat exchanger and outdoor air flow independently and according to the load, adjust the heat exchange volume of outdoor unit accurately and prevent wasting the capacity in part load time. Main 4-way valve should be used as the traditional 4-way valve, while the auxiliary 4-way valve should be used to adjust the heat-exchanger area of outdoor unit when in cooling mode.

The structure of the system and the piping work should be simple, so that the installation is easy. Each series of indoor units should have the same pipe dimension, and all the pipes should be connected by flare nut.

The system should have simple refrigerant piping system without any complicated maintenance work

Controls:
The system should have Individual control, group control, network control options. The system should have network control system that can realize intelligent management to the A/C system,

The system shall have auto debugging features like:

Automatically allocate ODU and IDU addresses
Automatically calculate numbers of ODU and IDU
Automatically detects errors;
Automatically starts debugging;

2.2.3 Air Cooled Condensing Units (CU-Units)

The condensing unit shall be of the vertical discharge, air cooled type, suitable for outdoor installation and sized to deliver the required capacity matched to relevant indoor units at specified ambient temperature. The condensing unit shall be of same manufacturer as that of Indoor A.C. Unit.

The condensing units shall be air-cooled type incorporating heat exchanger coils manufactured from copper tube copper fins or Aluminum Manganese anti rust alloy which should be coated with Golden protection Layer (Components: Epoxy Resin & Modified Acrylic, Silicon free), the anti-corrosive performance in salt-spray testing must be at-least 200% higher than normal blue/golden fins, factory treated to reduce the effect of atmospheric corrosion. The colour shall be manufacturer's standard. The air outlet grilles shall have plastic coated guards.

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 Flow (VRF) based centralized combination of multiple outdoor units of capacities given in schedules.

The outdoor units shall have all DC inverter compressors electronically controlled and capable of varying refrigerant flow with variation in cooling/heating requirements.

The capacity control of the outdoor units will be digitally controlled and shall be determined electronically by sensing operational temperatures, pressures, and ambient temperature etc

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

It shall be possible to connect up to 80 indoor units, capacity permitting, to one modular outdoor unit.

The outdoor unit shall have full capacity control to meet the load fluctuation up to 135%.

2.2.4 Indoor Units

Direct Expansion type Air conditioning units each carrying its own thermo-static expansion valve, shall be ceiling recessed (Cassette type) reversible, (Heat pump) type or ceiling concealed ducted type or Decorative Wall Mounted. All necessary components/parts shall be selected manufactured and assembled by the same manufacturer as for outdoor condensing units with Scroll Compressors.

The Indoor units shall include following items

1) DX.- Type coil
2) Washable filters
3) Supply air fan with Stepless DC Inverter motor
4) Automatic air swing facility. (Wherever required with the unit)
5) Drain arrangement.

The following type of indoor units may be used for this type of system.

Four way discharge 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 fresh air in the unit.

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

The heat exchanger coils shall 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 the desired room temperature.

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

A condensate drain pump shall be provided with the unit. The condensate shall be drained from the unit using thermally insulated u PVC piping and run directly to the nearest drain piping mains.

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

Ceiling concealed Duct type

The unit casing shall be manufactured from galvanized steel plate. Facility shall be provided for duct connection for introduction of fresh air in the unit and branch ductwork from the unit. The return air to the unit shall be through the bottom/back of the unit as per manufacturer's standard.

The heat exchanger coils shall 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 the desired room temperature.

The condensate shall be drained from the unit using thermally insulated u PVC piping and run directly to the nearest drain piping mains.

Wall mounted type

The unit casing shall be manufactured from heat resistant plastic. The casing colour shall be manufacturer's standard. The fan shall be cross-flow centrifugal type, statically and dynamically balanced to ensure low noise and vibration free operation.

The heat exchanger coils shall 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 the desired room temperature.

The condensate shall be drained from the unit using thermally insulated u PVC piping and run directly to the nearest drain piping mains.

3.0 REFRIGERANT PIPING AND SPECIALITIES

3.1 GENERAL

The Tender Drawings indicate generally routes of all piping and the Contractor shall provide all fittings and accessories necessary for satisfactory installation and operation of the systems.

All piping shall be grouped wherever practicable and shall be erected to present a neat appearance. Pipes shall be parallel to each other and parallel or at right angles to structural members of the building and shall give maximum possible headroom.

All pipe drops shall be truly vertical. No joints shall be formed in the thickness of walls, floors or ceilings. The Contractor shall be responsible for ascertaining the thickness of plaster and other wall finishes, skirting heights, cill lengths and floor finishes.

Piping shall not pass in front of doorways or windows and shall be generally arranged so that sufficient space shall be allowed for accessibility for servicing.

All drain piping shall pitch down in direction of flow. All drains from such items as drip pans of air conditioners shall spill over and open sight drain, floor drain or

other acceptable discharge points and terminated 150 mm above the drainage.

Approved pipe fittings shall be used and bending of pipes will not normally be allowed.

All 90° elbows used shall be of long radius type, except where space limitations restrict the use of long radius.

Piping shall not be installed passing through ductwork or directly under electric light fixtures.

3.2 REFRIGERANT PIPING AND SPECIALITIES

Refrigerant piping shall be copper tubing, type L (minimum), bright annealed, dehydrated and sealed, soft tempered tubing shall be used where bending is required and where flare joints are used, hard drawn tubing shall be used where no bending is required and silver-brazed joints are used, and for all tubing larger than 20 mm. Copper tube joints shall be brazed, except joints on lines 17 mm or smaller which may be flared. Fittings for flare joints shall be standard SF' forged brass flare-type with short shank flare units. Fittings for brazed joints shall be wrought copper or forge brass seat fittings. Cast seat type fittings will not be allowed for brazed joints.

3.2.1 INSTALLATION

It is imperative the method of installation and the materials used are also to high standards, to ensure trouble free operation and long term reliability.

The interconnecting pipe work must be installed by a competent and trained engineer. Refrigeration quality copper tube must be used, soft copper coils or half-hard straight lengths. The refrigeration quality tube must be soft drawn seamless high grade copper pipe. The copper tube must be selected taking into account the higher operating pressures of refrigerant, and that high pressures will occur throughout the system because of the reverse cycle operation.

The supplied branch pipe kits, must be used to make connections to indoor units, and the supplied manifold kits must be used to make connections between outdoor units (where applicable); it is not permitted to use standard fittings such as elbows, tees etc. the branch pipes shall be installed in accordance with the manufacturer's instructions, allowing unrestricted flow of refrigerant. All brazed joints shall be made with dry nitrogen purge to ensure the prevention of oxidization to the internal surface of the copper pipes. The ingress of moisture, dirt and any other contaminants to the interior of the copper pipes, and air conditioning units, must be prevented during the installation procedure. After the installation of pipe work, prior to the connection of the outdoor units, and sealing of insulation joints, the pipe work must be

pressure tested for leakage, using dry nitrogen.

Procedure for Copper Piping:

a) Cleaning: All copper tubing shall be properly cleaned prior to use. The following cleaning procedure shall be adopted.

i) A clean lint less cloth shall be drawn through the tubing by means of a wire to remove all coarse particles of dirt and dust

ii) A clean lint less cloth saturated with trichloroethylene shall be pulled through pipe and the procedure .repeated till no further discoloration sof the cloth is observed

iii) A clean cloth saturated with compressor oil squeezed dry shall be drawn through pipe.' Finally a clean cloth shall be drain through pipes.

b) General Instructions:

Pipes shall be cut accurately to measurements established at the job site and worked into place without springing or forcing, properly clearing all windows, doors and other openings. Excessive cutting or other weakening of the building structure to facilitate piping installation No installation will be permitted, without. written approval.-Layout drawing, required under the title of "App-oval of Material and Equipment" shall show locations of all supports, the load imposed on each fastening or anchor, typical details for special anchorage, for suspended piping, valves, tank, pumps, converters, and other mechanical equipment. Where supports are required between structural framing members, suitable intermediate metal framing shall be provided and detailed. Pipe shall have burrs removed by reaming and shall be installed to permit free expansion and contraction-without damage to joints and hangers." Changes in direction shall be made with fittings, except that bending of pipe and smaller will be permitted provided a pipe bender is used and type-sweep bends are formed. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks wrinkles, flattening or other malformations will not be accepted. All piping shall be installed with sufficient pitch to ensure adequate drainage and venting. Piping connections to equipment shall be provided with unions or flanges. Open ends of pipelines or equipment shall be properly capped or plugged during installation to keep dirt and other foreign matters out of the system.

Tubing shall be cut so ends are perfectly square and will "bottom" in the fitting. There shall be no gaps left through which solder dan run into the line. If possible, a pipe cutter shall be used. hacksaw must be used, it shall always be guided with a mitre-boxjto ensure a square, even cut. Tubing shall be reamed to remove burr being careful not to expand tubing while reaming.

The outside of the copper pipe and the inside of the fitting, where solder will be applied, shall be burnished. Fine crocus clothe or tight fitting brushes especially made for his type of work shall be used. Surfaces shall be burnished until all dirt and oxide is removed. Cleaned surface shall not be touched with hands or gloves. A- light coat of brazing flux shall be applied to both pipe and fittings.- An acid flux such as muriatic (hydrochloric acid) shall never be used as the resulting corrosion can scriously affect the pijjje and composition for brazing.

Joint shall be heated to proper brazing temperature being sure that it hot so brazing material will flow to all parts of the joint. The brazing material shall be fed to the joint until uniform link of brazing material appears around the pipe at the end of the fitting.

95-5 solder which is an alloy of 95% tin and 5% antimony shall be used.

When solenoid stop valves are being installed, the coil shall be removed to prevent the heat of soldering from ruining the insulation. When sight glass is being installed,' the glass shall be removed to prevent cracking. No heat shall be applied near the bulb of the expansion valve or any other place where an excessive temperature may cause damage.

Pipe insulation shall not be installed nor the piping anchored until Testing is completed-and all leaks have been properly eliminated.

Pipe Supports:

i) General: Pipe hangers, brackets, saddles, inserts, clamps, and pipe rolls including rods, bolts, shall conform to standard recommended practice. Design generally accepted, as exemplifying good engineering practice, using stock or production parts, shall be j utilized wherever possible. Chain, wire, strap or other make shift j devices will not be permitted as hangers or supports.

ii) Hangers shall be supported from clamps, concrete inserts, Philips concrete fasteners, or Raw bolts. Concrete inserts when used, shall be installed in the exact location prior to the pouring of concrete.

iii) Suspended Horizontal Piping:
Shall be supported by adjustable hangers or supports, which shall provide means of vertical adjustment after erection. Unless otherwise indicated on drawings maximum spacing between copper pipe supports the straight runs of pipe and tubing shall be in accordance with recommended spacing shown in the table

Maximum Spacing Between Copper tubing Supports:

MIN. TUBING	1/2	5/8	7/8	1	1	1	2	2	3	3

SIZE – INCHES				1/8	3/8	5/8	1/8	5/8	1/8	5/8
(Min) SPAN - FEET	5	6	6	7	8	9	10	10	11	12

Pipe hangers and supports shall be spaced not over 5 feet apart at heavy fittings and valves. A hanger shall be installed not over 1 foot from each change in direction of piping. Vertical piping shall be guided or supported in the center of each riser but not over 8 feet of centers and shall be supported at the base of the riser, on a base elbow or tee, with pipe stand only where required. For un-insulated brass or copper tubing, the riser clamp shall be compatible non-ferrous or electrolytic ally coated steel as for hangers.

Commissioning & Testing:

The contractor shall be responsible for commission the air conditioning unit in accordance with manufacturer's recommendations.

All AC Units will have a guarantee/warranty period of 12 months from the date of commissioning the units, and should any defects arise during this period which can be attributed to poor workmanship, improper material, or defective manufacture of the air conditioning units, for which the Consultant shall be the project engineer & consultant judge, the Contractor shall be required to replace or repair all defective parts, except compressors (burnt or otherwise) which shall be replaced with new compressors. All repairs and replacement shall be as directed by the Consultant. If the Noise Level from the unit _ create any nuisance or-its NC level (45 db) is not maintained then it is the responsibility of the contractor to meet the specification as stated in the schedule.

SUPPORTS & ANCHORS*: (If applicable)*

General:

Pipe hangers, brackets, saddles, inserts, claps and pipe rolls including rods, bolts, turn buckles, bases and protection shields shall conform to standard recommended engineering practice. Design generally accepted as exemplifying good engineering practice, using stock or production parts, shall be utilized wherever possible. Chain, wire, strap or other make shift devices will not be permitted as hangers or supports. Pipe hangers shall be capable of supporting the pipe in all conditions of operations. Hangers shall be supported with beam-clamps, concrete

inserts, Philips concrete fasteners, or raw-bolts. Concrete inserts when used shall be installed in the exact location prior to the pouring of the concrete.

Suspended Piping Supports: (If applicable)

(a) Piping shall be supported by adjustable hangers or supports, which shall provide a means of vertical adjustment after erection.

Additional Refrigerant:

Additional refrigerant only shall be used, and must be charged by weight only, using electronic scales. The amount of additional refrigerant must be accurately calculated from the manufacturer's data, based on the length and diameter of each section of the liquid refrigerant pipe work of the system.

3.3 CONDENSATE DRAIN PIPING:

All condensate drain piping including fittings shall be of UPVC, Class E, as per BS 3505.

a) Install drainpipes as and where shown on drawings.

b) Provide support at every 1 meter and at every change in direction.

c) Drainpipe shall be installed with proper slope.

d) Do-not connect drain piping to draining system. Use in-direct connection.

e) Insulate drain pipe with closed cell foam insulation.

3.4 PIPE SLEEVES:

All pipe opening through walls, floor slaps shall have sleeves with internal diameter at least 50 mm larger than the outside diameter of the pipe of the insulation passing through the sleeve.
Pipes passing through walls shall be provided with UPVC sleeves

Space between pipe and sleeve shall be packed with fiber glass at least 1.5 Iblft3 densities and sealed. All openings on roof shall be sealed water tight.

4.0 AIR DISTRIBUTION SYSTEM

4.1 GENERAL

a. Except as otherwise specified, all sheet metal ductwork, flexible ducts, flexible connections, dampers of all types and related items shall be in accordance with this section.

b. Make every duct bent with centreline radius not less than its width. Make every change in size or shape of duct with taper not exceeding 1 in 5. Unless otherwise indicated, provide throats at all branches with throat velocity same as main duct velocity, Construct square throat elbows, indicated or required, with internal turning vans in accordance with detail indicated.

c. Joints in all ductwork shall form smooth interior surface.

d. Support horizontal ductwork on galvanised iron hangers not less than 1" X 1/8". Spaced not more than 8 ft. on center for ducts up to 8 sq. ft. in area and not more than 4 ft on centers for larger ductwork.

e. Support vertical duct work at each floor with angles not less than 1 ¼" X 1 ¼" X 1/8", for ducts up to 30" wide 1-1/2" X 1-1/2" X 1/8", ducts from 31" to 60 " wide; provide minimum of two angles for each duct.

f. Furnish dampers indicated or required to balance distribution of air through various parts of duct systems to obtain air deliveries indicated at all air inlets and outlets.

g. For all ducts, dampers, access door, joints, stiffeners and hangers, "wide" is meant greatest dimension.

h. All ductwork, UNLESS OTHERWISE SPECIFIED, in accordance with recommendation of ASHRAE.

i. All the air plenums for linear grills shall be factory fabricated.

j. During construction, where it is necessary for ductwork to be left open for extended period before completion, temporarily close any such openings with sheet metal covers where necessary or required to prevent debris from entering ducts and /or to maintain opening straight and square.

k. All ducting measurements will be done after the installation.

4.2 DUCTWORK – MATERIAL

Unless otherwise specified or indicated.

a. Air Conditioning System: Galvanised steel sheet prime quality.

b. Ventilating System: Galvanised steel sheet prime quality.

GALVANISED STEEL DUCTWORK:

a. All ductwork, prime quality galvanised sheet steel:

1. To 12 inches maximum dimension, #26 USSG

2. 13 to 30 inches maximum dimension, #24 USSG

3. 31 to 60 inches maximum dimension #22 USSG

4. 61 to 90 inches maximum dimension #20 USSG

5. Over 90 inches maximum dimension #18 USSG

b. Transverse joint connections and duct-work stiffening, except as otherwise, specified:

1. To 24 inches wide: "S" slip, drive slip, pocket slip or bar slip on 94-inch centres.

2. 25 to 30 inches wide: "S" slip, drive slip, pocket slip or bar slip on 94 inch centers with 1 inch angles on 48 inch centres.

3. 31 to 40 inches wide: Drive slip, 1 inch pocket slip or 1 inch bar slip on 94 inch centers with 1 inch angles on 48 inch centres.

4. 41 to 60 inches wide: 1-1/2" angle connections, 1-1/2 inch pocket slip or 1-1/2 inch bar slip on 94 centers with 1-1/2 inch angles on 48 inch centres.

5. 61 to 90 inches wide: 1-1/2 inch angle connections, 1-1/2 inch pocket slip or 1-1/2 inch bar slip on 45 inch centers, with 1-1/2 inch angles on 24 inch centers.

6. 91 inches and larger: 2 inch angle connections, 1-1/2 inch pocket slip or 1-1/2 inch bar slip on 45 inch centers, with 1-1/2 inch angles on 24 inch centres.

c. On ductwork up to 60" wide, 45 inches long duct sections may be used.

d. Ductwork for distance of 20 ft. from fan inlet and outlet: Stiffened as specified above, except angles spaced on centers not greater than 24 inches, both transverse and longitudinal.

e. Stiffing angles: Riveted or spot welded to ductwork, may be of black structural steel. Angles, total girth, on all four sides of ductwork. Angles may be omitted at joints it joints ate equivalently reinforced.

f. Make longitudinal seams on all ductwork with Pittsburgh or double seams, locked and hammered tight, with smooth interior duct surface.

g. Cross-break all un-insulated ducts 18 inches wide and larger to prevent vibration or buckling.

4.3 FLEXIBLE DUCTS (If required)

All main duct and linear diffuser plenums shall be connected through flexible ducts. The sizes of flexible ducts are indicated on drawings or as directed by the consultant. The flexible duct shall be 2 ply aluminium flexible ducts with high tensile steel wire reinforcement, and shall be insulated with 1 inch thick 16 kg/m^3 glass fibre insulation, covered with aluminium foil vapour barrier insulation.

4.4 DAMPERS

General:

1. In all ductwork systems, furnish all dampers necessary for proper control and balancing of air distribution. Furnish dampers in all branches, with operating levers readily accessible. No damper greater than 48" long. For greater lengths provide dampers in equal sections as required. These shall be opposite blades configuration.

2. Same material as ductwork, except as otherwise specified, rigid 18g. Construction, free of all rattling and vibration, with edges crimped or creased for stiffness.

3. All dampers shall have through rods, not less than 3/8" diameter fastened to blade with 2 or more yokes with set screws, with steel washer at each end of damper rod.

4. Damper blades, two gauge numbers heavier than ductwork, # 18 gauge and lighter shall have both edges double hemmed. Blades longer than 36 inches shall have "V" crease in middle to receive damper rod.
5. Dampers shall have through damper rod with #14 gauge bearing plate at one end and quadrant and lever with lock screw at other end; damper lever fastened to rod with set screws.

6. On insulated ductwork, mount ,guardant on metal saddles finishing flush with insulation surface.

Multi-Leaf Dampers: Shall comply with requirements for single leaf dampers. All damper rods, linked together to operate as a unit.

Splitter Dampers: Provide for air adjustment in throats at duct branches, Rigid construction, securely held in adjusted position with adjusting rod connected to leading edge of damper and protruding through duct; hinged connection at damper and lock screw fitting connection at duct face. On insulated ductwork mount lock-screw fitting so that lock-screw is located outside insulation. For each splitter damper provide sufficient number of adjusting rods to prevent vibration or loosening of adjusted position. Length of splitter, at least equal to width of branch throat served.

4.5 ACCESS DOORS IN DUCTWORK

a. Furnish as indicated and wherever necessary or required for proper access to all instruments, controls and equipment and for convenient inspection, maintenance and replacement, of the same. In general, provide access doors for each plenum, fire dampers, automatic dampers, fan bearing and as indicated.

b. Size of access doors:

1. In ducts, 20" X 14", unless otherwise indicated.

2. In plenums, 21" X 60" with bottom set 12" above finished floor.

3. Access doors smaller than sizes listed above will be permitted only where necessary due to space limitations. In all cases where smaller doors are provided they shall be as large as space conditions permit.

c. In ductwork: Two-piece pan construction with outer side crimped over inner dished side and including frame and hardware. Dished portion filled with same insulations as used on duct or casing. Frame contact surface covered with continuous heavy dense fastened in place. Door contact surface, designed to close against felt to make door airtight. All hardware, brass construction. Provide not less than 2 hinges and not less than 2 heavy window type latches for each door where space conditions do not permit hinging of doors.

d. In casings: Similar to access doors in ductwork system except as follows:

1. Door adequately braced with interior angles or as approved.

2. 3 heavy brass hinges per door.

3. Latches: Operation either side of door, brass bronze construction, minimum 2 per door.

4.6 FLEXIBLE COLLARS

a. Unless otherwise specified, make connections between ductwork and fans by means of approved coated fabric collars with sewed and cemented seams, fastened by bolted metal strap.

b. Flexible connections – Flexible connections for air conditioning systems shall be at least 850 gr. 30 ounce glass fabric double coated with neoprene. Connections shall not be stretched tight but shall, after installation, be able to be moved in any direction at least 1 inch without stretching.

4.7 DUCT TEST HOLES

Duct test holes shall be required at different places for the purpose of air balancing. These shall be provided in main as well as branch ducts, for the insertion of Pitot tube. The diameter, constructions and spacing of these test holes shall be as shown in the drawings.

4.8 LEAKAGE AND PREVENTION

a. Duct leakage tests shall be carried out as recommended and test reports shall be submitted to the consultant for approval.

b. To this end, the contractor shall, in the construction of his work, use appropriate joint, seam, and connection caulking and sealers, to insure air tightness of the ductwork. In addition he shall apply a 3 inch wide frame resistant duct tape to all joints and seams that are not welded, soldered or other wise air tight. Tape shall be applied in a continuous and even strip on and around the joints.

c. For exposed ductwork, contractor shall confer with the Consultant as to the appropriate method of sealing to affect the most aesthetic appearance while maintaining an efficient seal.

4.9 ADJUSTMENT OF SYSTEMS AND TESTS

a. Upon completion of installation, balance air distribution by adjustment of dampers and apparatus so that actual air delivery of each diffuser, grille and register does not vary more than ± 5% from air quantities indicated. Adjust all registers and diffusers so that there are no drafts.

b. After balancing air distribution, test ventilating and air conditioning systems to certify compliance with Code requirements for ventilation and proper functioning of all operating devices.

c. Submit certification and test report as specified.

4.10 DUCT WORK INSULATION

a. Insulation:

All supply air ducting and return air-ducting shall be insulated with insulation. Panels shall be cut to size to fit duct being insulated, and shall be fixed to the duct with approved adhesive. Adhesive shall cover at least 75 % of cut area. Sheet metal hooks will not be allowed. The insulation is to be installed flush with the duct, but so as not to 'lessen the thickness of the insulation. Insulation shall be continuous, and no gaps, crevices, or other discontinuities shall be acceptable. The insulation shall be held in place additionally by using polyethylene-packaging bands, 10 mm wide.

b. Jacket:

To provide mechanical protection to the insulating shall be provided in mechanical
rooms, on duct, which are installed at, or below 2m or below 2m heights. Jacket shall be as indicated under INSULATION SCHEDULE (Section-3), pasted to insulation using approved adhesive. All circumferential and longitudinal joints shall be over-lapped at least 40mm.

c. Cladding:

All insulated ducting exposed to the atmosphere shall be provided with a cladding of 24 gage (0.70 mm) GI sheet over the insulation. All joints shall be sealed with "Silicon Sealant", so that the cladding becomes completely waterproof. Cladding shall also be installed at all other locations shown on the drawings.

d. Insulation Tapes:

At all insulation joints use. 75mm wide self-adhesive tape consisting of reinforced aluminum foil and white Kraft paper. Also applicable for Copper joints.

e. **Adhesive:**

Adhesive shall be rubber reinforced co-polymeric compound or approved equal.

4.11 AIR DEVICES

a. General:

These shall be factory-fabricated of powder coated or anodized aluminum and of color as approved and shall distribute the specified quantity of air evenly over the space intended, without causing noticeable drafts, or dead spots anywhere in the conditioned area. The Contractor shall be responsible for diffusion, spread, drop and throw. If according to the certified data of the manufacturer of the proposed-units, the sizes indicated on the drawings will not perform satisfactorily, the units

shall be re-selected to perform quietly and effectively in accordance with the .manufacturer's recommendations as approved by the Consultant. A schedule of all air inlets and outlets shall be submitted to the Consultant, indicating location, types, specified air quantity, neck or face velocity, sound power level values, pressure drop, throw and drop for registers and maximum and minimum diffusion range, prior to ordering.

b. Diffusers:

Shall fee round, half round, square, rectangular, slot, strip shaped or perforated type with fixed or adjustable air discharge pattern, as indicated on the drawings, Ceiling mounted units shall be furnished with anti-smudge device, unless the diffuser unit minimizes ceiling smudging through design features. Diffusers shall be provided with air deflectors specified herein. Ceiling mounted units shall be installed with trims tight against ceiling whether flush, recessed or surface mounted. Rubber gasket shall be provided between ceiling and surface mounted diffusers. Duct collar connecting the duct to diffuser shall be airtight and will not interfere with the volume controller. Return or exhaust units, when indicated, shall be similar to supply diffusers. Diffusers shall be provided with opposed blade volume controller with accessible key operator.

c. Registers:

Shall be of the type and size shown on the drawings as approved. Registers shall be provided with rubber gaskets between flanges and walls or ceilings. Wall supply registers shall be installed at least 6 inch (150mm) below the ceiling unless otherwise indicated. Registers shall be provided with opposed blade volume controllers with accessible key operator.

d. Grilles:

Shall be of sizes and type shown on the drawings. All grills shall be provided with control dampers unless otherwise indicated on drawings.

e. Installation:

Shall ensure that all lines are perpendicular and parallel to the building walls and other surfaces, flush with the ceiling and properly centered so that complete symmetry is obtained.

All diffusers shall be installed directly to the supply air ducting, so that the weight of the diffusers is not transferred to the false ceiling. Diffuser shall be so installed that the collar is flush with the ceiling. Gaskets shall be used to prevent leakage.

Registers and grills on sidewalls shall be fixed on wooden frames . Frame thickness shall be 6mm less than the register / grill collar and shall cover the full depth of the wall. Perfect alignment and symmetry shall be maintained.

After the system is in operation, if drafts, dead spots, or excessive noise are noticeable in the conditioned areas due to improper selection or construction of the air outlet, the air-outlet shall be changed to the proper type to remove the defect, without additional cost to the Employer.

5.0 INSTALLATION

5.1 REQUIREMENTS

The contractor shall obtain the approval and perform necessary inspections to the national, local and corporate codes and standards involved in the system used, and provide the Employer with the written documents required expressly by the acceptance, inspections and codes before the execution on site.

The manufacturer shall provide conformity certificates for products and the following information that comes with each piece of equipment:

A/C schematics, installation charts and specification (incl. standards for installation, commissioning and acceptance, requirements for installation of indoor and outdoor units, installation of refrigerant circuits, condensate circuits and electrical circuits, thermal insulation for refrigerant, and acceptance of concealed works);

Electrical schematics and wiring diagram
Operating specification and maintenance and commissioning manual (indicating fault, causes and method for trouble-shooting)
List of maintenance tools for accessories and spare parts, and instruments and apparatus;

Other necessary information on design, installation, commissioning, operation and maintenance;

The manufacturer shall provide the construction and performance of the unit as per the design scheme, which includes but not limited to the following:

Performance parameters of the unit like air volume, refrigerating output, heating output, power, weight, dimensions and more (included in a list); and
Performance description of main parts like, compressor, oil circuit, control system, refrigerant and more.

The manufacturer shall provide all particular test and inspection reports for A/C equipment, and assume responsibility for the accuracy and completeness of the test reports.

5.2 GENERAL

The All DC Inverter VRF system equipment has to be designed, manufactured,

tested and accepted in compliance with the following requirements.
Conduct detailed design, installation and commissioning of the equipment, piping and automation control system as recommended by the manufacturer.

After signing the contract, the bidder shall appoint his representative of the project who will coordinate all works throughout the project like drawing confirmation, packaging, shipment, field installation, commissioning and acceptance.

The manufacturer winning the contract shall complete the detailed design within 30 days after signing the contract. Before installation, related drawings and technical agreement shall be submitted complete, and approved by the client's representative. The unit shall be installed strictly to the approved drawings. In case of any change, prior approval from the Employer and confirmation by the designer shall be obtained.

Before installation, properly perform unpacking for inspection and all other necessary works, inform the purchaser and supervisor to be present, properly keep records and provide information feedback.

During the installation, strictly respect the rules for safety protection and fire safety. Take full account of the safety of installing and operating people, and take precautions against any accident. Avoid problems like sharp corner angles, burrs and cracking. Materials shall be fire-retardant, low-smoke and free of toxin.
All exposed pipes shall be neatly arranged and in parallel with other pipes and buildings. Make sure that all vertical pipes are plumb and arranged along the lines of the building.

Take precautions to prevent the refrigerant gas from discharging into the atmosphere.

For the unit, ensure the safe reliable run, easy operation and maintenance, and low cost of maintenance.

The system shall be of simple installation with economical and rational dimensions for the tubes, low cost in installation and optimized tubing.

All key components and devices shall have protective system available.

The surface of the unit and tubing shall not drip condensate.

Participants for the test include Employer or his representative, contractor, technical support personnel from the manufacturer, installing people and supervisor

5.3 INSTALLATION OF INDOOR UNIT

Indoor unit shall be installed/suspended in the ceiling. Strictly follow the standard for installation. Never have any part of the equipment damaged and make sure that it does not fall.

Before installing the indoor unit, make inspection and calibration. It shall be mounted firm and level with accurate position and elevation.

The indoor unit shall be so installed that the other services of the building will not be affected.

5.4 INSTALLATION OF OUTDOOR UNIT

The outdoor unit shall be so installed that the other services and the façade effect of the building will not be affected.

The outdoor unit will be mounted at the spot designated for A/C on the building drawing. Access for maintenance to the outdoor unit shall be made available.

The outdoor unit shall allow fast maintenance like fast replacement of the compressor.

The unit shall have vibration damping device, allow easy maintenance and provide good condition during operation. During the operation, abnormal sound and vibration shall not happen, and the unit shall run in quiet operational mode.

5.5 REFRIGERANT PIPING

Before installation, the copper tube shall be kept from ingress by moisture. The tube shall be purged and vacuum dried.

The interior of the tube shall be kept clean at work.

For welding, the tube shall be filled with nitrogen for protection against oxidation of the copper tube.

Copper tubes shall be purged before connection with the main unit.

Refrigerant tubes shall be subject to air-tightness test and the air-tightness maintained.

5.6 SUPPORTING AND SECURING

Hangers shall be fabricated and installed in line with the diagrams for supports and hangers provided by the designer or equipment manufacturer and approved by the supervisor.

Use screws. Generally, use hot dip galvanized steel wood screws to secure concrete, brick or block wall. In wet and exposed cases, use lubricated wood screws.

Use drilling machine of proper size and length, and fit for structure. Never use flame to bore in metal products.

All fasteners and securing methods shall comply with the rules from the manufacturer.

5.7 DISCHARGE OF CONDENSATE

Condensate shall be centrally drained, which shall be smooth without overflow and leakage.

If sloping is impracticable, provide a condensate lift pump.

5.8 THERMAL INSULATION

Condensate tubes are to be thermally insulated to prevent condensation.

5.9 CLEANING

The surface of the unit shall be free of scratches, stains and impression. It should be smooth, even in the coating, consistent in color and free of peeling-off, curls, cracks, bubbles, dripping marks etc

5.10 COMMISSIONING AND TRIAL RUN

When the system is installed, conduct the test before trial run under the supervision of the purchaser and Consultant to prove it is ready for trial run.

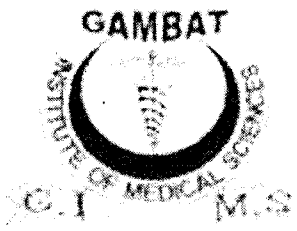
Participants for the trial run include technical support personnel from the manufacturer, installing people, supervisor and Employer.

The manufacturer winning the contract shall conduct commissioning and trial run of the equipment on site to verify the design, fabrication, operability and functions.

7.0 APPROVED MANUFACTURERS

LIST OF APPROVED MANUFACTURERS FOR AIR CONDITIONING WORK OF, GIMS

S.#	Name Of Equipment / Material	Brand Name
1	ALL DC Inverter Air Conditioning System	a. LG b. GREE c. YORK d. Hitachi
2	Building Management System	Same Brand
3	Flexible Duct	a. ATCO b. Aero Duct
4	Closed Cell Foam Insulation for pipes	a. Aeroflex b. Atco c. Aeroduct. d. Or approved equal.
5	LV cubicle ,switch board, Moter Control center, Desk control' Pannel, DBs.	a. Siemens b. Electro Mech c. Eletectrich d. Tecmen
6	L.T Cable and Wires	a. Pakistan Cable – Pakistan b. A.G.E Cable - Pakistan c. Fast Cable – Pakistan d. Pioneer Cables
7	PVC Conduit / Pipes	a. Galco – Pakistan b. Beta –Pakistan c. Dadex
8	Cable Tray, Cable Ladders	a. EZZI Engineering b. Karimi Electro Mech c. Or approved Equal
9	Refrigerant Copper Pipe	a. Muller USA
10	U PVC Pipe	a. AGM - Saudi Arabia b. Eurapipe – Australia c. Dadex - Pakistan



HVAC WORKS AT

LABORATORY BUILDING

GAMBAT INSTITUTE OF MEDICAL SCIENCES

TENDER DOCUMENTS

VOLUME-II

GENERAL CONDITIONS OF CONTRACT

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1 Scope of Work

1.1 The Selected Bidder will be responsible for the supply, installation, testing and commissioning of DC Inverter based VRF Air Conditioning system along with auxiliaries and components at Laboratory Building , Gambat Institute of Medical Sciences, Gambat.

1.2 Selected Bidder must ensure that the supplied equipment is fully operational, new and perform properly and meet RFP's Technical requirement.

1.3 At the time of installation and commissioning, Selected Bidder must provide comprehensive documentation of system deployed including diagrams, labeling, schematics, configuration and manuals etc.

1.4 Selected bidder shall be responsible for Training for knowledge transfer to engineers/operators and support personnel will also be the responsibility of the Bidder.

1.5 Selected bidder shall have to complete the project within required time period after signing the contract. The time period for completion of this project is 9 months.

2 Bids Submission Requirements

The objective of bid submission requirement is to provide bidders with the information to submit their bid in response of this RFP according to the specifications defined in this RFP and in order/sequence as set forth in this document. Bidders must follow below requirements while preparing their proposals/bids proposal and submission.

The bidder is required to submit TWO proposals: (1. Technical Proposal, 2. Financial Proposal) for this tender, there will 'Two stage – Two Envelope Procedure' for bidding.

2.1 The bidder is required to submit Bid in Two Envelopes. Envelope should also be labeled with the name, address and contact number of the bidding company.

2.2 Bidders shall submit the Bid along with brochures/data sheets explaining the items quoted.

2.3 The bidder must provide Project Execution Plan, Design Proposal with layouts, diagrams, etc. along with Technical Proposal.

2.4 Bidders are required to fill and sign all pages of "Bill of Costs" in writing while following the format given, and submit it as Financial Proposal. Financial Proposals not following the given format may lead to the rejection of bid.

2.5 Bidders are required to submit their financial proposals in PAK Rupees (Rs.)

2.6 The Bid Security equal to 2% of the Total Bid Value, in the form of Deposit at Call or a Bank Guarantee issued by a Scheduled Bank in Pakistan or from a foreign bank duly counter guaranteed by a Scheduled Bank in Pakistan or an insurance company having at least AA rating from PACRA/JCR in favor of Gambat Institute of Medical Sciences, Gambat must accompany the bid as part of proposal. The bid shall not be considered without Bid Security.

2.7 The Bidder shall clearly mention his delivery schedule and completion period of project in his proposal.

2.8 The bidder must submit letter verifying that the quoted solution complies with provided sizing information and will meet the required performance parameter.

3 Selection Procedure

3.1 A two step process will be used for the selection of a bidder for the award of this tender

3.2 GIMS intent in issuing this Tender Document is to award a contract to the lowest and best responsive bidder who meets specifications as laid out in technical specification and who fulfill all Mandatory Requirements mentioned in General Terms and Conditions. If any of the requirements or equipment specifications is not met by the bidder, the bid will be considered as non-responsive, and the bid of the next bidder will be considered.

3.3 After the approval of contract award, a contract agreement on the stamp paper worth Rs. 100/- shall be executed by the GIMS with selected bidder within 15 days from the date of issuance of Letter of Intent on standard terms and conditions.

3.4 For ordering purpose the price evaluation will be done against items.

3.5 Terms of Payment

a) Twenty percent (20%) payment shall be made in advance against Bank Guarantee issued by scheduled bank of Pakistan or Insurance Guarantee issued by AAA rated Insurance Company to the Contractor.

b) Thirty percent (30%) payment shall be made against B/L (Bill of Laden) of the equipment at the port of shipping of the country of origin.

c) Twenty percent (20%) payment shall be paid after successful delivery of equipment at GIMS, Gambat.

d) Twenty percent (20%) shall be paid after successful installation of equipment on site.

e) Ten percent (10%) payment shall be payable to the Contractor after issuance of certificate for successful installation, proper integration, testing & commissioning of all equipment as per requirement at GIMS, Gambat.

f) The successful bidder must provide O & M and comprehensive part warranty services till One (01) Years.

g) The successful bidder has to furnish the Performance Guarantee in the shape of Bank Guarantee from a scheduled bank of Pakistan equivalent to 10 % of the total contract. The said Guarantee will be released after the successful testing and commissioning of HVAC system at Trauma center , GIMS, Gambat

h) Invoices will be cleared as soon as possible not exceeding 20 days upon receiving the invoice.

i) All payments shall be made through cross cheque in the Pakistan Rupees (PKR).

j) Taxes will be deducted at source as per government rules at the time of payment.

k) The Bid Security (2%) of the successful bidder will be returned after the signing of the contract and delivery of equipment.

l) The bidder is responsible to deliver equipment at the sites at his own risk and cost.

4 Liquidated Damages

In case of delay, the Project Director, GIMS, Gambat reserves the right to impose a penalty not exceeding 10% of the total amount of the contract at the rate of 1% of the total contract value for each week of delay.

5 General Terms and Conditions

Following general terms & conditions apply to this RFP

5.1 Validity period of the bids regarding the award of contract shall be 2 months (60 days).

5.2 The decisions of Project Director, GIMS, Gambat will be binding on all concerned and will in no case be challengeable at any forum or any court of law.

5.3 Bids are liable to be rejected if; they are not conforming the terms, conditions and specifications stipulated in this RFP.

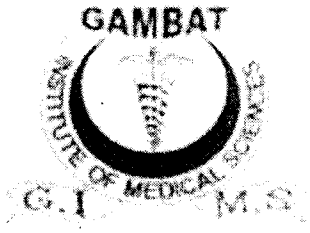
5.4 During the examination, evaluation and comparison of the bids, the Principal, GIMS, Gambat at its sole discretion may ask the bidder for clarifications of its bid.

5.5 The request for clarification and the response both shall be in writing/email. However, no change in the price or substance of the bid shall be sought, offered or permitted after bid submission.

5.6 Total Bid Value (Cost of equipment, Cost of Installation & Commissioning etc as per BOQ) shall account for financial evaluation and so shall be included in Total Bid Value.

5.7 The amount submitted as Earnest Money (2%) shall be refunded to the unsuccessful bidders after the decision of "Tender Committee" for the award of said tender.

5.8 If there is a discrepancy between unit price and total price in the submitted bid which is obtained by multiplying the unit price and quantity, the unit price shall prevail and total price shall be corrected. If there is a discrepancy between the words and figures, the amount in words shall prevail. If there is a mistake in



HVAC WORKS AT

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BILL OF QUANTITIES

addition/ totaling, that shall be corrected. If the bidder does not accept the corrected amount of bid, his bid shall be rejected and his bid security forfeited.

5.9 Incomplete and conditional BIDs will not be entertained.

5.10 In case of any dispute between the two parties of any matter arising out of after signing the contract agreement, the case shall be referred to Project Director, GIMS, Gambat whose decision shall be final and binding on both parties.

5.11 Bids submitted via email or fax will not be entertained.

5.12 Bidders indemnify GIMS, Gambat against all third party claims of infringement of patent trade mark, industrial design rights arising from use of the goods of any part thereof in Pakistan.

5.13 GIMS, Gambat reserves the right to accept/reject wholly or partially any tender at any stage of the tender process.

BILL OF QUANTITIES OF HVAC WORKS GIMS LABORATORY

Item No.	Description	Capacity	Qty	Unit	Rates	Amount (PKR)
	Supply of following equipment / system and material as per specifications and drawings complete in all respects and ready for use					
	Sub-Head "1" Equipment:(All DC Inverter VRF)					
1	Multi Split IDUs					
A	Multi system DX indoor AC units,4 way cassette type with all controls, thermostats and accessories / fittings	USRT				
a	AC-1	1	27	No		
b	AC-2	1.5	28	No		
c	AC-3	2	35	No		
d	AC-4	4	3	No		
B	Spares for Indoor type AC units as recommanded by the manufacture for 2 years consumption, Branch/Y Joints/BMS		1	Lot		
C	Branch Connectors/Y Joints		1	Lot		
D	Service Valves for all indoor units		1	Lot		
2	Multi Split ODUs (All DC Inverter VRF)					
A	Multi system outdoor units (Condensing Units), floor standing with all standard controls, safeties &accessones/ fittings	USRT				
a	CU-1	45	1	No		
b	CU-2	40	1	No		
c	CU-3	51	1	No		
d	CU-4	51	1	No		
B	Spares for AC Outdoor condensing Units as recommanded by the manufacture for 2 years consumption		1	Lot		
3	Energy Recovery Ventilators (ERV)					
	ERV-1 (1760 CFM)		1	No		
	ERV-2 (1760 CFM)		1	No		
	ERV-3 (1760 CFM)		1	No		
	ERV-4 (1760 CFM)		1	No		
4	Air cooled screw chiller	USRT				
	AWC-1	65	1	No		
5	Air Handling Units	USRT				
	AHU-1	12				
	AHU-2	12				
	AHU-3	14				
	AHU-4	14				
6	Chilled Water Pumps	125 USGPM	2	No		
	Total Of Sub Head "1"					

Item No.	Description	Capacity	Qty	Unit	Rates	Amount (PKR)
	INSTALLATION, TESTING & COMMISSIONING of following equipment / system and material as per schedule, specifications and drawings complete in all respects and ready for use. This work also includes cutting ,chipping and making holes in walls floors and slabs with the prior permission of engineer incharge and making good all the damages.					
	Sub-Head "2" Mechanical					
4	Multi Split IDUs					
A	Multi system DX indoor AC units,4 way cassette type with all controls ,thermostats and accessories / fittings	USRT				
a	AC-1	1	27	No		
b	AC-2	1.5	28	No		
c	AC-3	2	35	No		
d	AC-4	4	3	No		
B	Branch Connectors/Y Joints		1	Lot		
C	Service valves for all indoor units		1	Lot		
5	Multi Split ODUs					
A	Multi system outdoor units (Condensing Units), floor standing as per schedule with all standard controls ,safeties &accessories/	USRT				
a	ODU-1	45	1	No		
b	ODU-2	40	1	No		
c	ODU-3	51	1	No		
d	ODU-4	51	1	No		
B	ODU Rails		1	Lot		
3	Energy Recovery Ventilators (ERV)					
	ERV-1 (1760 CFM)		1	No		
	ERV-2 (1760 CFM)		1	No		
	ERV-3 (1760 CFM)		1	No		
	ERV-4 (1760 CFM)		1	No		
4	Air cooled screw chiller	USRT				
	AHU-1	65	1	No		
5	Air Handling Units	USRT				
	AHU-1	12	1	No		
	AHU-2	12	1	No		
	AHU-3	14	1	No		
	AHU-4	14	1	No		
6	Chilled Water Pumps	125 USGPM	2	No		
19	Providing and installing seamless Schedule 40 pipe including all tees, bend, reducers, hangers etc. complete as specified in the specifications and directed by the engineer incharge.					
		3" ø	27	RF		
		2" ø	108	RF		
		1-1/4" ø	122	RF		
20	Providing and installing pre-formed glass wool insulation 64 Kg/m3 density factory applied vapour barrier. Complete and directed by the engineer incharge.					
		3" ø	27	F		
		2" ø	108	F		
		1-1/4" ø	122	F		

Item No.	Description	Capacity	Qty	Unit	Rates	Amount (PKR)
	INSTALLATION, TESTING & COMMISSIONING of following equipment / system and material as per schedule specifications and drawings complete in all respects and ready for use. This work also includes cutting ,chipping and making holes in walls floors and slabs with the prior permission of engineer incharge and making good all the damages					
	Sub-Head "2" Mechanical					
4	Mult Split IDUs					
A	Multi system DX indoor AC units,4 way cassette type with all controls, thermostats and accessories / fittings	USRT				
a	AC-1	1	27	No		
b	AC-2	1.5	28	No		
c	AC-3	2	35	No		
d	AC-4	4	3	No		
B	Branch Connectors/Y Joints		1	Lot		
C	Service valves for all indoor units		1	Lot		
5	Multi Split ODUs					
A	Multi system outdoor units (Condensing Units) floor standing as per schedule with all standard controls, safeties &accessories/	USRT				
a	CU-1	45	1	No		
b	CU-2	40	1	No		
c	CU-3	51	1	No		
d	CU-4	51	1	No		
B	ODU Joints		1	Lot		
3	Energy Recovery Ventilators (ERV)					
	ERV-1 (1760 CFM)		1	No		
	ERV-2 (1760 CFM)		1	No		
	ERV-3 (1760 CFM)		1	No		
	ERV-4 (1760 CFM)		1	No		
4	Air cooled screw chiller	USRT				
	ACC-1	65	1	No		
5	Air Handling Units	USRT				
	AHU-1	12	1	No		
	AHU-2	12	1	No		
	AHU-3	14	1	No		
	AHU-4	14	1	No		
6	Chilled Water Pumps	125 USGPM	2	No		
19	Providing and installing seamless Schedule 40 pipe including all fixes, bend, reducers, hangers etc. complete as specified in the specifications and directed by the engineer incharge.					
		3" *	27	RF		
		2" *	108	RF		
		1-1/4" *	122	RF		
20	Providing and installing pre-formed glass wool insulation 64 Kg/m3 density factory applied vapour barrier. Complete and directed by the engineer incharge					
		3" *	27	RI		
		2" *	108	RI		
		1-1/4" *	122	RI		

Item No.	Description	Capacity	Qty	Unit	Rates	Amount (PKR)
	INSTALLATION, TESTING & COMMISSIONING of following equipment / system and material as per schedule, specifications and drawings complete in all respects and ready for use. This work also includes cutting, chipping and making holes in walls floors and slabs with the prior permission of engineer incharge and making good all the damages.					
	Sub-Head "2" Mechanical					
4	**Mult Split IDUs**					
A	Multi system DX indoor AC units,4 way cassette type with all controls, thermostats and accessories / fittings	USRT				
a	AC-1	1	27	No		
b	AC-2	1.5	28	No		
c	AC-3	2	35	No		
d	AC-4	4	3	No		
B	Branch Connectors/Y Joints		1	Lot		
C	Service valves for all indoor units		1	Lot		
5	Multi Split ODUs					
A	Multi system outdoor units (Condensing Units), floor standing as per schedule with all standard controls, safeties &accessories/	USRT				
a	CU-1	45	1	No		
b	CU-2	40	1	No		
c	CU-3	51	1	No		
d	CU-4	61	1	No		
B	ODU Joints		1	Lot		
3	**Energy Recovery Ventilators (ERV)**					
	ERV-1 (1760 CFM)		1	No		
	ERV-2 (1760 CFM)		1	No		
	ERV-3 (1760 CFM)		1	No		
	ERV-4 (1760 CFM)		1	No		
4	Air cooled screw chiller	USRT				
	AWC-1	60	1	No		
5	**Air Handling Units**	USRT				
	AHU-1	12	1	No		
	AHU-2	12	1	No		
	AHU-3	14	1	No		
	AHU-4	14	1	No		
6	Chilled Water Pumps	125 USGPM	2	No		
19	Providing and installing seamless Schedule 40 pipe including all tees, bend, reducers, hangers etc. complete as specified in the specifications and directed by the engineer incharge					
		3" *	27	RF		
		2" *	108	RF		
		1-1/4" *	122	RF		
20	Providing and installing pre-formed glass wool insulation 64 Kg/m3 density factory applied vapour barrier. Complete and directed by the engineer incharge					
		3" *	27	RI		
		2" *	108	RI		
		1-1/4" *	122	RI		

Item No.	Description	Capacity	Qty	Unit	Rates	Amount (PKR)
	Return Air Diffuser		2430	Sq.in		
F	Supplying and installing opposed blade volume dampers made from 16 SWG G.I sheets complete as specified in the specifications shown on the drawings and as directed by the engineer incharge.		1485	Sq.in		
G	Return air grills		3240	Sq.in		
11	Supply, fabrication and installation of G.I duct work, using prime quality sheet metal including all tees, bends, reducers, elbows, turning vanes splitters and dampers etc. complete in all respect as specified in specifications, shown on layout drawings and Standards Drawings and as directed by the engineer in charge.		1012	SM		
12	Providing and applying fiber glass insulation 1" thick, 12 KG/M^3 density with factory applied vapor barrier insulation on duct work with 6 oz Canvas cloth wrapping with adhesive. All longitudinal and circumferential joints shall be sealed with 2" wide self adhesive tape complete as specified in the specifications, shown on the drawings specified in the Schedule of Duct insulation and as directed by the engineer in charge.		1012	SM		
13	Providing and installing Flexible duct as shown in the drawings and directed by the engineer in charge.		47	SM		
14	Central Controller for complete VRF system		1	Job		
15	Air balancing of complete system by specialized contractor and contractor will submit 3 sets of balancing report		1	Job		
16	Preparing & supplying of shop drawings for complete job		1	Job		
17	Preparing & supplying of as built drawings for Complete job. 3 Sets on butter paper and one set on CD		1	Job		
18	Commissioning, Operation & maintenance of complete A/C system for one year period		1	Job		
19	**Exhaust Fans:**					
a	Providing and installing wall mounted propeller exhaust fans steel body including power wiring in steel conduits complete as specified in the specifications, shown on the drawing and as directed by the engineer incharge in the following sizes.					
	6" dia plastic body Exhaust Fans 100 CFM		8	Nos		
b	Supply, installation, testing and commissioning of inline toilet exhaust fans including power wiring as specified in the specifications and directed by the engineer in charge in following sizes					
	300 CFM 0.50" ESP		8	No		
20	18 Gauge G.I Trunking	18" x 8"	70	m		
		24" x 6"	70	m		
	Total Of Sub Head "2"					

Item No	Description	Capacity	Qty	Unit	Rates	Amount (PKR)
21	Sub Head "3" Electrical Work				1 "3" Electrical Work	
a	1x 4 core 16 mm square pvc/pvc copper conductor cable with single core 10 mm square pvc copper conductor cable as ECC running on single Cable tray for each Condesing units	16mm2 (4core)	121	m		
b	1x 4 core 10 mm square pvc/pvc copper conductor cable with single core 10 mm square pvc copper conductor cable as ECC running on single Cable tray for each Condesing units	10mm2 (4core)	121	m		
c	1 x 3 core 6 mm square pvc/pvc copper conductor cable with single core 2.5 mm square pvc copper conductor cable as ECC running on single Cable tray for each Condesing unit	6mm2 (3core)	3048	m		
22	Earth wiring	2.5mm2	3048	m		
		10mm2	243	m		
23	Communication wiring					
	Communication wiring from outdoor relevant unit to each indoor unit Shielded wire 3 core 0.75 sqmm out side in cable tray and inside in PVC conduit	0.75mm2	3048	m		
24	HVAC Electrical panels					
a	DB-01 at rooftop for VRF system		1	No		
b	DB-02 at rooftop for Chilled water system		1	No		
	Total Of Sub Head "3"					
	Sub Head "4" Civil Work					
25	Foundations for all equipment as required		1	Job		
26	Proper Beam Cutting and other holes for pipes		1	Job		
	Total Of Sub Head "4"					
	Sub Head "5" Miscellaneous					
28	Any Other item or quantity not mentioned above but required for the completion of job and satisfactory operation of system.		1	Job		
	Total Of Sub Head "5"					
	Total Of Sub Head "1" Rs					
	Total Of Sub Head "2" Rs					
	Total Of Sub Head "3" Rs					
	Total Of Sub Head "4" Rs					
	Total Of Sub Head "5" Rs					
	Grand Total Of 1+2+3+4+5 Rs					
	FINAL NET VALUE IN PAK RUPEES					

HVAC WORKS AT

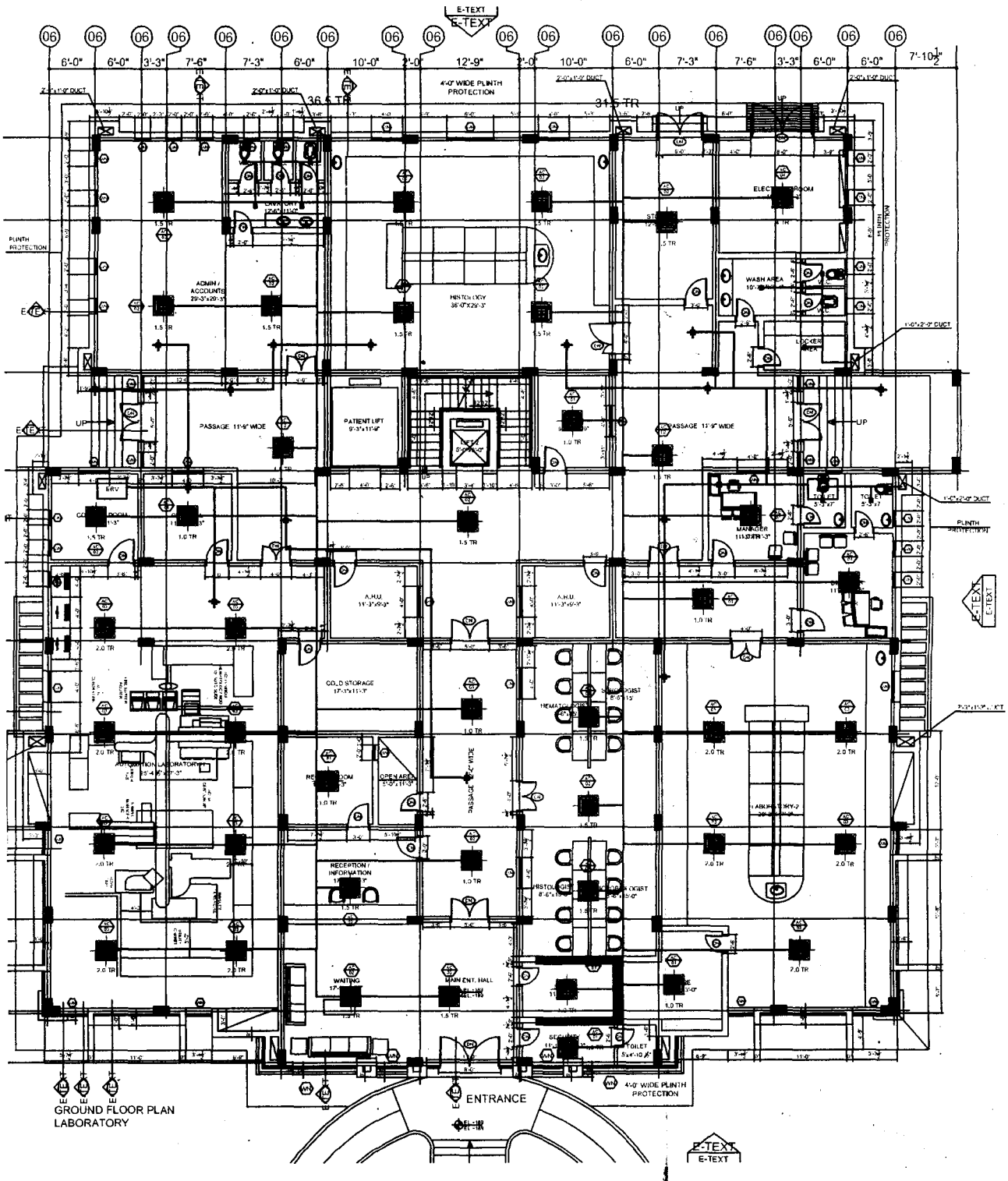
LABORATORY BUILDING

GAMBAT INSTITUTE OF MEDICAL SCIENCES

TENDER DOCUMENTS

VOLUME-IV

DESIGN DRAWINGS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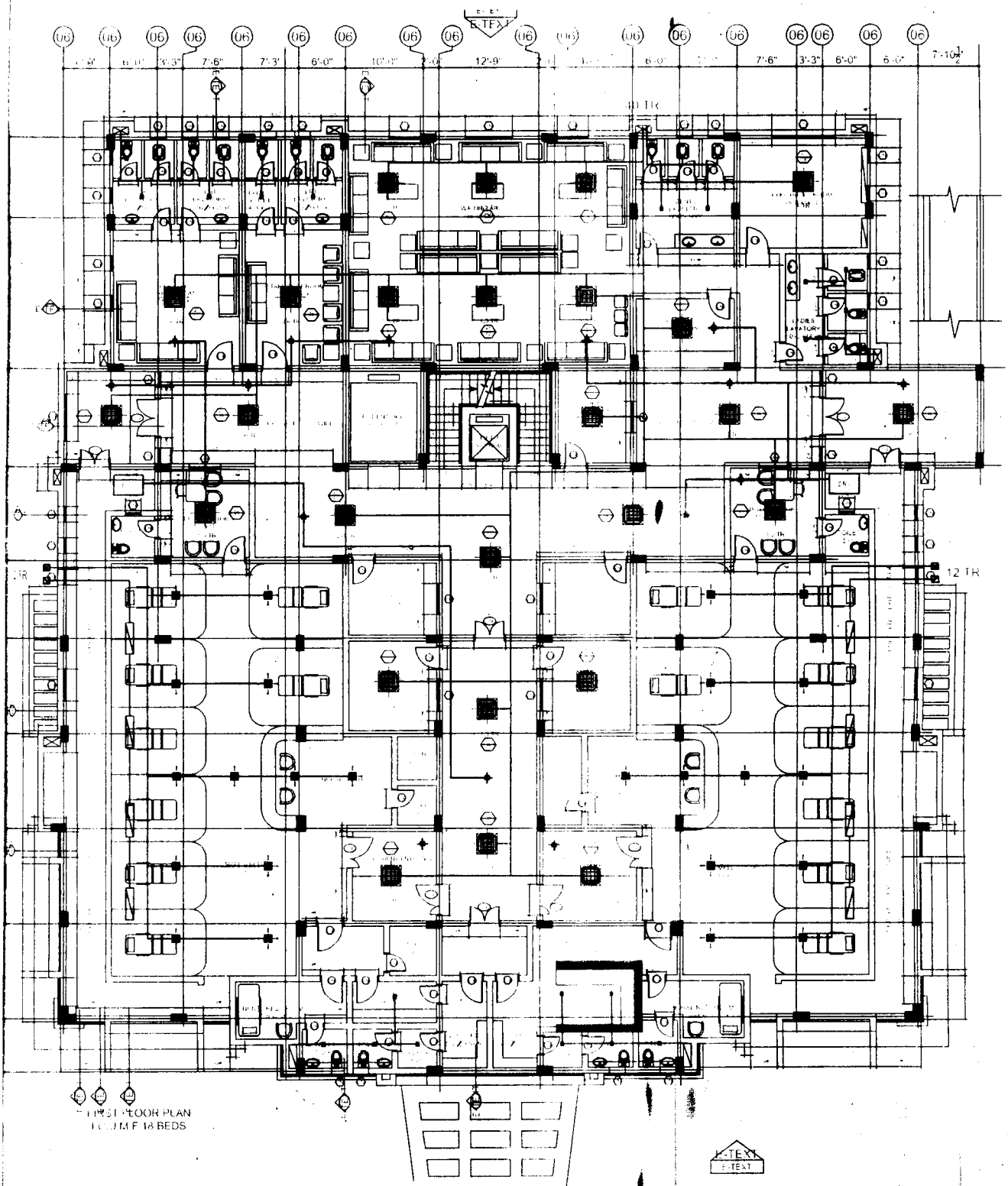
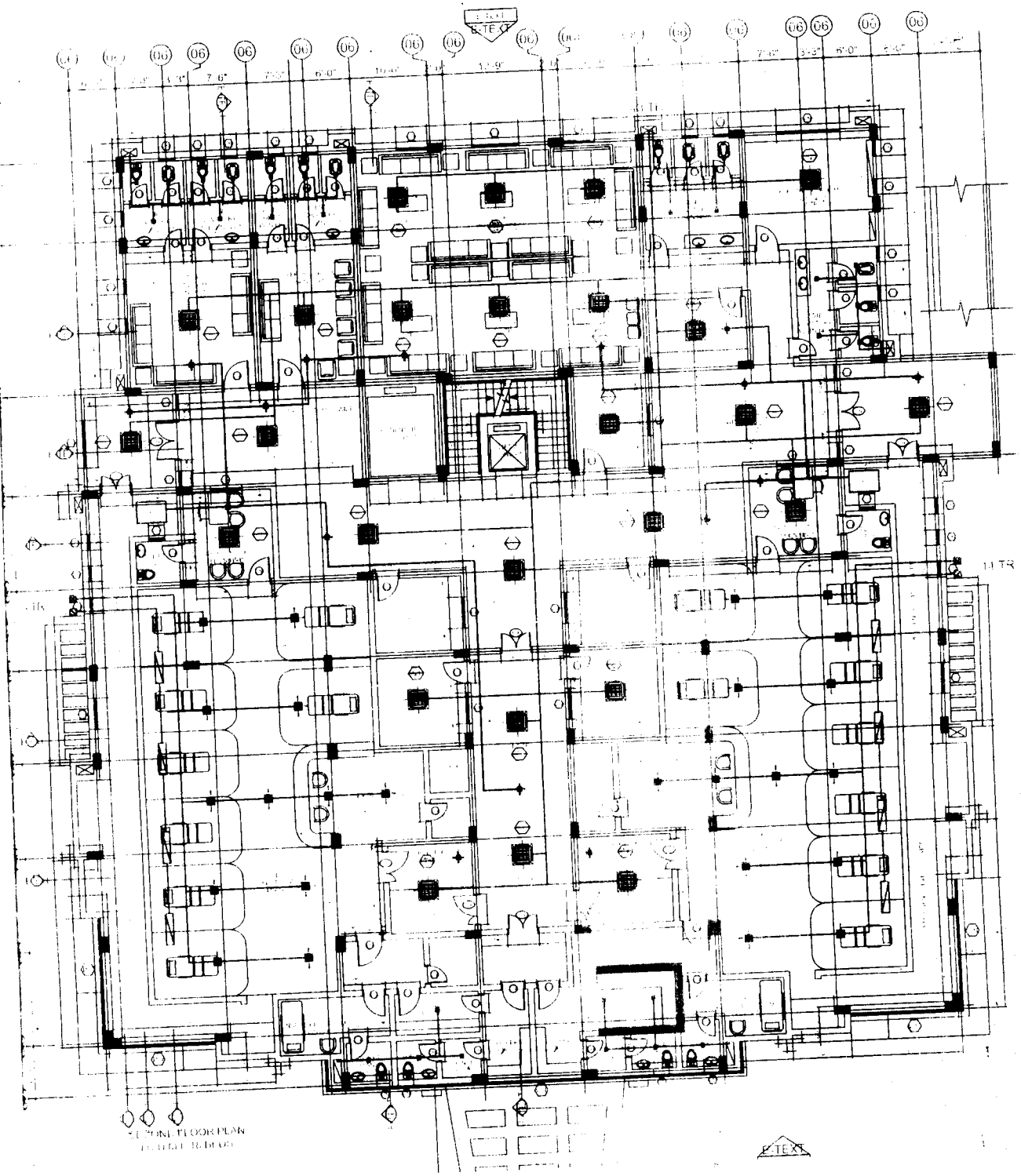
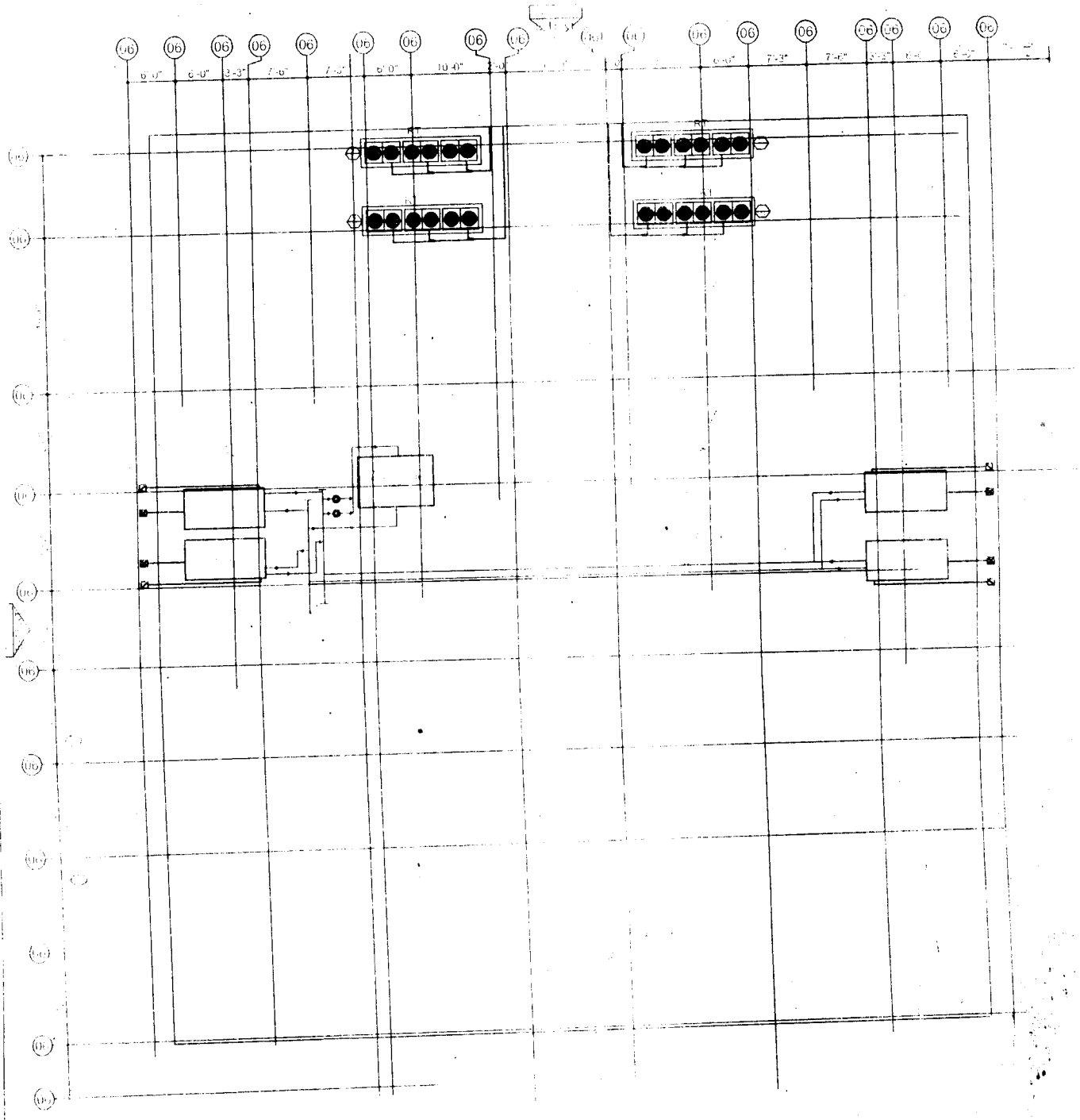
7'-6"
3'-3"
6'-0"
6'-0"
7'-10½"
4'-0" WIDE PLINTH PROTECTION
36.5 TR
31.5 TR
2'-6"x1'-0" DUCT
PLINTH PROTECTION
ADMIN / ACCOUNTS
HISTOLOGY
36'-0"X29'-3"
PASSAGE 11'-9" WIDE
PATIENT LIFT
LIFT
ELECTRICAL ROOM
WASH AREA
LOCKER AREA
MANAGER
A.H.U.
COLD STORAGE
17'-3"x11'-3"
AUTOMATION LABORATORY
RECEPTION / INFORMATION
OPEN AREA
WAITING
MAIN ENT. HALL
TOILET
ENTRANCE
4'-0" WIDE PLINTH PROTECTION
GROUND FLOOR PLAN
LABORATORY



FIRST FLOOR PLAN
FOR M.F 18 BEDS





SCHEDULE OF AIR HANDLING UNITS

													REMARKS
							CAPACITY MBH					WATER FLOW IN GPM	

Schedule of Air Cooled Screw Chiller

	USRT
	Air Cooled Screw Chiller
	GPM

Schedule of Centrifugal Pumps

Quantity	Description	Flow Rate			Pressure Rating	Remarks
2/ NOS	Centrifugal Pump	45 USGPM			125 PSIG	Duty & Standby

Schedule of Cassette Type Indoor Unit

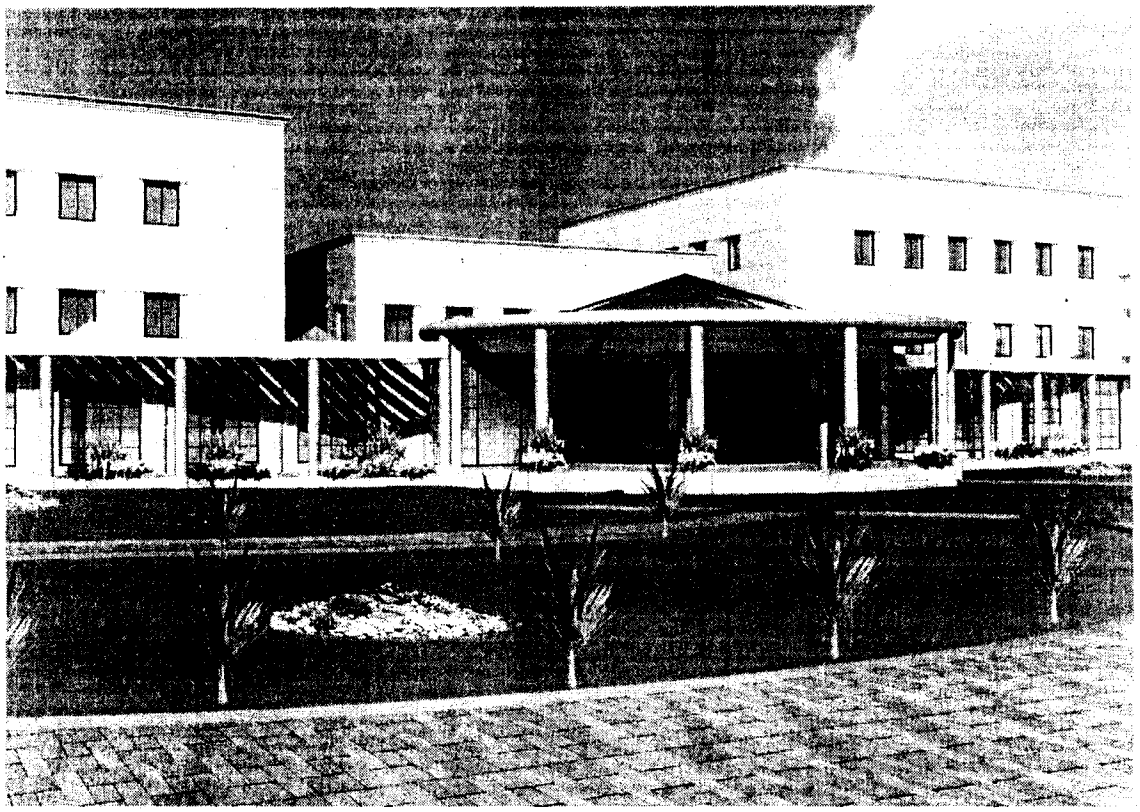
CODE	TYPE	QTY	TOTAL COOLING CAPACITY (TR)	ENTERING AIR		POWER SUPPLY
				DB DEG. F	WB DEG. F	
[illegible]	REVERSIBLE ALL DC INVERTER TYPE MULTI SPLIT A/C SYSTEM BASED CEILING HUNG CASSETTE TYPE INDOOR UNITS	27	1	75	62	220V 1PH/50HZ
[illegible]	—DO—	28	1.5	75	62	—DO—
AC-3	—DO—	35	2	75	62	—DO—
AC-4	—DO—	3	4	75	62	—DO—

Schedule of VRF All DC Inverter Condensing Units

CODE	TYPE	QTY.	COOLING CAPACITY (TR)	MAX. ENT. CONDENSER AIR TEMP. DEG. F	POWER SUPPLY
CU-1	REVERSIBLE ALL DC INVERTER AIR COOLED CONDENSER	1	45		400V/3PH 50HZ
CU-2	—DO—	1	40		—DO—
CU-3	—DO—	1	51		—DO—
CU-4	—DO—	1	51		—DO—

Schedule of Energy Recovery Ventilators

[illegible]	TYPE	QTY	[illegible]	ESTIMATED STATIC PRESS. SUPPLY (Pa)	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]



HVAC WORKS AT GAMBAT INSTITUTE OF MEDICAL SCIENCES

TENDER DOCUMENTS

ACADEMIC BLOCK

VOLUME-I

TECHNICAL SPECIFICATIONS

Table of Contents

GENERAL PROVISIONS
HVAC WORKS

1.1 HVAC SYSTEM CONCEPT

The building shall be air-conditioned by Variable Refrigerant Flow system (with R410A refrigerant), comprising of **ALL DC Inverter air-conditioning units.**

The system shall comprise of one or more outdoor units connected via inter-connecting refrigeration pipe work to multiple indoor units using branch pipe connecters. The system shall be complete with all the necessary electronic controls and associated control wiring to maintain the space design conditions.

1.2 DESIGN CONDITIONS

HVAC System has been designed for the conditions listed hereunder. These conditions are being given for the information of the Contractor to enable him to perform specified tests under these conditions.

Summer Outside Design Conditions

a)	Summer Dry Bulb Temp:	125° F
	Wet Bulb Temp:	82° F

Inside Design Conditions

a)	All air-conditioned areas	75°F ± 3° F 50% ± 10% RH

1.3 MATERIALS

All materials shall be of the highest grade, free from defects and imperfections, of recent manufacture and unused, and the classification and grades designated, conforming to the requirements of the latest issue of the appropriate specifications cited herein. All materials, supplies, and articles forming part of major equipment and not fabricated by the manufacturer of the equipment shall be the products of the recognized reputable manufacturers.

1.4 WORKMANSHIP

Workmanship and general finish shall be of the highest grade, in accordance with the requirements specified herein, and the latest standard practice.

1.5 EQUIPMENT

a) All equipment shall be manufactured by companies which have had at least ten years of previous experience in the design and manufacture of

equipment of comparable type, capacity and operating conditions, unless otherwise approved by the Consultant.

b) All equipment and materials supplied shall be from approved manufacturers who are adequately represented in Pakistan by an Agent capable of providing installation, commissioning and after sales service. All major equipment shall be imported directly from the manufacturers through their local agents. Import of this equipment through warehouses/Export Houses will not be accepted.

c) All equipment shall be of latest manufacture, not older than the year in which this contract is awarded and shall bear year of manufacture stamped on the manufacturer's name plate duly certified by the manufacturer.

d) When a manufacturer's product is specified by name, or equivalent, it shall be in the sole judgment of the Consultant as to acceptability of any product which is offered as equal to that specified.

e) Where two or more units of the same class of equipment are furnished, product of the same manufacturer shall be used; component parts of entire system need not be product of same manufacturer.

1.6 CHASES AND OPENINGS

The contractor shall provide templates or details for chases and openings to be left in walls and partitions to accommodate work under HVAC scope of works.

1.7 PROTECTION

The contractor shall keep pipe, duct and other openings closed to prevent entry of foreign matter. All fixtures, equipment and apparatus shall be covered and protected against dirt, water, chemical or mechanical damage, before and during the construction period. All fixtures, apparatus, or equipment damaged including damaged shop coats of paint shall be restored to original conditions prior to Commissioning and also again prior to Final Acceptance. All bright finished shafts, bearing housings and similar items shall be protected until in service. No rust will be permitted.

1.8 CUTTING, PATCHING AND REPAIRING

Required for proper installation and completion of HVAC works, including masonry work, concrete work, and carpentry work, painting and re-painting shall be performed by skilled craftsmen in respective trades, at expense of the Contractor. Construction shall be cut only after obtaining written permission from the Consultant.

1.9 LINES, LEVELS AND SPACES

The Contractor shall check dimensions at the building site and establish lines and levels for work specified in Specifications. The Contractor shall check with work of other trades to ensure proper clearance of piping, ductwork, conduit and other items. Any deviations observed between drawings and actual construction shall be brought to the notice of the Consultant. The erection supervisor shall regularly inspect, during progress of civil works, the areas allocated for installation of HVAC equipment and any conflict observed shall immediately be reported to the Consultant.

1.10 ACOUSTIC TREATMENT

The noise criterion (NC) < 35 (45 db) is to be obtained.

Sound measurements will be made at 5 feet above floor level in the area served and not more than 5 feet from the grilles, diffusers or other air devices being tested. Instruments for sound measurement shall be provided by the Contractor.

Provision is to be made to minimize noise and vibration. However, different manufacturers' equipment have varying sound and vibration characteristics and it is, therefore, the responsibility of the Contractor to ensure that the requirements in these specifications are fully met by the equipment he is offering. If the Contractor has any requirements for additional vibration or sound isolation, these must be incorporated into the price quoted.

All equipment installed should not be audible inside the occupied areas and the Contractor must ensure that the equipment he is offering is quiet and supplied with all necessary silencers to ensure satisfactory sound levels. Where silencers are required, these must be incorporated into the price quoted for such equipment, if these are not specified separately.

1.11 SAMPLES

Contractor shall provide at his cost, samples of materials, instruments, gauges and electrical items, for approval by the Consultant before order is placed for the same. Consultant may waive this requirement, if detailed published catalogues submitted by the contractor provide sufficient information for approval. These samples shall include, but not limited to

1. G.I. sheet
2. Pipes and fittings. (Refrigerant)
3. Duct insulation and covering.
4. Pipe insulation and covering
5. Insulation adhesive and tapes

6. Diffusers, grilles and registers
7. OA/EA louvers
8. All types of dampers.
9. Power and control cables
10. Pipe hangers etc

1.12 APPROVAL OF MATERIAL AND EQUIPMENT

As soon as practicable after the award of contact, the contractor shall submit for approval of the Consultant specifications, drawing, catalogue diagrams and other descriptive data for all materials components and equipment which the contractor proposes for use under this contract. For certain materials and equipment, data may be required to be submitted in accordance with a detailed form furnished by the Consultant. Items submitted shall be properly labeled to indicate item number, and other data required by the Specifications. All items shall be submitted time to permit proper consideration and action thereon without delaying the construction schedule.

1.13 TIME FOR DELIVERY

All equipment plant and machinery shall be delivered at site on such dates so as to ensure adherence to scheduled dates stated in programs of works submitted by the contractor and the Consultant informed of the progress of the shipment and notify them in advance, in writing, as to when the equipment will be ready for inspection at site by the Consultant and shall supply lists covering each consignment in sufficient detail to enable Consultant to check the contents of the package, if he so desires.

1.14 STANDARDS AND CODE REQUIREMENTS

All equipment and materials under HVAC Scope of works shall be furnished in conformity with the latest edition of applicable standards of ASME, ASHRAE, ARI, SMACNA, AMCA and applicable \Government and local Codes governing the same. In case of conflict, the stricter requirements shown/ specified shall govern.

Abbreviations for Codes and Standards referred in the Contract are as under:

1. ASME – American Society of Mechanical Engineers.
2. ASTM – American Society for Testing & Materials.
3. ASHRAE – American Society of heating, Refrigeration and Air conditioning Engineers.
4. NFPA—National Fire Protection Association, USA
5. ARI - Air-conditioning and Refrigeration Institute, USA.

6. SMACNA — Sheet Metal and Air-conditioning Contractors National Association.
7. GOVERNMENT - Government of Pakistan
8. LOCAL-Local authorities of the city where the Project is located
9. AMCA — Air Moving and Control Association inc. USA
10. P.S. - Pakistan Standards.
11. B.S. - British Standards.

1.15 ERECTION SUPERVISORS AND OPERATING STAFF

General

The Contractor shall provide the services of Erection Supervisors and Operating Staff in accordance with the requirements of the Conditions of Contract as specified here in.

Work by Erection Supervisors

a) The Erection Supervisor shall direct the activities of Contractor's employees as they concern the installation, commissioning balancing and testing of the Equipment furnished under this contract. The Contractor through his Erection Supervisors shall cooperate with other Contractors to whatever extent is necessary to produce an installation satisfactory to the Consultant in accordance with the requirements of the time schedule, the Drawings and the Specifications.

b) Erection Supervisor shall be present from the Commencement of Work and remain on Site until the substantial completion.

c) Should a disagreement arise between other Contractors and the Erection Supervisor, the matter shall be submitted without delay to the Consultant for his decision. Upon such decision, the Erection Supervisor shall proceed with the work in accordance therewith, immediately.

d) Erection Supervisor shall be a qualified HVAC/ Mechanical Associate Engineer, having at least 8-10 years experience in HVAC installation works of similar nature.

e) If the Contractor fails to fulfill his obligations and also fails to provide the services of the erection supervisor having the minimum qualifications as stated in sub. Clause (d) of this Clause then the Contractor would be obligated to pay to the Employer an agreed penalty amount per day for the number of days when the services of such erection supervisor are not provided. The Employer would be entitled to deduct the amount due from the Contractor in this regard for his running bill/any payable sums.

f) Provision of (e) above shall not apply when the Erection Supervisor is on authorized legal leave (casual), sick leave and official holidays only. His absence up to a period of ten (10) days will also be allowed when the contractor intends to replace the Erection Supervisor with the consent of the Consultant.

Operating Staff

The Contractor shall provide staff to operate the HVAC system continuously for twelve (12) hours a day during the Defect Liability period and whenever the HVAC facilities required.

Operating supervisor shall be a 3 (three) years Diploma holder HVAC or Mechanical from Government College of Technology etc. And having 4 (Four) years experience of similar plants with automatic controls.

The Contractor shall also arrange to provide proper training to Employer's staff to operate the HVAC system to the entire satisfaction of the Employer. All costs incidental to providing operating staff including staff salaries shall be deemed to be included in relevant item of schedule of Prices. No separate payment shall be made to the Contractor for fulfillment of his obligations under this clause.

16 AS BUILT DRAWINGS

The Contractor shall supply to the Consultant a set of "As-Built" drawings showing the contract works as installed, together with any other information necessary for operation and maintenance. Three copies or each drawing and other information shall be supplied, along with a reproducible copy.

17 MANUFACTURER'S DATA

Manufacturer's performance data, certified factory drawings and/or curves of apparatus giving full information as to capacity, performance at different operating and ambient conditions, dimensions, materials electrical data and all information pertinent to the adequacy of the submitted equipment shall be submitted for approval. One original and 3 copies of catalogues and other information shall be submitted.

Manufacturer's names, sizes, catalogue numbers and/or samples or all materials shall also be submitted for approval.

2.0 EQUIPMENT

2.1 GENERAL:

The contractor shall supply and install ALL DC inverter system (outdoor & indoor units) of the capacity and rating as shown on the Equipment Schedule/Bills of Quantities.

The units will have guarantee/warranty period of **1 year (12 months)** from the date of commissioning the units, and should any defects arise during this period which can be attributed to poor workmanship, improper materials, or defective manufacture of the air conditioning units, for which the consultant shall be the sole judge, the contractor shall be required to replace or repaired all defective parts, except compressors (burnt or otherwise) which shall be replaced with new compressors, all repairs and replacement shall be as desired by the consultant.

All equipment shall be of such overall dimensions, operating weights, service area requirements and configuration that it can be located where shown on the plans without any adverse effect on its performance and clearance requirements.

Provision for clearance and service spaces shall be made around all mechanical equipment as recommended by equipment manufacturers.

All equipment supplied under this section shall be brand new factory manufactured and factory assembled (unless otherwise specified) and complete in all respects. The type, characteristics, capacity ratings, component sections of all equipment shall be as specified /scheduled. All equipment shall be tested at factory for performance before shipment.

All equipment furnished by the Contractor shall include vibration isolation mounting pads, anchor bolts, frames or any other mounting or supporting accessories.

All equipment shall be complete with all accessories necessary to serve the intended purpose, whether specified or not.

2.2 MULTI SPLIT AIR-CONDITIONING UNITS (R410A):

2.2.1 Overview
ALL DC Inverter System:

All equipment shall be brand new products from certified and approved manufacturers.

VRF system shall comprise refrigerant, outdoor unit (air-cooled), indoor DX fan coil device, liquid, air suction and pressure relief pipes, condensate pipe, branch-joints, connection tool kit, and a separate micro-processor control system.
Indoor/outdoor units, and other key parts shall be manufactured and assembled by the same manufacturer.
In case of fittings other than the standard ones from the manufacturer, approval shall be obtained before use.
The refrigerant for the VRF system shall be R-410a
The refrigerant for the VRF system shall comply with local regulations and ensure a higher COP value for the A/C equipment.
The VRF system shall satisfy the requirement for design indoor temperature.
Nameplate shall be attached to each product at a notable position, indicating the following, as a minimum:

1. Product name, model and specification;
2. Name and trademark of manufacturer;
3. Date of production, product No. or batch number; and
4. Output power, noise and other main parameters.

2.2.2 Features

The ALL DC Inverter VRF system shall have the following features:
Variable-capacity compressor:
The compressors should be DC Inverter type compressor controlling the cooling and heating capacity automatically according to the load.
The solenoid valve should be installed for the compressor's loading/ unloading between the upper parts of the fixed scroll and the suction pipe. When the solenoid valve is turned off, the fixed scroll should be close to the orbiting (Loading).When the solenoid valve is turned on, the fixed scroll should be separated from the orbiting scroll (Unloading).This process should control the on / off time of the valve and the rotating refrigerants in the circle thus adjusting the capacity.
The cooling capacity of the outdoor units should adjust automatically, according to the number of operating indoor unit(s).

PWM valve should take away the fixed scroll by lifting up through the difference of pressure after the digital scroll compressor being connected to the outlet and inlet of suction, Therefore, the capacity of compressor should adjust automatically according to the operation status such as loading when the valve is closed or unloading when the valve is opened. PWM means the ON/OFF signal to the valve for loading /unloading.

DC Inverter units should be based on a system that is free of oil separator and oil recycling equipment. In the loading state, the speed of the refrigerant should be enough to move oil back to the compressor.
The maximum pipe length between indoor unit and outdoor unit should not be greater than 175 m.

The maximum height difference between indoor unit and outdoor unit should not be greater than 70m.
The maximum distance between the first branch to the farthest indoor unit should not be greater than 40m.
The maximum height difference between indoor units should not be greater than 15m.
The system should offer at least 5 basic modules, which could be freely assembled in 2, 3 and 4 units modular combinations as per requirement.
The system should offer 2HP increments of capacity range, which should meet customer needs accurately and the maximum capacity combination should be up to 64HP.

The system should have a gas balance device among compressors, which should balance the gas suction volume among different compressors.

The system should have an inner-screw copper heat-exchanger, which can create higher heat exchange efficiency and powerful heating capacity especially in low ambient temperature. Outdoor heat-exchange area should be adjusted by running load. The system should have dual EXV, which should achieve up to 960 steps refrigerant adjusting precision to insure precise control of refrigerant and raise system circulation efficiency.

The combination of one main and one auxiliary four way valve should control the outdoor heat exchanger and outdoor air flow independently and according to the load, adjust the heat exchange volume of outdoor unit accurately and prevent wasting the capacity in part load time. Main 4-way valve should be used as the traditional 4-way valve, while the auxiliary 4-way valve should be used to adjust the heat-exchanger area of outdoor unit when in cooling mode.

The structure of the system and the piping work should be simple, so that the installation is easy. Each series of indoor units should have the same pipe dimension, and all the pipes should be connected by flare nut.

The system should have simple refrigerant piping system without any complicated maintenance work

Controls:
The system should have Individual control, group control, network control options.
The system should have network control system that can realize intelligent management to the A/C system, and adapt to Lonworks protocol and should be able to connect to the BMS:
1 computer should be able to control maximum 16 indoor CCM and monitor 16 outdoor CCM;
1 indoor CCM should be able to control maximum 64 indoor units;
1 outdoor CCM should be able to monitor 32 outdoor units;
1 Computer should be able to control maximum 1024 indoor units and monitor 512 outdoor units.

2.2.3 Air Cooled Condensing Units (CU-Units)

The condensing unit shall be of the vertical discharge, air cooled type, suitable for outdoor installation and sized to deliver the required capacity matched to relevant indoor units at specified ambient temperature. The condensing unit shall be of same manufacturer as that of Indoor A.C. Unit.

The condensing units shall be air-cooled type incorporating heat exchanger coils manufactured from copper tube copper fins or Aluminum Manganese anti rust alloy which should be coated with Golden protection Layer (Components: Epoxy Resin & Modified Acrylic, Silicon free), the anti-corrosive performance in salt-spray testing must be at-least 200% higher than normal blue/golden fins, factory treated to reduce the effect of atmospheric corrosion. The colour shall be manufacturer's standard. The air outlet grilles shall have plastic coated guards.

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 Flow (VRF) based centralized combination of multiple outdoor units of capacities given in schedules.

The outdoor units shall have at least 1 DC inverter compressor electronically controlled and capable of varying refrigerant flow with variation in cooling/heating requirements.

The capacity control of the outdoor units will be digitally controlled and shall be determined electronically by sensing operational temperatures, pressures, and ambient temperature etc

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 135%.

2.2.4 Indoor Units

Direct Expansion type Air conditioning units each carrying its own thermo-static expansion valve, shall be ceiling recessed (Cassette type) reversible, (Heat pump) type or ceiling concealed ducted type or Decorative Wall Mounted. All necessary components/parts shall be selected manufactured and assembled by the same manufacturer as for outdoor condensing units with Scroll Compressors.
The Indoor units shall include following items

1) DX.- Type coil
2) Washable filters
3) Supply air fan with motor
4) Automatic air swing facility. (Wherever required with the unit)
5) Drain arrangement.

The following type of indoor units may be used for this type of system.

Four way discharge 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 fresh air in the unit.

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

The heat exchanger coils shall 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 the desired room temperature.

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

A condensate drain pump shall be provided with the unit. The condensate shall be drained from the unit using thermally insulated u PVC piping and run directly to the nearest drain piping mains.

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

Ceiling concealed Duct type

The unit casing shall be manufactured from galvanized steel plate. Facility shall be provided for duct connection for introduction of fresh air in the unit and branch ductwork from the unit. The return air to the unit shall be through the bottom/back of the unit as per manufacturer's standard.

The heat exchanger coils shall 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 the desired room temperature.

The condensate shall be drained from the unit using thermally insulated u PVC piping and run directly to the nearest drain piping mains.

Wall mounted type

The unit casing shall be manufactured from heat resistant plastic. The casing color shall be manufacturer's standard. The fan shall be cross-flow centrifugal type, statically and dynamically balanced to ensure low noise and vibration free operation.

The heat exchanger coils shall 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 the desired room temperature.

The condensate shall be drained from the unit using thermally insulated u PVC piping and run directly to the nearest drain piping mains.

3.0 REFRIGERANT PIPING AND SPECIALITIES

3.1 GENERAL

The Tender Drawings indicate generally routes of all piping and the Contractor shall provide all fittings and accessories necessary for satisfactory installation and operation of the systems.

All piping shall be grouped wherever practicable and shall be erected to present a neat appearance. Pipes shall be parallel to each other and parallel or at right angles to structural members of the building and shall give maximum possible headroom.

All pipe drops shall be truly vertical. No joints shall be formed in the thickness of walls, floors or ceilings. The Contractor shall be responsible for ascertaining the thickness of plaster and other wall finishes, skirting heights, cill lengths and floor finishes.

Piping shall not pass in front of doorways or windows and shall be generally arranged so that sufficient space shall be allowed for accessibility for servicing.

All drain piping shall pitch down in direction of flow. All drains from such items as drip pans of air conditioners shall spill over and open sight drain, floor drain or other acceptable discharge points and terminated 150 mm above the drainage.

Approved pipe fittings shall be used and bending of pipes will not normally be allowed.

All 90° elbows used shall be of long radius type, except where space limitations restrict the use of long radius.

Piping shall not be installed passing through ductwork or directly under electric light fixtures.

3.2 REFRIGERANT PIPING AND SPECIALITIES

Refrigerant piping shall be copper tubing, type L (minimum), bright annealed, dehydrated and sealed, soft tempered tubing shall be used where bending is required and where flare joints are used, hard drawn tubing shall be used where no bending is required and silver-brazed joints are used, and for all tubing larger than 20 mm. Copper tube joints shall be brazed, except joints on lines 17 mm or smaller which may be flared. Fittings for flare joints shall be standard SF' forged brass flare-type with short shank flare units. Fittings for brazed joints shall be wrought copper or forge brass seat fittings. Cast seat type fittings will not be allowed for brazed joints.

3.2.1 INSTALLATION

It is imperative the method of installation and the materials used are also to high standards, to ensure trouble free operation and long term reliability.

The interconnecting pipe work must be installed by a competent and trained engineer. Refrigeration quality copper tube must be used, soft copper coils or half-hard straight lengths. The refrigeration quality tube must be soft drawn seamless high grade copper pipe. The copper tube must be selected taking into account the higher operating pressures of refrigerant, and that high pressures will occur throughout the system because of the reverse cycle operation.

The supplied branch pipe kits, must be used to make connections to indoor units, and the supplied manifold kits must be used to make connections between outdoor units (where applicable); it is not permitted to use standard fittings such as elbows, tees etc. the branch pipes shall be installed in accordance with the manufacturer's instructions, allowing unrestricted flow of refrigerant. All brazed joints shall be made with dry nitrogen purge to ensure the prevention of oxidization to the internal surface of the copper pipes. The ingress of moisture, dirt and any other contaminants to the interior of the copper pipes, and air conditioning units, must be prevented during the installation procedure. After the installation of pipe work, prior to the connection of the outdoor units, and sealing of insulation joints, the pipe work must be pressure tested for leakage, using dry nitrogen.

Procedure for Copper Piping:

a) Cleaning: All copper tubing shall be properly cleaned prior to use. The following cleaning procedure shall be adopted.

i) A clean lint-less cloth shall be drawn through the tubing by means of a wire to remove all coarse particles of dirt and dust

ii) A clean lint-less cloth saturated with trichloroethylene shall be pulled through pipe and the procedure .repeated till no further discoloration of the cloth is observed

iii) A clean cloth saturated with compressor oil squeezed dry shall be drawn through pipe.' Finally a clean cloth shall be drain through pipes.

b) General Instructions:

Pipes shall be cut accurately to measurements established at the job site and worked into place without springing or forcing, properly clearing all windows, doors and other openings. Excessive cutting or other weakening of the building structure to facilitate piping installation No installation will be permitted, without. written approval.-Layout drawing, required under the title of "App-oval of Material and Equipment" shall show locations of all supports, the load imposed on each fastening or anchor, typical details for special anchorage, for suspended piping, valves, tank, pumps, converters, and other mechanical equipment. Where supports are required between structural framing members, suitable intermediate metal framing shall be provided and detailed. Pipe shall have burrs removed by reaming and shall be installed to permit free expansion and contraction-without damage to joints and hangers." Changes in direction shall be made with fittings, except that bending of pipe and smaller will be permitted provided a pipe bender is used and type-sweep bends are formed. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks wrinkles, flattening or other malformations will not be accepted. All piping shall be installed with sufficient pitch to ensure adequate drainage and venting. Piping connections to equipment shall be provided with unions or flanges. Open ends of pipelines or equipment shall be properly capped or plugged during installation to keep dirt and other foreign matters out of the system.

Tubing shall be cut so ends are perfectly square and will "bottom" in the fitting. There shall be no gaps left through which solder dan run into the line. If possible, a pipe cutter shall be used. hacksaw must be used, it shall always be guided with a mitre-boxjto ensure a square, even cut. Tubing shall be reamed to remove burr being careful not to expand tubing while reaming.

The outside of the copper pipe and the inside of the fitting, where solder will be applied, shall be burnished. Fine crocus clothe or tight fitting brushes especially made for his type of work shall be used. Surfaces shall be burnished until all dirt and oxide is removed. Cleaned surface shall not be touched with hands or gloves. A- light coat of brazing flux shall be applied to both pipe and fittings.- An acid flux such as muriatic (hydrochloric acid) shall never be used as the resulting corrosion can seriously affect the pijjje and composition for brazing.

Joint shall be heated to proper brazing temperature being sure that it hot so brazing material will flow to all parts of the joint. The brazing material shall be fed to the joint until uniform link of brazing material appears around the pipe at the end of the fitting.

95-5 solder which is an alloy of 95% tin and 5% antimony shall be used.

When solenoid stop valves are being installed, the coil shall be removed to prevent the heat of soldering from ruining the insulation. When sight glass is being installed,' the glass shall be removed to prevent cracking. No heat shall be applied near the bulb of the expansion valve or any other place where an excessive temperature may cause damage.

Pipe insulation shall not be installed nor the piping anchored until Testing is completed-and all leaks have been properly eliminated.

Pipe Supports:

i) General: Pipe hangers, brackets, saddles, inserts, clamps, and pipe rolls including rods, bolts, shall conform to standard recommended practice. Design generally accepted, as exemplifying good engineering practice, using stock or production parts, shall be j utilized wherever possible. Chain, wire, strap or other make shift j devices will not be permitted as hangers or supports.

ii) Hangers shall be supported from clamps, concrete inserts, Philips concrete fasteners, or Raw bolts. Concrete inserts when used, shall be installed in the exact location prior to the pouring of concrete.

iii) Suspended Horizontal Piping:
Shall be supported by adjustable hangers or supports, which shall provide means of vertical adjustment after erection. Unless otherwise indicated on drawings maximum spacing between copper pipe supports the straight runs of pipe and tubing shall be in accordance with recommended spacing shown in the table

Maximum Spacing Between Copper tubing Supports:

MIN. TUBING SIZE – INCHES	1/2	5/8	7/8	1 1/8	1 3/8	1 5/8	2 1/8	2 5/8	3 1/8	3 5/8
(Min) SPAN - FEET	5	6	6	7	8	9	10	10	11	12

Pipe hangers and supports shall be spaced not over 5 feet apart at heavy fittings and valves. A hanger shall be installed not over 1 foot from each change in

direction of piping. Vertical piping shall be guided or supported in the center of each riser but not over 8 feet of centers and shall be supported at the base of the riser, on a base elbow or tee, with pipe stand only where required. For un-insulated brass or copper tubing, the riser clamp shall be compatible non-ferrous or electrolytic ally coated steel as for hangers.

Commissioning & Testing:

The contractor shall be responsible for commission the air conditioning unit in accordance with manufacturer's recommendations.
All AC Units will have a guarantee/warranty period of 12 months from the date of commissioning the units, and should any defects arise during this period which can be attributed to poor workmanship, improper material, or defective manufacture of the air conditioning units, for which the Consultant shall be the project engineer & consultant judge, the Contractor shall be required to replace or repair all defective parts, except compressors (burnt or otherwise) which shall be replaced with new compressors. All repairs and replacement shall be as directed by the Consultant. If the Noise Level from the unit _ create any nuisance or-its NC level (45 db) is not maintained then it is the responsibility of the contractor to meet the specification as stated in the schedule.

SUPPORTS & ANCHORS*: (If applicable)*

General:
Pipe hangers, brackets, saddles, inserts, claps and pipe rolls including rods, bolts, turn buckles, bases and protection shields shall conform to standard recommended engineering practice. Design generally accepted as exemplifying good engineering practice, using stock or production parts, shall be utilized wherever possible. Chain, wire, strap or other make shift devices will not be permitted as hangers or supports. Pipe hangers shall be capable of supporting the pipe in all conditions of operations. Hangers shall be supported with beam-clamps, concrete inserts, Philips concrete fasteners, or raw-bolts. Concrete inserts when used shall be installed in the exact location prior to the pouring of the concrete.

Suspended Piping Supports: (If applicable)

(a) Piping shall be supported by adjustable hangers or supports, which shall provide a means of vertical adjustment after erection.

Additional Refrigerant:

Additional refrigerant only shall be used, and must be charged by weight only, using electronic scales. The amount of additional refrigerant must be accurately calculated from the manufacturer's data, based on the length and diameter of each section of the liquid refrigerant pipe work of the system.

3.3 CONDENSATE DRAIN PIPING:

All condensate drain piping including fittings shall be of UPVC, Class E, as per

BS 3505.

a) Install drainpipes as and where shown on drawings.

b) Provide support at every 1 meter and at every change in direction.

c) Drainpipe shall be installed with proper slope.

d) Do-not connect drain piping to draining system. Use in-direct connection.

e) Insulate drain pipe with closed cell foam insulation.

3.4 PIPE SLEEVES:

All pipe opening through walls, floor slaps shall have sleeves with internal diameter at least 50 mm larger than the outside diameter of the pipe of the insulation passing through the sleeve.
Pipes passing through walls shall be provided with UPVC sleeves

Space between pipe and sleeve shall be packed with fiber glass at least 1.5 Iblft3 densities and sealed. All openings on roof shall be sealed water tight.

4.0 AIR DISTRIBUTION SYSTEM

4.1 GENERAL

a. Except as otherwise specified, all sheet metal ductwork, flexible ducts, flexible connections, dampers of all types and related items shall be in accordance with this section.

b. Make every duct bent with centreline radius not less than its width. Make every change in size or shape of duct with taper not exceeding 1 in 5. Unless otherwise indicated, provide throats at all branches with throat velocity same as main duct velocity, Construct square throat elbows, indicated or required, with internal turning vans in accordance with detail indicated.

c. Joints in all ductwork shall form smooth interior surface.

d. Support horizontal ductwork on galvanised iron hangers not less than 1" X 1/8". Spaced not more than 8 ft. on center for ducts up to 8 sq. ft. in area and not more than 4 ft on centers for larger ductwork.

e. Support vertical duct work at each floor with angles not less than 1 ¼" X 1 ¼" X 1/8", for ducts up to 30" wide 1-1/2" X 1-1/2" X 1/8", ducts from 31" to 60 " wide; provide minimum of two angles for each duct.

f. Furnish dampers indicated or required to balance distribution of air through various parts of duct systems to obtain air deliveries indicated at all air inlets and outlets.

g. For all ducts, dampers, access door, joints, stiffeners and hangers, "wide" is meant greatest dimension.

h. All ductwork, UNLESS OTHERWISE SPECIFIED, in accordance with recommendation of ASHRAE.

i. All the air plenums for linear grills shall be factory fabricated.

j. During construction, where it is necessary for ductwork to be left open for extended period before completion, temporarily close any such openings with sheet metal covers where necessary or required to prevent debris from entering ducts and /or to maintain opening straight and square.

k. All ducting measurements will be done after the installation.

4.2 DUCTWORK – MATERIAL

Unless otherwise specified or indicated.

a. Air Conditioning System: Galvanised steel sheet prime quality.

b. Ventilating System: Galvanised steel sheet prime quality.

GALVANISED STEEL DUCTWORK:

a) All ductwork, prime quality galvanised sheet steel:

b) To 12 inches maximum dimension, #26 USSG

c) 13 to 30 inches maximum dimension, #24 USSG

d) 31 to 60 inches maximum dimension #22 USSG

e) 61 to 90 inches maximum dimension #20 USSG

f) Over 90 inches maximum dimension #18 USSG

g) Transverse joint connections and duct-work stiffening, except as otherwise, specified:

h) To 24 inches wide: "S" slip, drive slip, pocket slip or bar slip on 94-inch centres.

i) 25 to 30 inches wide: "S" slip, drive slip, pocket slip or bar slip on 94 inch centers with 1 inch angles on 48 inch centres.

j) 31 to 40 inches wide: Drive slip, 1 inch pocket slip or 1 inch bar slip on 94 inch centers with 1 inch angles on 48 inch centres.

k) 41 to 60 inches wide: 1-1/2" angle connections, 1-1/2 inch pocket slip or 1-1/2 inch bar slip on 94 centers with 1-1/2 inch angles on 48 inch centres.

l) 61 to 90 inches wide: 1-1/2 inch angle connections, 1-1/2 inch pocket slip or 1-1/2 inch bar slip on 45 inch centers, with 1-1/2 inch angles on 24 inch centers.

m) 91 inches and larger: 2 inch angle connections, 1-1/2 inch pocket slip or 1-1/2 inch bar slip on 45 inch centers, with 1-1/2 inch angles on 24 inch centres.

n) On ductwork up to 60" wide, 45 inches long duct sections may be used.

o) Ductwork for distance of 20 ft. from fan inlet and outlet: Stiffened as specified above, except angles spaced on centers not greater than 24 inches, both transverse and longitudinal.

p) Stiffing angles: Riveted or spot welded to ductwork, may be of black structural steel. Angles, total girth, on all four sides of ductwork. Angles may be omitted at joints it joints ate equivalently reinforced.

q) Make longitudinal seams on all ductwork with Pittsburgh or double seams, locked and hammered tight, with smooth interior duct surface.

r) Cross-break all un-insulated ducts 18 inches wide and larger to prevent vibration or buckling.

4.3 FLEXIBLE DUCTS (If required)

All main duct and linear diffuser plenums shall be connected through flexible ducts. The sizes of flexible ducts are indicated on drawings or as directed by the consultant. The flexible duct shall be 2 ply aluminium flexible ducts with high tensile steel wire reinforcement, and shall be insulated with 1 inch thick 16 kg/m3 glass fibre insulation, covered with aluminium foil vapour barrier insulation.

4.4 DAMPERS

General:

a. In all ductwork systems, furnish all dampers necessary for proper control and balancing of air distribution. Furnish dampers in all branches, with operating levers readily accessible. No damper greater than 48" long. For greater lengths provide dampers in equal sections as required. These shall be opposite blades configuration.

b. Same material as ductwork, except as otherwise specified, rigid 18g. Construction, free of all rattling and vibration, with edges crimped or creased for stiffness.

c. All dampers shall have through rods, not less than 3/8" diameter fastened to blade with 2 or more yokes with set screws, with steel washer at each end of damper rod.

d. Damper blades, two gauge numbers heavier than ductwork, # 18 gauge and lighter shall have both edges double hemmed. Blades longer than 36 inches shall have "V" crease in middle to receive damper rod.

e. Dampers shall have through damper rod with #14 gauge bearing plate at one end and quadrant and lever with lock screw at other end; damper lever fastened to rod with set screws.

f. On insulated ductwork, mount guardant on metal saddles finishing flush with insulation surface.

Multi-Leaf Dampers: Shall comply with requirements for single leaf dampers. All damper rods, linked together to operate as a unit.

Splitter Dampers: Provide for air adjustment in throats at duct branches, Rigid construction, securely held in adjusted position with adjusting rod connected to leading edge of damper and protruding through duct; hinged connection at damper and lock screw fitting connection at duct face. On insulated ductwork mount lock-screw fitting so that lock-screw is located outside insulation. For each splitter damper provide sufficient number of adjusting rods to prevent vibration or loosening of adjusted position. Length of splitter, at least equal to width of branch throat served.

4.5 ACCESS DOORS IN DUCTWORK

a. Furnish as indicated and wherever necessary or required for proper access to all instruments, controls and equipment and for convenient inspection, maintenance and replacement, of the same. In general, provide access doors for each plenum, fire dampers, automatic dampers, fan bearing and as indicated.

b. Size of access doors:

a. In ducts, 20" X 14", unless otherwise indicated.

b. In plenums, 21" X 60" with bottom set 12" above finished floor.

c. Access doors smaller than sizes listed above will be permitted only where necessary due to space limitations. In all cases where smaller doors are provided they shall be as large as space conditions permit.

d. In ductwork: Two-piece pan construction with outer side crimped over inner dished side and including frame and hardware. Dished portion filled with same insulations as used on duct or casing. Frame contact surface covered with continuous heavy dense fastened in place. Door contact surface, designed to close against felt to make door airtight. All hardware, brass construction. Provide not less than 2 hinges and not less than 2 heavy window type latches for each door where space conditions do not permit hinging of doors.

e. In casings: Similar to access doors in ductwork system except as follows:

f. Door adequately braced with interior angles or as approved.

g. 3 heavy brass hinges per door.

h. Latches: Operation either side of door, brass bronze construction, minimum 2 per door.

4.6 FLEXIBLE COLLARS

Unless otherwise specified, make connections between ductwork and fans by means of approved coated fabric collars with sewed and cemented seams, fastened by bolted metal strap.

Flexible connections – Flexible connections for air conditioning systems shall be at least 850 gr. 30 ounce glass fabric double coated with neoprene. Connections shall not be stretched tight but shall, after installation, be able to be moved in any direction at least 1 inch without stretching.

4.7 DUCT TEST HOLES

Duct test holes shall be required at different places for the purpose of air balancing. These shall be provided in main as well as branch ducts, for the insertion of Pitot tube. The diameter, constructions and spacing of these test holes shall be as shown in the drawings.

4.8 LEAKAGE AND PREVENTION

i. Duct leakage tests shall be carried out as recommended and test reports shall be submitted to the consultant for approval.

j. To this end, the contractor shall, in the construction of his work, use appropriate joint, seam, and connection caulking and sealers, to insure air tightness of the ductwork. In addition he shall apply a 3 inch wide frame resistant duct tape to all joints and seams that are not welded, soldered or other wise air tight. Tape shall be applied in a continuous and even strip on and around the joints.

k. For exposed ductwork, contractor shall confer with the Consultant as to the appropriate method of sealing to affect the most aesthetic appearance while maintaining an efficient seal.

4.9 ADJUSTMENT OF SYSTEMS AND TESTS

l. Upon completion of installation, balance air distribution by adjustment of dampers and apparatus so that actual air delivery of each diffuser, grille and register does not vary more than ± 5% from air quantities indicated. Adjust all registers and diffusers so that there are no drafts.

m. After balancing air distribution, test ventilating and air conditioning systems to certify compliance with Code requirements for ventilation and proper functioning of all operating devices.

n. Submit certification and test report as specified.

4.10 DUCT WORK INSULATION

a. Insulation:

All supply air ducting and return air-ducting shall be insulated with insulation. Panels shall be cut to size to fit duct being insulated, and shall be fixed to the duct with approved adhesive. Adhesive shall cover at least 75 % of cut area. Sheet metal hooks will not be allowed. The insulation is to be installed flush with the duct, but so as not to 'lessen the thickness of the insulation. Insulation shall be continuous, and no gaps, crevices, or other discontinuities shall be acceptable. The insulation shall be held in place additionally by using polyethylene-packaging bands, 10 mm wide.

b. Jacket:

To provide mechanical protection to the insulating shall be provided in mechanical
rooms, on duct, which are installed at, or below 2m or below 2m heights. Jacket shall be as indicated under INSULATION SCHEDULE (Section-3), pasted to insulation using approved adhesive. All circumferential and longitudinal joints shall be over-lapped at least 40mm.

c. Cladding:

All insulated ducting exposed to the atmosphere shall be provided with a cladding of 24 gage (0.70 mm) GI sheet over the insulation. All joints shall be sealed with "Silicon Sealant", so that the cladding becomes completely waterproof. Cladding shall also be installed at all other locations shown on the drawings.

o. Insulation Tapes:

At all insulation joints use. 75mm wide self-adhesive tape consisting of reinforced aluminum foil and white Kraft paper. Also applicable for Copper joints.

e. **Adhesive:**

Adhesive shall be rubber reinforced co-polymeric compound or approved equal.

4.11 AIR DEVICES

a. General:

These shall be factory-fabricated of powder coated or anodized aluminum and of color as approved and shall distribute the specified quantity of air evenly over the space intended, without causing noticeable drafts, or dead spots anywhere in the conditioned area. The Contractor shall be responsible for diffusion, spread, drop and throw. If according to the certified data of the manufacturer of the proposed-units, the sizes indicated on the drawings will not perform satisfactorily, the units shall be re-selected to perform quietly and effectively in accordance with the .manufacturer's recommendations as approved by the Consultant. A schedule of all air inlets and outlets shall be submitted to the Consultant, indicating location, types, specified air quantity, neck or face velocity, sound power level values, pressure drop, throw and drop for registers and maximum and minimum diffusion range, prior to ordering.

b. Diffusers:

Shall fee round, half round, square, rectangular, slot, strip shaped or perforated type with fixed or adjustable air discharge pattern, as indicated on the drawings, Ceiling mounted units shall be furnished with anti-smudge device, unless the diffuser unit minimizes ceiling smudging through design features. Diffusers shall be provided with air deflectors specified herein. Ceiling mounted units shall be installed with trims tight against ceiling whether flush, recessed or surface mounted. Rubber gasket shall be provided between ceiling and surface mounted diffusers. Duct collar connecting the duct to diffuser shall be airtight and will not interfere with the volume controller. Return or exhaust units, when indicated, shall be similar to supply diffusers. Diffusers shall be provided with opposed blade volume controller with accessible key operator.

c. Registers:

Shall be of the type and size shown on the drawings as approved. Registers shall be provided with rubber gaskets between flanges and walls or ceilings. Wall supply registers shall be installed at least 6 inch (150mm) below the ceiling unless otherwise indicated. Registers shall be provided with opposed blade volume controllers with accessible key operator.

d. Self Closing Gravity Louvers:

These shall be of aluminum construction, and shall consist of self-closing gravity louvers at one end and fixed louvers at the other end.

e. Grilles:

Shall be of sizes and type shown on the drawings. All grills shall be provided with control dampers unless otherwise indicated on drawings.

k. Installation:

Shall ensure that all lines are perpendicular and parallel to the building walls and other surfaces, flush with the ceiling and properly centered so that complete symmetry is obtained.

All diffusers shall be installed directly to the supply air ducting, so that the weight of the diffusers is not transferred to the false ceiling. Diffuser shall be so installed that the collar is flush with the ceiling. Gaskets shall be used to prevent leakage.

Registers and grills on sidewalls shall be fixed on wooden frames . Frame thickness shall be 6mm less than the register / grill collar and shall cover the full depth of the wall. Perfect alignment and symmetry shall be maintained.

After the system is in operation, if drafts, dead spots, or excessive noise are noticeable in the conditioned areas due to improper selection or construction of the air outlet, the air-outlet shall be changed to the proper type to remove the defect, without additional cost to the Employer.

5.0 BUILDING MANAGEMENT SYSTEM

5.1 GENERAL

The Contractor shall be solely responsible to supply, install, test, commission and maintain the complete BMS and control system, including supply and installation of all necessary hardware software, field devices, conducting, wiring and testing. The complete system shall be in accordance with the specifications, tender drawings & manufacturer's recommendations.

The Contractor shall include and provide all interface components for BMS including dry contracts, current transformers, cables, sensors, and etc. to interface with other mechanical & electrical equipment as detailed in the specifications, control sequences & I/O summary.

All labor, material, equipment and software necessary to meet the functional requirement of the system as specified herein shall be included in the scope of work. Drawings are diagrammatic only and all controls, material, etc. not shown but necessary required to meet the functional intent shall be provided without any additional cost to the owner.

All wiring in connection with the automatic control system shall be as per manufacturer's recommendations. The term "wiring" shall be construed to include as required for mounting and connection of the electrical control devices. The control manufacturer shall furnish detailed wiring diagram shall show all necessary interface connections for approval of the Consultant. Similarly drawings for all graphics to be generated for display shall be submitted by the control manufacturer for approval of the Consultant.

The contractor shall discuss the electrical control layout with the Consultant and coordinate at site with other services for exact route, location and position of electrical lines and equipment.

All system components are to be designed and built to be fault tolerant to the following:

i. Satisfactory operation without damage at 120% and 80% of rated voltage and at ± 3 hertz variation in line frequency..
ii. Static, transient" and short circuit protection on all inputs and outputs.
iii. Bus connected devices to be a/c coupled or equivalent, so that any single device failure will not disrupt or halt bus communication.

5.2 DESCRIPTION OF THE SYSTEM

The BMS shall, as a minimum, incorporate Direct Digital Controls Energy Management System, Equipment Monitoring and. Controls System consisting of the following digital elements.

a) Individual input/output point scanning, processing and control.

b) Direct Digital Controls.
c) Energy Management.
d) Alarm Detection.
e) Time, event and holiday scheduling.
f) Temporary Scheduler.
g) Bus communications interface and control.

Microcomputer-based pc-type work stations central and associated peripherals and software functions shall be the primary operator interface for the system. All hardware and software required for the interface to the peer communications network and peripheral devices shall be included. The complete Building Management System (BMS) shall control monitor and log all points listed in the schedule of input/output points.

The central processing equipment shall be complete with all the necessary peripherals for CPU and operator interface. All inter-communication wiring and cabling between central

The BMS system shall monitor and /or control the following services as indicated in the control sequences and or the BOQ.

a) Indoor A/C units
b) Outdoor condensing units

The microcomputer-based Pc-type works stations shall be able to integrate with each other by networking such that if any of the work stations fails, the other work stations shall automatically be used as a back-up for the whole system.

5.3 SYSTEM CONFIGURATION:

The central processing equipment shall comprise of the following basic components to form a true "Distributed intelligence" technique.

a) Operator work station shall be complete with personal computer, rated for such application with sufficient memory and performance capacity to perform all functions as called for in this specification, operator terminal comprising keyboard and computer mouse for access to the BMS for command entry, data input and output display, and color graphic display unit for data input/output alarm display, review, status checking of the system.

b) The proposed locations of the BMS workstation with equipment installed shall be as indicated hereunder:

i) Building Command Center in SERVER ROOM

One (1) BMS work station system with 17 inch color monitor.

One (1) high speed system printer for data hard copy.

6.0 INSTALLATION

6.1 REQUIREMENTS

The contractor shall obtain the approval and perform necessary inspections to the national, local and corporate codes and standards involved in the system used, and provide the Employer with the written documents required expressly by the acceptance, inspections and codes before the execution on site.

The manufacturer shall provide conformity certificates for products and the following information that comes with each piece of equipment:

A/C schematics, installation charts and specification (incl. standards for installation, commissioning and acceptance, requirements for installation of indoor and outdoor units, installation of refrigerant circuits, condensate circuits and electrical circuits, thermal insulation for refrigerant, and acceptance of concealed works);

Electrical schematics and wiring diagram
Operating specification and maintenance and commissioning manual (indicating fault, causes and method for trouble-shooting)
List of maintenance tools for accessories and spare parts, and instruments and apparatus;

Other necessary information on design, installation, commissioning, operation and maintenance;

The manufacturer shall provide the construction and performance of the unit as per the design scheme, which includes but not limited to the following:

Performance parameters of the unit like air volume, refrigerating output, heating output, power, weight, dimensions and more (included in a list); and
Performance description of main parts like, compressor, oil circuit, control system, refrigerant and more.

The manufacturer shall provide all particular test and inspection reports for A/C equipment, and assume responsibility for the accuracy and completeness of the test reports.

6.2 GENERAL

The ALL DC Inverter VRF system equipment has to be designed, manufactured, tested and accepted in compliance with the following requirements.

Conduct detailed design, installation and commissioning of the equipment, piping and automation control system as recommended by the manufacturer.

After signing the contract, the bidder shall appoint his representative of the project who will coordinate all works throughout the project like drawing confirmation, packaging, shipment, field installation, commissioning and acceptance.

After signing the contract, the successful bidder shall get the final design vetted by a HVAC consultant. The cost of vetting shall be borne by the bidder and is deemed to be included in the bid price.

The manufacturer winning the contract shall complete the detailed design within 30 days after signing the contract. Before installation, related drawings and technical agreement shall be submitted complete, and approved by the client's representative. The unit shall be installed strictly to the approved drawings. In case of any change, prior approval from the Employer and confirmation by the designer shall be obtained.

Before installation, properly perform unpacking for inspection and all other necessary works, inform the purchaser and supervisor to be present, properly keep records and provide information feedback.

During the installation, strictly respect the rules for safety protection and fire safety. Take full account of the safety of installing and operating people, and take precautions against any accident. Avoid problems like sharp corner angles, burrs and cracking. Materials shall be fire-retardant, low-smoke and free of toxin.
All exposed pipes shall be neatly arranged and in parallel with other pipes and buildings. Make sure that all vertical pipes are plumb and arranged along the lines of the building.

Take precautions to prevent the refrigerant gas from discharging into the atmosphere.

For the unit, ensure the safe reliable run, easy operation and maintenance, and low cost of maintenance.

The system shall be of simple installation with economical and rational dimensions for the tubes, low cost in installation and optimized tubing.

All key components and devices shall have protective system available.

The surface of the unit and tubing shall not drip condensate.

Participants for the test include Employer or his representative, contractor, technical support personnel from the manufacturer, installing people and supervisor

6.3 INSTALLATION OF INDOOR UNIT

Indoor unit shall be installed/suspended in the ceiling. Strictly follow the standard

for installation. Never have any part of the equipment damaged and make sure that it does not fall.

Before installing the indoor unit, make inspection and calibration. It shall be mounted firm and level with accurate position and elevation.

The indoor unit shall be so installed that the other services of the building will not be affected.

6.4 INSTALLATION OF OUTDOOR UNIT

The outdoor unit shall be so installed that the other services and the façade effect of the building will not be affected.

The outdoor unit will be mounted at the spot designated for A/C on the building drawing. Access for maintenance to the outdoor unit shall be made available.

The outdoor unit shall allow fast maintenance like fast replacement of the compressor.

The unit shall have vibration damping device, allow easy maintenance and provide good condition during operation. During the operation, abnormal sound and vibration shall not happen, and the unit shall run in quiet operational mode.

6.5 REFRIGERANT PIPING

Before installation, the copper tube shall be kept from ingress by moisture. The tube shall be purged and vacuum dried.

The interior of the tube shall be kept clean at work.

For welding, the tube shall be filled with nitrogen for protection against oxidation of the copper tube.

Copper tubes shall be purged before connection with the main unit.

Refrigerant tubes shall be subject to air-tightness test and the air-tightness maintained.

6.6 SUPPORTING AND SECURING

Hangers shall be fabricated and installed in line with the diagrams for supports and hangers provided by the designer or equipment manufacturer and approved by the supervisor.

Use screws. Generally, use hot dip galvanized steel wood screws to secure concrete, brick or block wall. In wet and exposed cases, use lubricated wood screws.

Use drilling machine of proper size and length, and fit for structure. Never use flame to bore in metal products.

All fasteners and securing methods shall comply with the rules from the manufacturer.

6.7 DISCHARGE OF CONDENSATE

Condensate shall be centrally drained, which shall be smooth without overflow and leakage.

If sloping is impracticable, provide a condensate lift pump.

6.8 THERMAL INSULATION

Condensate tubes are to be thermally insulated to prevent condensation.

6.9 CLEANING

The surface of the unit shall be free of scratches, stains and impression. It should be smooth, even in the coating, consistent in color and free of peeling-off, curls, cracks, bubbles, dripping marks etc

6.10 COMMISSIONING AND TRIAL RUN

When the system is installed, conduct the test before trial run under the supervision of the purchaser and Consultant to prove it is ready for trial run.

Participants for the trial run include technical support personnel from the manufacturer, installing people, supervisor and Employer.

The manufacturer winning the contract shall conduct commissioning and trial run of the equipment on site to verify the design, fabrication, operability and functions.

The technical staff from the manufacturer winning the contract shall make available the special tools, consumables and special instruments and apparatus required for the installation and commissioning.

Commissioning and trial run shall take place only after satisfactory results are available for the system purging, air-tightness test, evacuation, filling refrigerant, condensate tube connection test, and test for control line and power line, and checked and signed by supervisor and project management people.

Commissioning and trial run shall take place to the equipment piece by piece, and the record for commissioning shall be submitted to the user.

The A/C condensate tubes have to be subject to water-tightness test.

6.11 CONTROL SYSTEM

The control mode for VRF system will be defined by the manufacturer via consultation with the Employer and approved by the designer.

The control line will run in conduit. Power line and control line shall be routed separately and spaced as required by the standards.

The control system of the unit shall allow self-regulation, automatically regulating the operational state of the compressor in line with the set indoor temperature and the operational condition of the indoor unit.

Each indoor unit will be equipped with a standard wired remote controller which is secured to the wall. The control panel of the screen displays all operational conditions, provides temperature setting, cooling/heating mode setting, air volume regulation, self-diagnosis of faults, fault alarm display, and prompt for cleaning filtering screen, and allows easy enquiry of faults and system inspection.

The control system shall centrally control all the indoor units and allow separate control of each indoor unit. The control panel shall enable simple operation and correct operation and judgment by the operator via instructions.

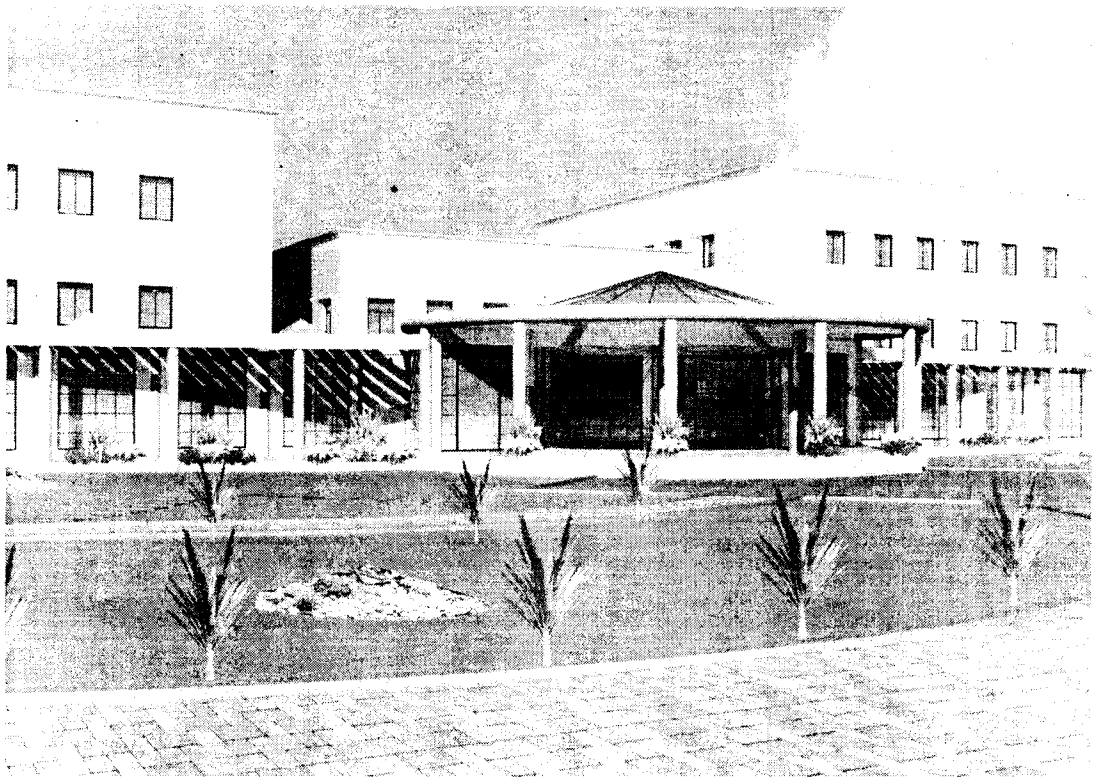
Intelligent central control will be used for the A/C and the following functions shall be available:

Central control: allowing uniform setting of On/Off, temperature and operational modes for A/Cs in different zones, and operating authority of the remote controller.

7.0 APPROVED MANUFACTURERS

LIST OF APPROVED MANUFACTURERS FOR AIR CONDITIONING WORK OF, GIMS

S.#	Name Of Equipment / Material	Brand Name
1	DC Inverter Air Conditioning System	a. LG b. GREE c. YORK d. Hitachi
2	Building Management System	Same Brand
3	Flexible Duct	a. ATCO b. Aero Duct
4	Closed Cell Foam Insulation for pipes	a. Aeroflex b. Atco c. Aeroduct. d. Or approved equal.
5	LV cubicle ,switch board, Moter Control center, Desk control' Pannel, DBs.	a. Siemens b. Electro Mech c. Eletectrich d. Tecmen
6	L.T Cable and Wires	a. Pakistan Cable – Pakistan b. A.G.E Cable - Pakistan c. Fast Cable – Pakistan d. Pioneer Cables
7	PVC Conduit / Pipes	a. Galco – Pakistan b. Beta –Pakistan c. Dadex
8	Cable Tray, Cable Ladders	a. EZZI Engineering b. Karimi Electro Mech c. Or approved Equal
9	Refrigerant Copper Pipe	a. Muller USA
10	U PVC Pipe	a. AGM - Saudi Arabia b. Eurapipe – Australia c. Dadex - Pakistan



HVAC WORKS AT GAMBAT INSTITUTE OF MEDICAL SCIENCES

TENDER DOCUMENTS

VOLUME-II

GENERAL CONDITIONS OF CONTRACT

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Scope of Work

1.1 The Selected Bidder will be responsible for the supply, installation, testing and commissioning of DC Inverter based VRF Air Conditioning system along with auxiliaries and components at College Building, Gambat Institute of Medical Sciences, Gambat.

1.2 Selected Bidder must ensure that the supplied equipment is fully operational, new and perform properly and meet RFP's Technical requirement.

1.3 At the time of installation and commissioning, Selected Bidder must provide comprehensive documentation of system deployed including diagrams, labeling, schematics, configuration and manuals etc.

1.4 Selected bidder shall be responsible for Training for knowledge transfer to engineers/operators and support personnel will also be the responsibility of the Bidder.

1.5 Selected bidder shall have to complete the project within required time period after signing the contract. The time period for completion of this project is 9 months.

Bids Submission Requirements

The objective of bid submission requirement is to provide bidders with the information to submit their bid in response of this RFP according to the specifications defined in this RFP and in order/sequence as set forth in this document. Bidders must follow below requirements while preparing their proposals/bids proposal and submission.

The bidder is required to submit TWO proposals: (1. Technical Proposal, 2. Financial Proposal) for this tender, there will 'Two stage – Two Envelope Procedure' for bidding.

2.1 The bidder is required to submit Bid in Two Envelopes. Envelope should also be labeled with the name, address and contact number of the bidding company.

2.2 Bidders shall submit the Bid along with brochures/data sheets explaining the items quoted.

2.3 The bidder must provide Project Execution Plan, Design Proposal with layouts, diagrams, etc. along with Technical Proposal.

2.4 Bidders are required to fill and sign all pages of "Bill of Costs" in writing while following the format given, and submit it as Financial Proposal. Financial Proposals not following the given format may lead to the rejection of bid.

2.5 Bidders are required to submit their financial proposals in PAK Rupees (Rs.)

2.6 The Bid Security equal to 2% of the Total Bid Value, in the form of Deposit at Call or a Bank Guarantee issued by a Scheduled Bank in Pakistan or from a foreign bank duly counter guaranteed by a Scheduled Bank in Pakistan or an insurance company having at least AA rating from PACRA/JCR in favor of Gambat Institute of Medical Sciences, Gambat must accompany the bid as part of proposal. The bid shall not be considered without Bid Security.

2.7 The Bidder shall clearly mention his delivery schedule and completion period of project in his proposal.

2.8 The bidder must submit letter verifying that the quoted solution complies with provided sizing information and will meet the required performance parameter.

Selection Procedure

3.1 A two step process will be used for the selection of a bidder for the award of this tender

3.2 GIMS intent in issuing this Tender Document is to award a contract to the lowest and best responsive bidder who meets specifications as laid out in technical specification and who fulfill all Mandatory Requirements mentioned in General Terms and Conditions. If any of the requirements or equipment specifications is not met by the bidder, the bid will be considered as non-responsive, and the bid of the next bidder will be considered.

3.3 After the approval of contract award, a contract agreement on the stamp paper worth Rs. 100/- shall be executed by the GIMS with selected bidder within 15 days from the date of issuance of Letter of Intent on standard terms and conditions.

3.4 For ordering purpose the price evaluation will be done against items.

3.5 Terms of Payment

a) Twenty percent (20%) payment shall be made in advance against Bank Guarantee issued by scheduled bank of Pakistan or Insurance Guarantee issued by AAA rated Insurance Company to the Contractor.

b) Thirty percent (30%) payment shall be made against B/L (Bill of Laden) of the equipment at the port of shipping of the country of origin.

c) Twenty percent (20%) payment shall be paid after successful delivery of equipment at GIMS, Gambat.

d) Twenty percent (20%) shall be paid after successful installation of equipment on site.

e) Ten percent (10%) payment shall be payable to the Contractor after issuance of certificate for successful installation, proper integration, testing & commissioning of all equipment as per requirement at GIMS, Gambat.

f) The successful bidder must provide O & M and comprehensive part warranty services till One (01) Years.

g) The successful bidder has to furnish the Performance Guarantee in the shape of Bank Guarantee from a scheduled bank of Pakistan equivalent to 10 % of the total contract. The said Guarantee will be released after the successful testing and commissioning of HVAC system at GIMS, Gambat.

h) Invoices will be cleared as soon as possible not exceeding 20 days upon receiving the invoice.

i) All payments shall be made through cross cheque in the Pakistan Rupees (PKR).

j) Taxes will be deducted at source as per government rules at the time of payment.

k) The Bid Security (2%) of the successful bidder will be returned after the signing of the contract and delivery of equipment.

l) The bidder is responsible to deliver equipment at the sites at his own risk and cost.

Liquidated Damages

In case of delay, the Project Director, GIMS, Gambat reserves the right to impose a penalty not exceeding 10% of the total amount of the contract at the rate of 1% of the total contract value for each week of delay.

General Terms and Conditions

Following general terms & conditions apply to this RFP

5.1 Validity period of the bids regarding the award of contract shall be 2 months (60 days).

5.2 The decisions of Project Director, GIMS, Gambat will be binding on all concerned and will in no case be challengeable at any forum or any court of law.

5.3 Bids are liable to be rejected if; they are not conforming the terms, conditions and specifications stipulated in this RFP.

5.4 During the examination, evaluation and comparison of the bids, the Principal, GIMS, Gambat at its sole discretion may ask the bidder for clarifications of its bid.

5.5 The request for clarification and the response both shall be in writing/email. However, no change in the price or substance of the bid shall be sought, offered or permitted after bid submission.

5.6 Total Bid Value (Cost of equipment, Cost of Installation & Commissioning etc as per BOQ) shall account for financial evaluation and so shall be included in Total Bid Value.

5.7 The amount submitted as Earnest Money (2%) shall be refunded to the unsuccessful bidders after the decision of "Tender Committee" for the award of said tender.

5.8 If there is a discrepancy between unit price and total price in the submitted bid which is obtained by multiplying the unit price and quantity, the unit price shall prevail and total price shall be corrected. If there is a discrepancy between the words and figures, the amount in words shall prevail. If there is a mistake in

addition/ totaling, that shall be corrected. If the bidder does not accept the corrected amount of bid, his bid shall be rejected and his bid security forfeited.

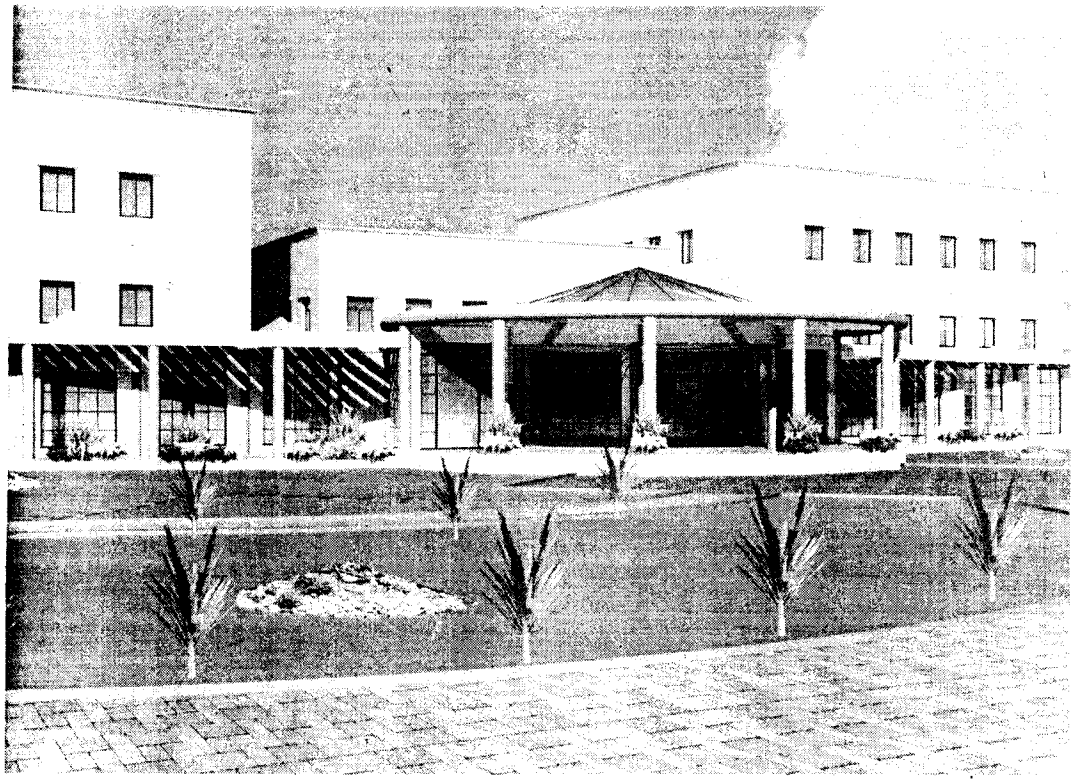
5.9 Incomplete and conditional BIDs will not be entertained.

5.10 In case of any dispute between the two parties of any matter arising out of after signing the contract agreement, the case shall be referred to Project Director, GIMS, Gambat whose decision shall be final and binding on both parties.

5.11 Bids submitted via email or fax will not be entertained.

5.12 Bidders indemnify GIMS, Gambat against all third party claims of infringement of patent trade mark, industrial design rights arising from use of the goods of any part thereof in Pakistan.

5.13 GIMS, Gambat reserves the right to accept/reject wholly or partially any tender at any stage of the tender process.



HVAC WORKS AT GAMBAT INSTITUTE OF MEDICAL SCIENCES

Bill Of Quantities

VOLUME-III

GENERAL CONDITIONS OF CONTRACT

ALL Floors BOQ

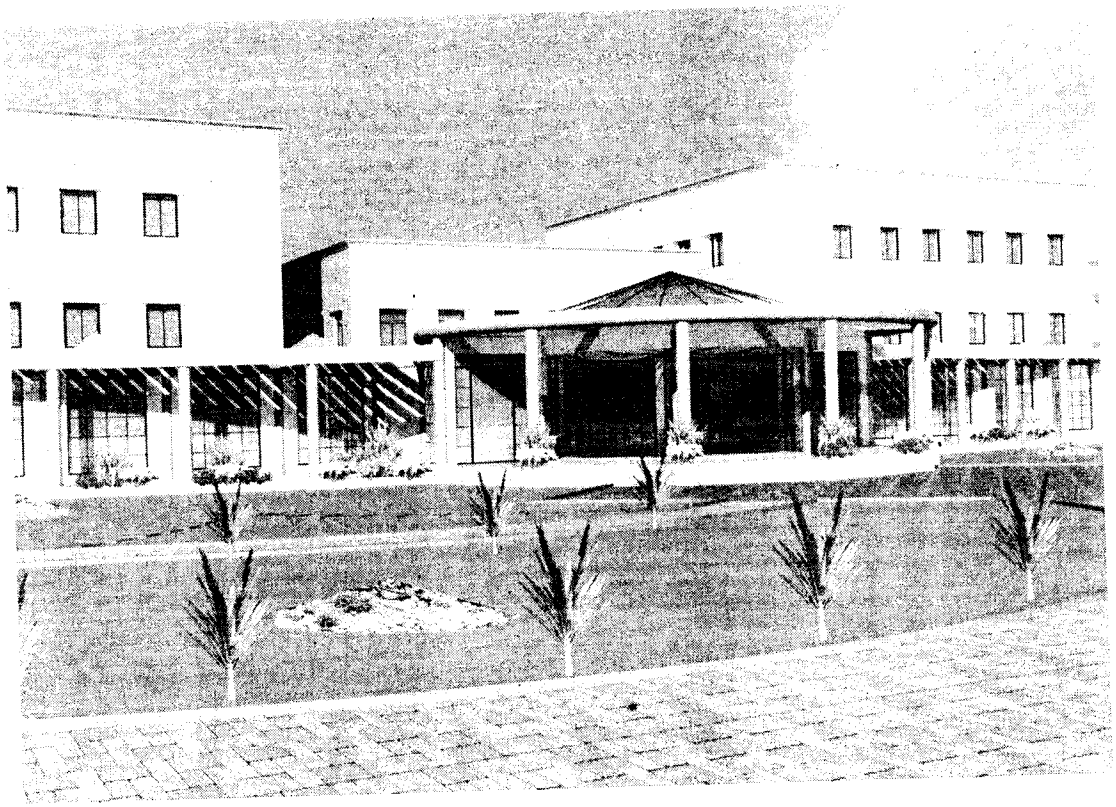
DC INVERTER SCROLL

SUPPLY, Installation of VRF System

Item No.	Description	Capacity	Qty	Unit	Rates	Amount
	Supply of following VRF equipment / system and material as per specifications and drawings complete in all respects and ready for use. These prices should be on FOR at Site bases inclusive of all Taxes.	**Net Capacity Not Less than**				
	Sub-Head "1" Equipment:VRF DC Inverter scroll					
1	**Multi Split IDUs**					
A	Multi system DX indoor A/C units with all controls, thermostats and accessories / fittings etc	USRT				
a	Decorative 4-way cassette					
		4	14	No		
b	Floor Ceiling Type Indoor Unit					
		1	1	No		
		1.5	4	No		
		2	4	No		
		3	92	No		
		3.5	79	No		
c	Wall Mounted Type Indoor Unit					
		1	15	No		
		1.5	27	No		
		2	39	No		
B	Spares for Indoor type AC units as recommanded by the manufacture for 2 years consumption, Branch/Y Joints/Central Controller		1	Lot		
C	Branch Connectors/Y Joints					
			37	No		
			54	No		
			96	No		
			52	No		
			18	No		
2	**Multi Split ODUs**					
A	Multi system outdoor units (Condensing Units), floor standing with all standard controls, safeties &accessories/ fittings	USRT				
a	Air-cooled Condensing Unit / CU-GF-01	47.1	1	No		
b	Air-cooled Condensing Unit / CU-GF-02	51.4	1	No		
c	Air-cooled Condensing Unit / CU-GF-03	50	1	No		
d	Air-cooled Condensing Unit / CU-GF-04	24.3	1	No		
e	Air-cooled Condensing Unit / CU-GF-05	37.1	1	No		
f	Air-cooled Condensing Unit / CU-GF-06	51.4	1	No		
g	Air-cooled Condensing Unit / CU-1F-01	41.6	1	No		
h	Air-cooled Condensing Unit / CU-1F-02	51.4	1	No		
i	Air-cooled Condensing Unit / CU-1F-03	35.3	1	No		
j	Air-cooled Condensing Unit / CU-1F-04	37.1	1	No		
k	Air-cooled Condensing Unit / CU-1F-05	43.2	1	No		
l	Air-cooled Condensing Unit / CU-1F-06	51.4	1	No		
m	Air-cooled Condensing Unit / CU-1F-07	41.6	1	No		
n	Air-cooled Condensing Unit / CU-1F-08	44.9	1	No		
o	Air-cooled Condensing Unit / CU-2F-01	44.9	1	No		
p	Air-cooled Condensing Unit / CU-2F-02	51.4	1	No		
q	Air-cooled Condensing Unit / CU-2F-03	41.6	1	No		
r	Air-cooled Condensing Unit / CU-2F-04	44.9	1	No		
B	Spares for All Outdoor condensing Units as recommended by the manufacture for 2 years consumption.		1	Lot		
C	Branch Connectors/Y Joints					
			49	No		
		*** Total Of Sub Head "1"**				

Item No	Description	Capacity	Qty	Unit	Rates	Amount
	INSTALLATION, TESTING & COMMISSIONING of following equipment / system and material as per schedule, specifications and drawings complete in all respects and ready for use. This work also includes cutting, chipping and making [illegible] in walls, floors and slabs with the prior permission of [illegible] all the damage					
	Sub-Head "2" Mechanical					
3	Multi Split IDUs					
A	Multi system, DX type A.C. units with all controls, thermostats and accessories, fittings etc	USRT				
a	Decorative 4-way cassette					
		4	14	No		
b	Floor Ceiling Type Indoor Unit					
		1	1	No		
		1.5	4	No		
		2	4	No		
		[illegible]	92	No		
		3.5	79	No		
c	Wall Mounted Type Indoor Unit					
		[illegible]	15	No		
		1.5	27	No		
		2	39	No		
B	Branch connectors / Joints		1	Lot		
4	Multi Split ODUs					
A	Multi system outdoor units (Condensing Units), floor standing with all standard controls, switches & accessories / fittings	USRT				
a	Air Cooled Condensing Unit / CU-GF-01	47.1	1	No		
b	Air Cooled Condensing Unit / CU-GF-02	51.4	1	No		
c	Air Cooled Condensing Unit / CU-GF-03	50	1	No		
d	Air Cooled Condensing Unit / CU-[illegible]	[illegible]	1	No		
e	Air Cooled Condensing Unit / CU-[illegible]	[illegible]	1	No		
f	Air Cooled Condensing Unit / CU-[illegible]	51.4	1	No		
g	Air Cooled Condensing Unit / CU-1F-01	41.6	1	No		
h	Air Cooled Condensing Unit / CU-1F-02	51.4	1	No		
i	Air Cooled Condensing Unit / CU-1F-03	35.3	1	No		
j	Air Cooled Condensing Unit / CU-1F-04	37.1	1	No		
k	Air Cooled Condensing Unit / CU-1F-05	49.2	1	No		
l	Air Cooled Condensing Unit / CU-1F-06	51.4	1	No		
m	Air Cooled Condensing Unit / CU-1F-07	41.6	1	No		
n	Air Cooled Condensing Unit / CU-1F-08	44.9	1	No		
o	Air Cooled Condensing Unit / CU-2F-01	44.9	1	No		
p	Air Cooled Condensing Unit / CU-2F-02	51.4	1	No		
q	Air Cooled Condensing Unit / CU-2F-[illegible]	41.6	1	No		
[illegible]	[illegible]	[illegible]	1	No		
B	[illegible]		1	Lot		
5	Copper tube L or K type with all accessories fittings/hanging frames					
a	Refrigerant pipe with all fittings and installation	Φ54.1 (2-1/8")	342.00	m		
b	Refrigerant pipe with all fittings and installation	Φ44.5 (1-3/4")	325.50	m		
c	Refrigerant pipe with all fittings and installation	Φ41.3 (1-5/8")	334.50	m		
d	Refrigerant pipe with all fittings and installation	Φ34.9 (1-3/8")	257.00	m		
e	Refrigerant pipe with all fittings and installation	Φ28.6 (1-1/8")	489.00	m		
f	Refrigerant pipe with all fittings and installation	Φ25.4 (1")	382.00	m		
g	Refrigerant pipe with all fittings and installation	Φ22.2 (7/8")	584.50	m		
h	Refrigerant pipe with all fittings and installation	Φ19.1 (3/4")	[illegible]02.00	m		
i	Refrigerant pipe with all fittings and installation	Φ15.9 (5/8")	1280.00	m		
j	Refrigerant pipe with all fittings and installation	Φ12.7 (1/2")	268.50	m		
k	Refrigerant pipe with all fittings and installation	Φ9.52 (3/8")	[illegible]37.00	m		
l	Refrigerant pipe with all fittings and installation	Φ6.35 (1/4")	65.00	m		
6	[illegible] insulation [illegible] for liquid gas pipes (approved Brand ATCO, AERO DUCT, AEROFLEX)		1	Job		
7	Condensate drain piping UPVC with 1/2" thick armaflex insulation or equivalent	32mm	1,07[illegible]	m		
		25mm	[illegible]75	m		

Ref No	Description	Capacity	Qty	Unit	Rates	Amount (PKR)
8	Control Software for complete Air Conditioning System including Work Station with 17" color monitor & one high speed printer		1	Job		
9	Air balancing of complete system by specialized contractor and contractor will submit 3 sets of balancing report		1	Job		
10	Preparing & supplying of shop drawings for complete job		1	Job		
11	Preparing & supplying of as built drawings for complete job, 3 Sets on butter paper and one set on CD		1	Job		
12	Commissioning of complete HVAC System		1	Job		
13	18 Gauge G I Trunking	[illegible]	20	m	18" x 6"	
		Total Of Sub Head "2"			Total Of Sub Head "2"	
14	Sub Head "3" Electrical Work					
a	4 core 16 mm square pvc/pvc copper conductor cable with single core 16 mm square pvc copper conductor cable as E.G.C. laying on Single Cable tray for each Condensing units	16mm2 (4Core)	450	m		
b	4 core 10 mm square pvc/pvc copper conductor cable with single core 10 mm square pvc copper conductor cable as E.G.C. laying on Single Cable tray for each Condensing units	10mm2 (4Core)	450	m		
c	4 core 6 mm square pvc/pvc copper conductor cable with single core 6 mm square pvc copper conductor cable as E.G.C. laying on single Cable tray for each condensing unit	6mm2 (4Core)	225	m		
15	Earth wiring	2.5mm2	3,225	m	2.5mm2	
		10mm2	900	m	10mm2	
16	Communication wiring Communication wiring from outside terminal unit to out side unit. Shielded wire 3 core 0.75 sqmm cut size in cable tray and inside a PVC conduit	0.75mm2	3,225	m		
17	HVAC Electrical panels		5	No		
a	DB for all cooling for Condensing units					
		Total Of Sub Head "3"				
	Sub Head "4" Civil Work					
18	Civil work for all equipment as required		1	Job		
19	Proper beam cutting and other holes for pipes		1	Job		
		Total Of Sub Head "4"				
	Sub Head "5" Miscellaneous					
20	Any Other item or quantity not mentioned above but required for the completion of job and satisfactory operation of system			Job		
		Total Of Sub Head "5"				
	Total Of Sub Head 1 Rs					
	Total Of Sub Head 2 Rs					
	Total Of Sub Head 3 Rs					
	Total Of Sub Head 4 Rs					
	Total Of Sub Head 5 Rs					
	FINAL NET VALUE					

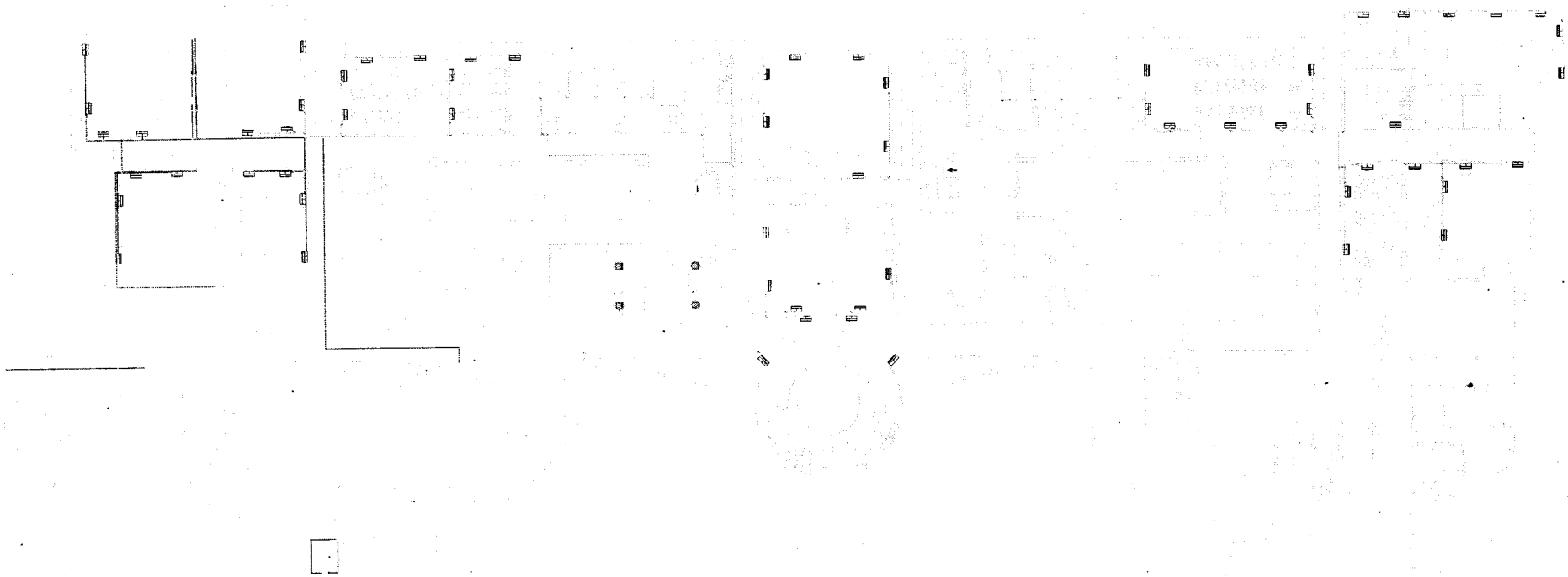


HVAC WORKS AT GAMBAT INSTITUTE OF MEDICAL SCIENCES

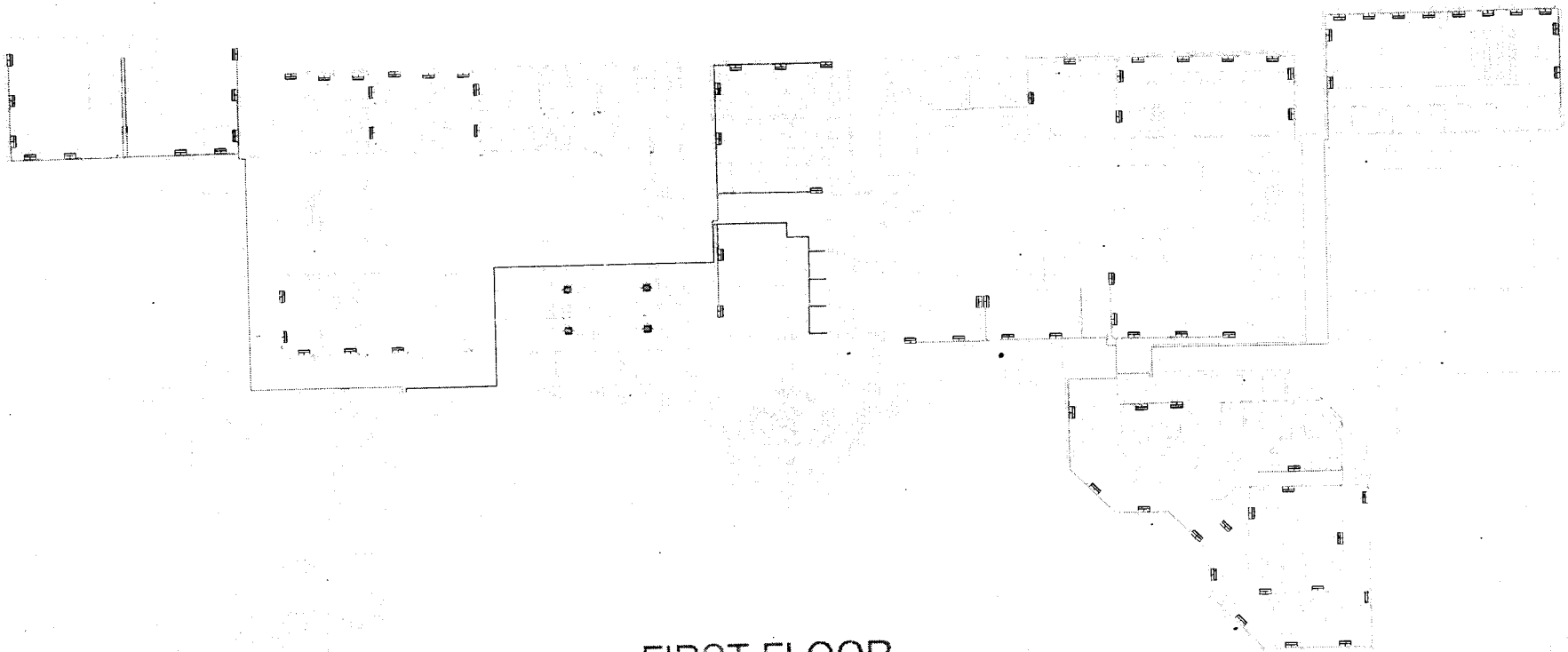
HVAC DRAWINGS

VOLUME-IV

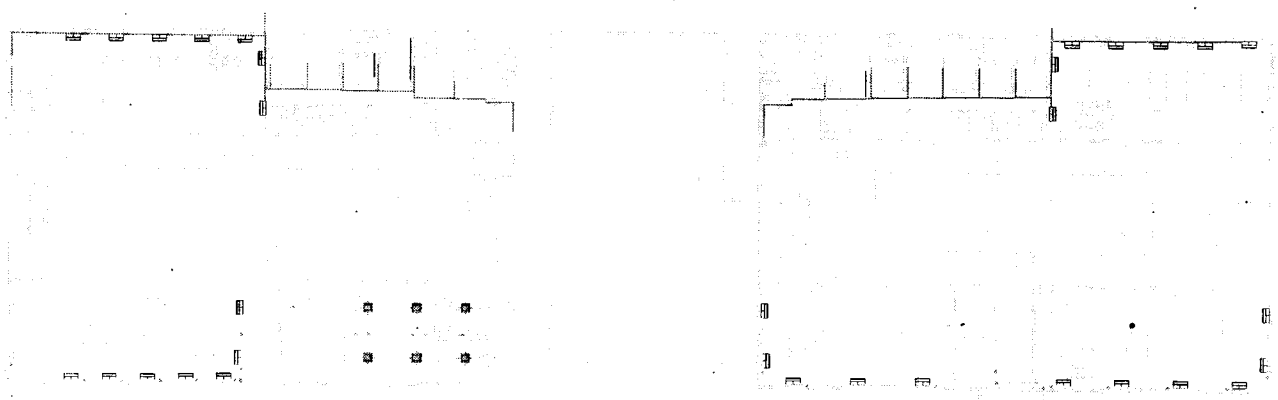
GENERAL CONDITIONS OF CONTRACT



GROUND FLOOR



FIRST FLOOR



SECOND FLOOR