STATE BANK OF INDIA

PREMISES & ESTATE DEPARTMENT, SBI, LOCAL HEAD OFFICE, 3rd FLOOR,
HOSHANGABAD ROAD, BHOPAL 462 010

PART – A: TECHNICAL BID

TENDER ID:- LHO/BHO/P&E/2025-26/79

TENDER FOR AIR CONDITIONING WORKS OF PROPOSED CANTEEN AREA AT FIFTH FLOOR, SBI, LHO, BHOPAL

TENDER SUBMITTED BY:

NAME : _____

ADDRESS : _____

_____

_____

GSTIN NO. : _____

DATE : _____

ISSUED TO: All Empanelled Contractors in this category.

CLIENT:

STATE BANK OF INDIA

PREMISES & ESTATE DEPARTMENT

LOCAL HEAD OFFICE,

HOSHANGABAD ROAD BHOPAL,

M.P. 462011

ARCHITECT:

THE GRID

E-326, GREATER KAILESH-II

NEW DELHI -110048

+91-9810135852

INDEX

NOTICE INVITING TENDERS

TENDER FOR AIR CONDITIONING WORKS OF PROPOSED AIR-CONDITIONING WORK OF CANTEEN AREA, FIFTH FLOOR AT SBI, LHO, BHOPAL

Premises & Estate Department, SBI, Bhopal invites "**online item rate e-Tender**" for captioned work from the SBI eligible contractors. Contractors who receive invitation/NIT from e-tendering agency are only entitled to quote for this tender.

Details of the tenders are as under:

Sr.No.	Particulars	Details
1	Name of work	Tender for Air-conditioning works of Canteen Area, fifth floor at SBI, LHO, Bhopal
2	Nature of Work	Air Conditioning Works (VRF)
3	Estimated Cost	**Rs.61,93,625.00 excluding AMC cost.**
4	Time allowed for completion	**6 Months**
	Earnest Money Deposit	**Rs.62,000.00 (Rupees Sixty-Two Thousand Only)** by means of Demand Draft only (Valid for a period of 90 Days from the last date of submission of the tender) from any scheduled Nationalized Bank drawn in favor of Assistant General Manager (P&E) and payable at Bhopal.
5	Initial Security Deposit (ISD)	2% of contract amount (EMD will be returned on receipt of ISD). The successful bidder(s) shall be responsible to deposit Initial security deposit @ 2% of the Contract Value by way of demand draft in favour of Assistant General Manager (P&E) and payable at Bhopal within 10 days from the date of receipt of work order from SBI/Arcitects. The SBI may consider accepting ISD in the form of Bank Guarantee issued by any Scheduled Bank in the format supplied/approved by the SBI within its sole discretion but the same cannot be considered as a right of the bidder.
6	Additional security Deposit	Additional Security deposit (ASD)/Additional performance Guarantee (APG) shall be applicable if the bid price is below 10.00 % of the estimated cost put to tender. The amount of such ASD/ APG shall be the difference between 90.00 % of estimated cost put to tender and the quoted price. Such ASD could be in the form of FDR / Bank's guarantee in the Bank's name as per format approved by the Bank. On successful completion of

		work ASD will be returned to the contractor. In case contractor fails to complete the work in time or as per tender specification or leave the job incomplete, the bank will be at liberty to recover the dues from ASD or to forfeit such ASD as the case may be within its sole discretion
7	Date of availability of tender documents on Service Provider's website	
	(b) **Price Bid**	**23.10.2025** Available at M/s e-Procurement Technologies Ltd., our Service Provider's portal https://etender.sbi/
8	Last date & time for submission of EMD of tender document	**23.10.2025 by 03:00 PM** Note: It is sole responsibility of the bidder to ensure submission of their EMD by stipulated date and time at specified address failing which they will not be allowed to participate in E-Tendering
9	Address for submission of EMD of tender document	The Assistant General Manager, Premises & Estate Department, State Bank of India, Local Head Office, 3rd Floor, Hoshangabad Road, Bhopal-462 010.
10	Date and Time of opening of Online Technical Bid	**23.10.2025 by 03:30 PM**
11	Last date & time for submission of Online Technical bid	**23.10.2025 by 03:00 PM** at Service Provider's portal https://etender.sbi/SBI/
12	Date and Time of opening of Online Price Bid	**23.10.2025 by 03:00 PM**
13	Date and time for submission of Online Price Bid *by the bidders qualified in Technical Bid.*	**23.10.2025 till 03:00 PM** at Service Provider's portal https://etender.sbi/SBI/
14	Defects Liability period	One year from the date of virtual completion of work.
15	Liquidated Damages	0.50% per week subject to max. 5% of contract amount for delay in completion of work.
16	Name of Project Architect	**THE GRID,** E-326, GREATER KAILESH-II , NEW DELHI -1100 9810135852

16	Validity of offer	90 days from the date of opening of Price-bid
17	Value of Interim Certificate	5.00 Lacs No advance on materials / plant / machinery or mobilization advance shall be paid under any circumstances
18	**Submission of Technical Bid (Hard Copy)**	1. Contractors shall download the entire Technical Bid to get acquainted with the terms and conditions and **shall upload compulsorily the pages numbered from 01 to 09 of the technical bid** without fail in the e-tendering portal after putting the signature and seal. Failing to upload as stated above, the tender will be rejected. 2. However, **L1 Tenderer** should submit the whole technical bid spirally bound securely and in serial order containing all pages duly signed with company seal and date to this Office within 7 days of receipt of confirmation. Failure to submit the hardcopy ofTechnical Bid may render the bidder disqualifies.
19	**e-Tender Service Provider Contact persons:** Primary Contact Numbers: - M:- 9081000427, 9904407997 1.Jaymeet Rathod: 079-68136829,jaymeet.rathod@eptl.in2.Vinayak Khambe: 079-68136835,vinayak.k@eptl.in 3 Nadeem Mansuri: 079-68136853,nadeem@eptl.in 4 Nandan Valera: 079-68136843,nandan.v@eptl.in 5 Hemangi Patel: 079-68136852,hemangi@eptl.in 6 Kanchan Kumari: 079-68136820,kanchan.k@eptl.in 7. Deepak Narekar: 079-68136863,deepak@eptl.in 8 AnshulJuneja: 079-68136840,anshul.juneja@eptl.in 9 Salina Motani: 079-68136831,salina.motani@eptl.in 10 Devang Patel: 079-68136859,devang@eptl.in Alternate Contact No.: Riddhi Panchal: 079-40270506, 8460518168,riddhi.pancal@auctiontigher.net	

20. No conditions other than mentioned in the tender will be considered, and if given they will have to be withdrawn before opening of the price-bid.

21. The SBI reserve their rights to accept or reject any or all the tenders, either in whole or in part without assigning any reason(s) for doing so and no claim / correspondence shall be entertained in this regard.

22. Tenders received without EMD shall be summarily rejected and such tenders shall not be allowed to participate in the online price bidding process.

23. In case the date of opening of tenders is declared as a holiday, the tenders will be opened on the next working day at the same time.

24. For any clarifications regarding E-Tendering procedure, System requirements etc. please contact M/s E-Procurement Technologies Limited, Ahmedabad, whose address is mentioned in the NIT.

Yours Faithfully,

Assistant General Manager (P&E)

SECTION – 1

INSTRUCTIONS TO THE TENDERERS

1.0 **Scope of work**

Sealed Tenders are invited by M/s. The Grid, New Delhi for and on behalf of SBI**,** for Tender for proposed Air Conditioning Works of Canteen Area at 5th floor, SBI, LHO, Bhopal.

1. Site and its location

The proposed work is to be carried out Canteen Area, 5th Floor, SBI,LHO, Bhopal

2.0 **Tender documents**

The work has to be carried out strictly according to the conditions stipulated in the tender consisting of the following documents and the most workmen like manner.

Instructions to tenderers

General conditions of Contract

Special conditions of Contract

Additional specifications

Drawings

Price bid A

The above documents shall be taken as complementary and mutually explanatory of one another but in case of ambiguities or discrepancies, shall take precedence in the order given below;

a) Price Bid

b) Technical specifications

c) Drawings

d) Special conditions of contract

f) General conditions of contract

g) Instructions to Tenderers

The tender documents are not transferable.

3.0 **Site Visit**

The tenderer must obtain himself on his own responsibility and his own expenses all information and data that may be required for the purpose of filling this tender document

and enter into a contract for the satisfactory performance of the work. The tenderer is requested satisfy himself regarding the availability of water, power, transport and communication facilities, the character quality and quantity of the materials, labour, the law and order situation, climatic conditions local authorities requirement, traffic regulations etc.

The tenderer will be fully responsible for considering the financial effect of any or all the factors while submitting his tender.

4.0 **Earnest Money**

The tenderers are requested to submit the Earnest Money of **Rs.62,000.00 (Rupees Sixty Two Thousand Only)** by means of Demand Draft only (Valid for a period of 90 Days from the last date of submission of the tender) from any Scheduled Nationalized Bank drawn in favour of State Bank of India and payable in Bhopal.

EMD in any other form other than as specified above will not be accepted. Tender not accompanied by the EMD in accordance with clause 4.1 above shall be rejected.

No interest will be paid on the EMD.

EMD of unsuccessful tenderer will be refunded within 30 days of award of Contract.

EMD of successful tenderer will also be returned on receipt of Initial Security Deposit.

5.0 **Initial/ Security Deposit**

The successful tenderer will have to submit a sum equivalent to 2% of accepted tender value in favour of SBI within a period of 15 days of acceptance of tender. EMD will be returned on receipt of Initial security Deposit.

Security Deposit

Total security deposit shall be 5% of contract value. Out of this 2% of contract value is in the form of Initial Security Deposit (ISD) which includes the EMD. Balance 3% shall be deducted from the running account bill of the work at the rate of 10% of the respective running account bill i.e., deduction from each running bill account will be @10% till Total Security Deposit (TSD) including ISD reaches to 5% of contract value. The 50% of the Total Security Deposit shall be paid to the contract on the basis of Architect's certifying the virtual completion. The balance 50% would be paid to the contractors after the defects liability period as specified in the contract.

6.0 **Additional Security Deposit**

7 Additional Security deposit (ASD)/Additional performance Guarantee (APG) shall be applicable if the bid price is below 10.00 % of the estimated cost put to tender. The amount of such ASD/ APG shall be the difference between 90.00 % of estimated cost put to tender and the quoted price.
Such ASD could be in the form of FDR / Bank's guarantee in the Bank's name as per format approved by the Bank. On successful completion of work ASD will be returned to the contractor. In case contractor fails to complete the work in time or as per tender specification or leave the job incomplete, the bank will be at liberty to recover the dues from ASD or to forfeit such ASD as the case may be within its sole discretion.

No interest shall be paid to the amount retained by the Bank as Security Deposit&

Additional Security Deposit.

7.0 **Signing of contract Documents**

The successful tenderer shall be bound to implement the contract by signing an agreement and conditions of contract attached herewith within 30 days from the receipt of intimation of acceptance of the tender by the Bank. However, the written acceptance of the tenders by the Bank will constitute a binding agreement between the Bank and successful tenderer whether such formal agreement is subsequently entered into or not.

8.0 **Completion Period**

Time is essence of the contract. The work should be completed in all respect accordance with the terms of contract within a period of **6 months** from the date of award of work.

9.0 **Validity of tender**

Tenders shall remain valid and open for acceptance for a period of 90 days from the date of opening price bid. If the tenderer withdraws his/her offer during the value period or makes modifications in his/her original offer which are not acceptable to Bank without prejudice to any other right or remedy the Bank shall be at liberty forfeit the EMD.

10.0 **Liquidated Damages**

The liquidated damages shall be 0.50% per week subject to a maximum of 5% of contract value.

11.0 **Rate and prices:**

In case of item rate tender

The tenderers shall quote their rates for individual items both in words and figure. In case of discrepancy between the rate quoted in words and figures, the unit rate quantity in words will prevail**.** If no rate is quoted for one or more items such tender shall be treated as “Incomplete Tender” and shall be summarily rejected.

The amount of each item shall be calculated and the requisite total is given. In case of discrepancy between the unit rate and the total amount calculated from multiplication of unit rate and the quantity the unit rate quoted will govern and the amount will be corrected.

The tenderers need not quote their rates for which no quantities have been given. In case the tenderers quote their rates for such items those rates will be ignored and will not be considered during execution.

The tenderers should not change the units as specified in the tender. If any unit is changed the tenders would be evaluated as per the original unit and the contractor would be paid accordingly.

The tenderer should not change or modify or delete the description of the item. If any discrepancy is observed he should immediately bring to the knowledge of the Architect/ SBI.

Each page of the BOQ shall be signed by the authorized person and cutting or overwriting shall be duly attested by him.

Each page shall be totaled and the grand total shall be given.

The rate quoted shall be firm and shall include all costs, allowances etc. excluding G.S.T, which shall be payable / reimbursed at actuals.

The SBI reserves their rights to accept any tenders, either in whole or in part or may entrust the work in phases or may drop the part scope of work at any stage of the project within its sole discretion without assigning any reason(s) for doing so and no claim / correspondence shall be entertained in this regard.

In case it is decided by the SBI to drop one or more buildings from the scope of work at any stage of the project, the contractor shall not be entitled to raise any claim / compensation for such deleted scope of work. Also, the SBI may consider issuing work order for various buildings in phases but within a reasonable time interval and the contractor shall be bound to execute the same within the stipulated time period and as per rates quoted by them in this tender without any claim for price escalation.

LETTER OF UNDERTAKING

To,
The Assistant General Manager (P&E),
Premises & Estate Department,
State Bank of India,
Local Head Office, 3rd Floor,
Hoshangabad Road, Bhopal. 462 010

Dear Sir,
Having examined the drawings, specification, design and schedule of quantities relating to the works specified in the memorandum hereinafter set out and having visited and examined the site of the works specified in the said memorandum and having acquired the requisite information relating thereto as affecting the tender, I/We hereby offer to execute the works specified in the said memorandum at the rates mentioned in the attached Schedule of Quantities and in accordance in all respects with the specifications, design, drawings and instructions in writing referred to in conditions of tender, the Articles of Agreement, Special Conditions, Schedule of Quantities and Conditions of Contract and with such materials as are provided for by, and in all other respects in accordance with such conditions so far as they may be applicable.

MEMORANDUM

(a)	Description of work	Tender for Air Conditioning works of Canteen Area, 5th floor, SBI, LHO, Bhopal
(b)	Earnest Money	**Rs.62,000.00 (Rupees Sixty two thousand Only)**by means of Demand Draft / Pay Order (Valid for a period of 90 Days from the last date of submission of the tender) from any scheduled Nationalized Bank drawn in favour of State Bank of India and payable in Bhopal.
(c)	Time allowed for completion of the Works from Seven day after the date of written Order or date of handing over of the site (Whichever is later) to commence the work	**6 months**

1) Should this tender be accepted, I/we hereby agree to abide by and fulfill the terms and provisions of the said conditions of contract annexed hereto so far as may be applicable or in default thereof to forfeit and pay to SBI, the amount mentioned in the said contract.

2) I / We have deposited a sum of of **Rs.62,000.00 (Rupees Sixty Two Thousand Only)** the total tender amount as Earnest Money with the State Bank of India on behalf of SBI which amount is not to bear any interest. Should I / We fail to execute the Contract when called upon to do so I / We do hereby agree that this sum shall be forfeited by me/us to State Bank of India.

I/ We have read and understood various clauses of this tender and hereby submit our specific undertaking and concurrence in terms clause 6.2 of “Instruction to tenderer” to deposit **Additional Security Deposit (ASD**) Additional Security deposit (ASD)/Additional

performance Guarantee (APG) shall be applicable if the bid price is below 10.0 % of the estimated cost put to tender. The amount of such ASD/ APG shall be the difference between 90.00 % of estimated cost put to tender and the quoted price.

3) Further, under any circumstances, whatsoever, if I/We fail to comply the same including compliance of any such other conditions of tender within the stipulated time. I /We hereby, authorized SBI to cancel my/Our tender, to forfeit my EMD/ISD/ASD and to take further necessary action as deemed fit including debarring our firm from participating in SBI future tenders/de-paneling etc.

4) I/ We understand that as per terms of this tender, the SBI may consider accepting our tender in part or whole or may entrust the various work proposed in phases. We, therefore, undertake that we shall not raise any claim/ compensation in the eventuality of Bank/SBI deciding to drop any of the work from the scope of work of this tender at any stage during the contract period. Further, we also undertake to execute the work entrusted to us in phases on our approved rates and within stipulated time limit without any extra claim for price escalation as also provided for in the clause 11.1.14“Instructions to Tenderers” of this tender.

5) I/ We, hereby, also undertake that, we will not raise any claim for any escalation in the prices of any of the material during the currency of contract/execution/completion period including authorized extended contract period, if any.

6) Our Bankers are:
   I)

   ii)

   The names of partners of our firm are:
   i)

   ii)

   Name of the partner of the firm
   Authorised to sign
   Or
   (Name of person having Power of Attorney to sign the Contract. (Certified true copy of the Power of Attorney should be attached)
   Yours faithfully,
   Signature of Contractors.
   Signature and addresses of Witnesses
   i)

   ii)

(A) Contact Information

E-Procurement Technologies Ltd.	State Bank of India
B-704, Wall Street - II, Opp. Orient Club, Nr. Gujarat College, Ahmedabad - 380 006. Gujarat State, India Tel.: +91 79 61200 579 | 580 | 567 | 569 | 566 Mr.Samjad Khan E-mail : samjad@auctiontiger.net Contact No : 9879996111 / 9265871720	The Assistant General Manager (P&E), Premises & Estate Department, State Bank of India, Local Head Office, 3rd Floor, Hoshangabad Road, Bhopal. 462 010 Officer Name : Mr. Deepak Vishwakarma Department :SBI Contact No :+91 8889988331

(B) SAMPLE BUISNESS RULE DOCUMENT

ONLINE E-TENDERING FOR AIR CONDITIONING WORKS OF CANTEEN AREA, 5TH FLOOR AT SBI, LHO, BHOPAL

(A) Business rules for E-tendering:

1. Only empaneled contractors with SBI under appropriate category who are invited by the project Architect/SBI shall only be eligible to participate.

2. SBI will engage the services of an E-tendering service provider who will provide necessary training and assistance before commencement of online bidding on Internet.

3. In case of e-tendering, SBI will inform the vendor in writing, the details of service provider to enable them to contact and get trained.

4. Business rules like event date, closing and opening time etc. also will be communicated through service provider for compliance.

5. Contractors have to send by email, the compliance form in the prescribed format (provided by service provider),before start of E-tendering. Without this the vendor will not be eligible to participate in the event.

6. The Contractors will be required to submit the various documents in sealed Envelope to the office of State Bank of India at the address mentioned hereinbefore by the stipulated date i.e. (1) Hard Copy of Technical Bid duly signed and stamped on each page (2) Demand Draft of specified amount of EMD (3) Copy of Receipt/Challan of Cost of Tender documents. Contractors not submitting any one or more documents shall not be eligible to participate in the on-line price bidding.

7. E-tendering will be conducted on schedule date & time.

8. **The e-tendering will be treated as closed only when the bidding process gets closed in all respects for the item listed in the tender.**

9. **Terms & conditions of E-tendering:**

   SBI shall finalize the Tender through e-tendering mode for which M/s. E-Procurement Technologies Ltd.has been engaged by SBI an authorized service provider. Please go through the guidelines given below and submit your acceptance to the same along with your Commercial Bid.

10. E-tendering shall be conducted by SBI through M/s. E-Procurement Technologies Ltd., on pre-specified date. While the Contractors shall be quoting from their own offices/ place of their choice, Internet connectivity and other paraphernalia requirements shall have to be ensured by Contractors themselves. In the event of failure of their Internet connectivity, (due to any reason whatsoever it may be) it is the bidders' responsibility. In order to ward-off such contingent situation bidders are requested to make all the necessary arrangements/ alternatives such as back–up power supply whatever required so that they are able to circumvent such situation and still be able to participate in the E-tendering successfully. Failure of power at the premises of Contractors during the E-tendering cannot be the cause for not participating in the E-tendering. On account of this the time for the E-tendering cannot be extended and SBI is not responsible for such eventualities.

11. M/s. E-Procurement Technologies Ltd.., shall arrange to train your nominated person(s), without any cost to you. They shall also explain you all the Rules related to the E-tendering. You are required to give your compliance on it before start of bid process.

12. BIDDING CURRENCY AND UNIT OF MEASUREMENT: Bidding will be conducted in Indian currency & Unit of Measurement will be displayed in Online E-tendering.

13. BID PRICE: The Bidder has to quote the rate as per the Tender Document provided by SBI their appointed Architects.

14. VALIDITY OF BIDS: The Bid price shall be firm for a period specified in the tender document and shall not be subjected to any change whatsoever.

15. Procedure of E-tendering:

    i. <u>Online E-tendering:</u>

    (a) The NIT &Technical bid available on the Bank's website during the period specified in the NIT.
    (b) Online e-tendering is open to the empaneled bidders who receive NIT from the Architect and qualified for participating in the price bidding as provisions mentioned herein above through SBI approved Service Provider.
    (c) The Price-Bid shall be made available online by the Service Provider wherein the contractors will be required to fill-in their percentage above/below the estimated cost.
    (d) The Contractors are advised not to wait till the last minute to submit their online item-wise quote in the price bid to avoid complications related with internet connectivity, network problems, system crash down, power failure, etc.
    (e) It is mandatory to all the bidders participating in the price bid to quote their rates for each and every item.
    (f) In case, contractor fails to quote their rates for any one or more tender items, their tender shall be treated as ***"Incomplete Tender***" and shall be liable for rejection.

16. LOG IN NAME & PASSWORD: Each Bidder is assigned a Unique User Name & Password by M/s. E-Procurement Technologies Ltd. The Bidders are requested to change the Password after the receipt of initial Password from M/s. E-Procurement Technologies Ltd. All bids made from the Login ID given to the bidder will be deemed to have been made by the bidder.

17. BIDS PLACED BY BIDDER: Bids will be taken as an offer to execute the work as specified. Bids once made, cannot be cancelled / withdrawn and the Bidder shall be bound to execute the work at the quoted bid price. In case the L-1 Bidder backs out or fail to complete the work as per the rates quoted, SBI shall at liberty to take action as deemed necessary including de-paneling such contractors and forfeiting their EMD.

18. At the end of the E-tendering, SBI will decide upon the winner. SBI decision on award of Contract shall be final and binding on all the Bidders.

19. SBI shall be at liberty to cancel the E-tendering process / tender at any time, before ordering, without assigning any reason.

20. SBI shall not have any liability to bidders for any interruption or delay in access to the site irrespective of the cause.

21. Other terms and conditions shall be as per your techno-commercial offers and other

correspondences till date.

22. OTHER TERMS & CONDITIONS:

- The Bidder shall not involve himself or any of his representatives in Price manipulation of any kind directly or indirectly by communicating with other suppliers / bidders.

- The Bidder shall not divulge either his Bids or any other exclusive details of SBI to any other party.

- SBI decision on award of Contract shall be final and binding on all the Bidders.

- SBI reserve their rights to extend, reschedule or cancel any E-tendering within its sole discretion.

- SBI or its authorized service provider M/s. E-Procurement Technologies Ltd. shall not have any liability to Bidders for any interruption or delay in access to the site irrespective of the cause.

- SBI or its authorized service provider/s. E-Procurement Technologies Ltd. is not responsible for any damages, including damages that result from, but are not limited to negligence.

- SBI or its authorized service M/s. E-Procurement Technologies Ltd. will not be held responsible for consequential damages, including but not limited to systems problems, inability to use the system, loss of electronic information etc.

N.B.

- All the Bidders are required to submit the Process Compliance Statement (Annexure II) duly signed to M/s. E-Procurement Technologies Ltd..

- **All the bidders are requested to ensure that they have a valid digital signature certificate well in advance to participate in the online event.**

SIGNATURE OF THE CONTRACTOR
WITH SEAL

(B) Process Compliance Statement (Annexure II)

(The bidders are required to print this on their company's letter head and sign, stamp before emailing)

To,
E-Procurement Technologies Ltd. (Auction Tiger)
B-704 Wall Street - II,
Opp. Orient Club,
Nr. Gujarat College, Ahmedabad - 380 006.
Gujarat State, India

Sub: Tender for Air Conditioning Works of Canteen area, 5th floor at SBI, LHO, Bhopal

Dear Sir,

This has reference to the Terms & Conditions for the Reverse Auction mentioned in the Tender document

This letter is to confirm that:

1) The undersigned is authorized representative of the company.
2) We have studied the Commercial Terms and the Business rules governing the Reverse Auction as mentioned in RFP of SBI as well as this document and confirm our agreement to them.
3) We also confirm that we have taken the training on the auction tool and have understood the functionality of the same thoroughly.
4) We confirm that SBI and ETL shall not be liable & responsible in any manner whatsoever for my/our failure to access & bid on the e-auction platform due to loss of internet connectivity, electricity failure, virus attack, problems with the PC, any other unforeseen circumstances etc. before or during the tendering event.
5) **We also confirm that we have a valid digital signature certificate issued by a valid Certifying Authority.**
6) We also confirm that we will mail the price confirmation / break up of our quoted price as per Annexure III & Annexure IV within 24 hours of the completion of the bid/ reverse auction and the format as requested by SBI/ETL.
7) We, hereby confirm that we will honor the Bids placed by us during the E-tendering/ auction process.

With regards,
Date:
Signature with company seal
Name:
Company / Organization:
Designation within Company / Organization:
Address of Company / Organization:
Scan it and send to this Document on sujith@eptl.in

(C) **Price Confirmation Letter (Annexure III)**

(The bidders are required to print this on their company's letter head and sign, stamp before emailing)

To,
E-Procurement Technologies Ltd. (Auction Tiger)
B-704, Wall Street - II,
Opp. Orient Club,
Nr. Gujarat College, Ahmedabad - 380 006.
Gujarat State, India

Sub: Tender for Air Conditioning Works of Canteen area, 5th floor at SBI, LHO, Bhopal

Online Price Bid Date:

Dear Sir,

We confirm that we have quoted.

Thanking you and looking forward to the valuable order from SBI.

Yours sincerely,

For _____

Name:
Company:
Date:
Seal:
Scan it and send to this Document on sujith@eptl.in

(D) **Price break up (Annexure IV)**

Detailed Price Break up as per tender document

GENERAL CONDITIONS OF CONTRACT

Definitions: -

"Contract means the documents forming the tender and the acceptance thereof and the formal agreement executed between State Bank of India (client) and the contractor, together with the documents referred there in including these conditions, the specifications, designs, drawings and instructions issued from time to time by the Architects/ Bank and all these documents taken together shall be deemed to form one contract and shall be complementary to one another.

In the contract the following expressions shall, unless the context otherwise requires, have the meaning hereby respectively assigned to them.

'SBI' shall mean State Bank of India (client) a body Corporate created under State Bank of India Act 1955, having its Corporate Centre at State Bank Bhavan, Madame Cama Road, Mumbai 400 021 and a Local Head Office at Hoshangabad Road Bhopal 462 010 and includes the client's representatives, successors and assigns.

'Site Engineer' shall mean an Engineer appointed by the SBI at site as their representative for day-to-day supervision of work and to give instructions to the contractors.

'The Contractor' shall mean the individual or firm or company whether incorporate not, undertaking the works and shall include legal personal representative of individual or the composing the firm or company and the permitted assignees of individual or firms of company.

The expression 'works' or 'work' shall mean the permanent or temporary work description in the "Scope of work" and / or to be executed in accordance with the contract includes materials, apparatus, equipment, temporary supports, fittings and things of kinds to be provided, the obligations of the contractor hereunder and work to be done by the contractor under the contract.

5. 'Engineer' shall mean the representative of the Architect/consultant.

6. 'Drawings' shall mean the drawings prepared by the Architects and issued by the Engineer and referred to in the specifications and any modifications of such drawings as may be issued by the Engineer from time to time 'Contract value shall mean value of the entire work as stipulated in the letter of acceptance of tender subject such additions there to or deductions there from as may be made under the provide herein after contained.

7. Spécifications' shall mean the specifications referred to in the tender and modifications thereof as may time to time be furnished or approved by the Architect/ Consultant.

8. "Month" means calendar month.

1.1.9 "Week" means seven consecutive days.

1 .1.10"Day" means a calendar day beginning and ending at 00 Hrs. and 24 Hrs. respectively.

11. "SBI's Engineer" shall mean The Civil / Electrical Engineer in - charge of the Project, as nominated by the Assistant General Manager, Premises & Estate Department, State Bank of India, LHO, Bhopal.

12. The following shall constitute the Joint Project Committee (herein under referred to as JPC) for assessing and reviewing the progress of the work on the project and to issue instructions or directions from time to time for being observed and followed by the

Architects Site Engineer /PMC and other consultants / contractors engaged in the execution of the project.

i) Assistant General Manager, Premises & Estate Department of SBI
ii) SBI Engineer (Civil and Electrical) in-charge of the Project, as may be nominated by the Assistant General Manager, Premises & Estate Department, State Bank of India, LHO, Bhopal.
iii) Concerned partner / proprietor of the Architects and their Resident Architect Member.

CLAUSE

1.0 Total Security Deposit

Total Security deposit comprise of

Earnest Money Deposit

Initial security deposit

Retention Money

a) Earnest Money Deposit -

The tenderer shall furnish EMD of **Rs.62,000.00 (Rupees Sixty two thousand only)**in the form of Demand draft or banker's cheque drawn in favour of Assistant General Manager (P&E), State Bank of India payable at Bhopal. No tender shall be considered unless the EMD is so deposited in the required form. No interest shall be paid on this EMD. The EMD of the unsuccessful tenderer shall be refunded soon after the decision to award the contract is taken without interest. The EMD shall stand absolutely forfeited if the tenderer revokes his tender at any time the period when he is required to keep his tender open acceptance by the SBI or after it is accepted by the SBI the contractor fails to enter into a formal agreement or fails to pay the initial security deposit as stipulated or fails to commence the work within the stipulated time. EMD of successful tenderer shall also be refunded on receipt of ISD.

b) Initial Security Deposit (ISD)

The amount of ISD shall be 2% of accepted value of tender in the form of DD/FDR drawn on any scheduled Bank and shall be deposited within 15 days from the date of acceptance of tender.

ADDITIONAL SECURITY DEPOSIT / PERFORMANCE GUARANTEE

Additional Security deposit (ASD)/Additional performance Guarantee (APG) shall be applicable if the bid price is below 10.00 % of the estimated cost put to tender. The amount of such ASD/ APG shall be the difference between 90.00 % of estimated cost put to tender and the quoted price.

. Such ASD could be in the form of FDR / Bank's guarantee in the Bank's name as per format approved by the Bank. On successful completion of work ASD will be returned to the contractor. In case contractor fails to complete the work in time or as per tender specification or leave the job incomplete, the bank will be at liberty to recover the dues from ASD or to forfeit such ASD as the casemay be within its sole discretion.
No interest shall be paid to the amount retained by the Bank as Security Deposit.

c) Retention Money: -

Besides the SD as deposited by the contractor in the above said manner, the Retention money shall be deducted from the running account bill at the rate of 10% of the gross value of work done by the contractor and claimed in each bill provided the total security deposit i.e. ISD plus EMD plus Retention Money shall both together not exceed 5% of the contract value.The50% of the total security deposit shall be refunded to the contractor without any interest on issue of Virtual Completion certificate by the Architect/consultant. The balance 50% of the total security deposit shall be refunded to the contractors without interest within fifteen days after the end of defects liability period provided the contractor has satisfactorily attended to all defects, if any, in accordance with the conditions of contract including site clearance.

2.0 **Language**

The language in which the contract documents shall be drawn shall be in English.

3.0 **Errors, omissions and discrepancies**

In case of errors, omissions and/ or disagreement between written and scaled dimensions on the drawings or between the drawings and specifications etc., the following order shall apply.

i) Between scaled and written dimension (or description) on a drawing, the latter shall be adopted.

ii) Between the written or shown description or dimensions in the drawings and the corresponding one in the specification the former shall be taken as correct.

iii) Between written description of the item in the specifications and descriptions in bills of quantities of the same item, the former shall be adopted:

a) In case of difference between rates written in figures and words, the rate in words shall prevail.

b) Between the duplicate / subsequent copies of the tender, the original tender shall be taken as correct.

4.0 **Scope of Work:**

The contractor shall carryout complete and maintain the said work in every respect strictly accordance with this contract and with the directions of and to the satisfaction Bank to be communicated through the Architect/consultant. The Architect/consultant at the directions of the SBI from time to time issue further drawings and / or write instructions, details directions and explanations which are here after collectively references to as Architect's /consultant's instructions in regard to the variation or modification of the design, quality or quantity of any work or the addition or omission or substitution work. Any discrepancy in the drawings or between BOQ and / or drawings and / or specifications. The removal from the site of any material brought thereon by the Contractor and any substitution of any other materials therefore the removal and / or re-executed of any work executed by him. The dismissal from the work of any person engaged thereupon.

5.0 i) **Letter of Acceptance:**

Within the validity period of the tender the SBI shall issue a letter of acceptance directly or through the Architect by registered post or otherwise depositing at the of the contractor as given in the tender to enter into a Contract for the execution of the work as per the terms of the tender. The letter of acceptance shall constitute a binding contract between the SBI and the contractor.

ii) **Contract Agreement:**

On receipt of intimation of the acceptance of tender from the SBI/ Architect, the successful tenderer shall be bound to implement the contract and within fifteen days there of shall sign an agreement in a non-judicial stamp paper of appropriate value.

6.0 **Ownership of drawings**:

All drawings, specifications and copies thereof furnished by the SBI through its Architect / consultants are the properties of the SBI. They are not to be used on other work.

Detailed drawings and instructions:

The SBI through its Architects / consultants shall furnish with reasonable proper additional instructions by means of drawings or otherwise necessary for the execution of the work. All such drawings and instructions shall be consistent with contract documents, true developments thereof and reasonably inferable there.

The work shall be executed in conformity therewith and the contractor prepare a detailed programme schedule indicating therein the date of start and completion of various activities on receipt of the work order and submit the same to the SBI through the Architect/consultant

7.0 **Copies of agreement**

Two copies of agreement duly signed by both the parties with the drawings shall be handed over to the contractors.

8.0 **Liquidated damages:**

If the contractor fails to maintain the required progress in terms of clause 28/29 of GCC or to complete the work and clear the site including vacating their office on or before the contracted or extended date or completion, without justification in support of the cause of delay, he may be called upon without prejudice to any other right of remedy available under the law to the SBI on account of such breach to pay a liquidated damage at the rate of 0.50% of the contract value which subject to a maximum of 5% of the contract value.

9.0 **Materials, Appliances and Employees**

Unless or otherwise specified the contractor shall provide and pay for all materials, labour, water, power, tools, equipment transportation and any other facilities that are required for the satisfactory execution and completion of the work. Unless or otherwise specified all materials shall be new and both workmanship and materials shall be best quality. The contractor shall at all times enforce strict discipline and good order among his employees and shall not employ on the work any unfit person or anyone not skilled in the work assigned to him. Workman whose work or behavior is found to be unsatisfactory by the SBI /ARCHITECT/ consultant he shall be removed from the site immediately.

10.0 **Permits, Laws and Regulations:**

Permits and licenses required for the execution of the work shall be obtained by the contractor at his own expenses. The contractor shall give notices and comply with the regulations, laws, and ordinances rules, applicable to the contract. If the contractor observes any discrepancy between the drawings and specifications, he shall promptly notify the SBI in writing under intimation of the Architect/ Consultant. If the contractor performs any act, which is against the law, rules and regulations he shall meet all the costs arising there from and shall indemnify the SBI any legal actions arising there from.

11.0 **Setting out Work:**

The contractor shall set out the work and shall be responsible for the true and perfect setting out of the same and for the correctness of the positions, levels, dimensions, and alignment of all parts thereof and get it approved by the Architect / consultant before proceeding with the work. If at any time any error in this respect shall appear during the progress of the works, irrespective of the fact that the layout had been approved by, the Architect / consultant the contractor shall be responsible for the same ad shall his own expenses rectify such error, if so, required to satisfaction of the SBI

12.0 **Protection of works and property:**

The contractor shall continuously maintain adequate protection. of all his work from damage and shall protect the SBI's properties from injury or loss arising in connection with contract. He shall make good any such damage, injury, loss, except due to causes beyond his control and due to his fault or negligence.

He shall take adequate care and steps for protection of the adjacent properties. The contractor shall take all precautions for safety and protections of his employees on the works and shall comply with all applicable provisions of Govt. and local bodies' safety laws and building codes to prevent accidents, or injuries to persons or property on about or adjacent to his place of work. The contractor shall take insurance covers as per clause 24.0 at his own cost. The policy may be taken in joint names of the contractor and the SBI and the original policy may be lodged with the SBI

13.0 **Inspection of work:**

The SBI / Architect / Consultant or their representatives shall at all reasonable times have free access to the work site and / or to the workshop, factories, or other places where materials are lying or from where they are obtained and the contractor shall give every facility to the SBI/Architect/consultant and their representatives necessary for inspection and examination and test of the materials and workmanship. No person unless authorized by the SBI/ Architect /Consultant except the representative of Public authorities shall be allowed on the work at any time. The proposed work either during its construction stage or its completion can also be inspected by the Chief Technical Examiner's Organization a wing of Central Vigilance commission.

14.0 **Assignment and subletting**

The whole of work included in the contract shall be executed the contractor and he shall not directly entrust and engage or indirectly transfer, assign or underlet the contract or any part or share there of or interest therein without the written consent of the SBI through the Architect and no undertaking shall relieve the contractor from the responsibility of the

contractor from active & superintendence of the work during its progress.

15.0 **Quality of materials, workmanship & Test**

All materials and workmanship shall be best of the respective kinds described in the contract and in accordance with Architect/consultant instructions and shall be subject from time to time to such tests as the Architect/consultant may direct at the place of manufacture or fabrication or on the site or an approved testing laboratory. The contractor shall provide such assistance, instruments, machinery, labor, and materials as are normally required for examining measuring sampling and testing any material or part of work before incorporation in the work for testing as may be selected and required by the Architect/consultant.

ii) Samples

All samples of adequate numbers, size, shades & pattern as per specifications shall be supplied by the contractor without any extra charges. If certain items proposed to be used are of such nature that samples cannot be presented or prepared at the site detailed literature / test certificate of the same shall be provided to the satisfaction of the Architect/consultant. Before submitting the sample / literature the contractor shall satisfy himself that the material / equipment for which he is submitting the sample / literature meet with the requirement of tender specification. Only when the samples are approved in writing by the Architect / consultant the contractor shall proceed with the procurement and installation of the particular material / equipment. The approved samples shall be the signed by the Architect / Consultant for identification and shall be kept on record at site office until the completion of the work for inspection / comparison at any time. The Architect/Consultant shall take reasonable time to approve the sample. Any delay that might occur in approving the samples for reasons of its not meeting the specifications or other discrepancies inadequacy in furnishing samples of best qualities from various manufacturers and such other aspects causing delay on the approval of the materials / equipment etc. shall be to the account of the contractor.

iii) Cost of tests

The cost of making any test shall be borne by the contractor if such test is intended by or provided for in the specification or BOQ.

iv) Costs of tests not provided for

If any test is ordered by the Architect/ Consultant which is either

a) If so intended by or provided for or (in the cases above mentioned) is not so particularized, or though so intended or provided for but ordered by the Architect / Consultant to be carried out by an independent person at any place other than the site or the place of manufacture or fabrication of the materials tested or any Government / approved laboratory, then the cost of such test shall be borne by the contractor.

16.0 **Obtaining information related to execution of work**

No claim by the contractor for additional payment shall be entertained which is consequent upon failure on his part to obtain correct information as to any matter affecting the execution of the work nor any misunderstanding or the obtaining incorrect information or the failure to obtain correct information relieve him from any risks or from the entire responsibility for the fulfillment of contract.

17.0 **Contractor's Superintendence**

The contractor shall give necessary personal superintendence during the execution the works and as long, thereafter, as the Architect / Consultant may consider necessary until the expiry of the defects liability period, stated here to.

18.0 **Quantities**

i) The bill of quantities (BOQ) unless or otherwise stated shall be deemed to have been prepared in accordance with the Indian Standard Method of Measurements and quantities. The rate quoted shall remain valid for variation of quantity against individual item to any extent. The entire amount paid under Clause 19, 20 hereof as well as amounts of prime cost and provision sums, if any, shall be excluded.

19.0 **Works to be measured**

The Architect/Consultant may from time to time intimate to the contractor that he requires the work to be measured and the contractor shall forthwith attend or send a representative to assist the Architect in taking such measurements and calculation and to furnish all particulars or to give all assistance required by any of them. Such measurements shall be taken in accordance with the Mode of measurements detail in the specifications. The representative of the Architect / Consultant shall take measurements with the contractor's representative and the measurements shall be entered in the measurement book. The contractor or his authorized representative shall sign all the pages of the measurement book in which the measurements have been recorded in token of his acceptance. All the corrections shall be duly attested by both representatives. No over writings shall be made in the Measurement Book (M.B.) Should the contractor not attend or neglect or omit to depute his representative to take measurements, the measurements recorded by the representative of the Architect / consultant shall be final. All authorized extra work, omissions and all variations made shall be included such measurement.

20.0 **Variations**

No alteration, omission or variation ordered in writing by the Architect / consultant vitiates the contract. In case the SBI / Architect / Consultant thinks proper at any during the progress of works to make any alteration in, or additions to or omission from the works or any. alteration in the kind or quality of the materials to be used therein, the Architect / Consultant shall give notice thereof in writing to the contractor shall confirm in writing within seven days of giving such oral instructions the contract shall alter to, add to, or omit from as the case may be in accordance with such but the contractor shall not do any work extra to or make any alterations or additions to or omissions from the works or any deviation from any of the provisions of the contract, stipulations, specifications or contract drawings without previous consent in writing of the Architect/ Consultant and the value of such extras, alterations, additions or omissions shall in all cases be determined by the Architect / Consultant and the same shall be added to or deducted from the contract value, as the case may be.

21.0 **Valuation of Variations**

No claim for an extra shall be allowed unless it shall have been executed under the authority of the Architect / Consultant with the concurrence of the SBI as herein mentioned. Any such extra is herein referred to as authorized extra and shall be made in accordance with the following provisions.

a) (i) The net rates or prices in the contract shall determine the valuation of the extra work where such extra work is of similar character and executed under similar conditions as the work priced herein.

(ii) Rates for all items, wherever possible should be derived out of the rates given in the priced BOQ.

b) The net prices of the original tender shall determine the value of the items omitted, provided if omissions do not vary the conditions under which any remaining items of Works are carried out, otherwise the prices for the same shall be valued under sub-Clause 'c' hereunder.

c) Where the extra works are not of similar character and/or executed under similar conditions as aforesaid or where the omissions vary the conditions under which any remaining items or works are carried out, then the contractor shall within 7 days of the receipt of the letter of acceptance inform the Architect/ consultant of the rate which he intends to charge for such items of work, duly supported by analysis of the rate or rates claimed and the Architect/ consultant shall fix such rate or prices as in the circumstances in his opinion are reasonable and proper, based on the market rate.

d) Where extra work cannot be properly measured or valued the contractor shall be allowed day work prices at the net rates stated in the tender, of the BOQ or, if not, so stated then in accordance with the local day work rates and wages for the district; provided that in either case, vouchers specifying the daily time (and if required by the Architect/Consultant) the workman's name and materials employed be delivered for verifications to the Architect /consultant at or before the end of the week following that in which the work has been executed.

e) It is further clarified that for all such authorized extra items where rates cannot be derived from the tender, the Contractor shall submit rates duly supported by rate analysis worked on the 'market rate basis for material, labour hire / running charges of equipment and wastages etc. plus 15% towards establishment charges, contractor's overheads and profit. Such items shall, not be eligible for escalation.

22.0 **Final measurement**

The measurement and valuation in respect of the contract shall be completed within two months of the virtual completion of the work.

23.0 **Virtual Completion Certificate (VCC)**

On successful completion of entire works covered by the contract to the full satisfaction of the SBI, the contractor shall ensure that the following works have been completed the satisfaction of the SBI:

a) Clear the site of all scaffolding, wiring, pipes, surplus materials, contractor's labour equipment and machinery.

b) Demolish, dismantle and remove the contractor's site office, temporary works, structure including labour sheds/camps and constructions and other items and things whatsoever brought upon or erected at the site or any land allotted to the contractor by the SBI not incorporated in the permanent works.

c) Remove all rubbish, debris etc. from the site and the land allotted to the contractor the

SBI and shall clear, level and dress, compact the site as required by the SBI

d) Shall put the SBI in undisputed custody and possession of the site and all land allot by the SBI

e) Shall hand over the work in a peaceful manner to the SBI

f) All defects / imperfections have been attended and rectified as pointed out by the Architects to the full satisfaction of SBI

g)

Upon the satisfactory fulfillment by the contractor as stated above, the contractor is entitled to apply to the Architect / consultant is satisfied of the completion of work. Relative to which the completion certificate has been sought, the Architect/ consultant shall within fourteen (14) days of the receipt of the application for completion certificate, issue a VCC in respect of the work for which the VCC has applied.

This issuance of a VCC shall not be without prejudice to the SBI's rights and contractor liabilities under the contract including the contractor's liability for defects liability nor shall the issuance of VCC in respect of the works or work at any site be construction as a waiver of any right or claim of the SBI against the contractor in respect of or work at the site and in respect of which the VCC has been issued.

24.0 **Work by other agencies**

The SBI / Architect / consultant reserves the rights to use premises and any portion the site for execution of any work not included in the scope of this contract which it may desire to have carried out by other persons simultaneously and the contractor shall not only allow but also extend reasonable facilities for the execution of such work. The contractor however shall not be required to provide any plant or material for the execution of such work except by special arrangement with the SBI. Such work shall be carried out in such manner as not to impede the progress of the works included in the contract.

Insurance of works

Without limiting his obligations and responsibilities under the contract the contractor shall insure in the joint names of theSBI and the contractor against all loss of damages from whatever cause arising other than the excepted risks, for which he is responsible under the terms of contract and in such a manner that the SBIand contractor are covered for the period stipulated vide clause of GCC and are also covered during the period of maintenance for loss or damage arising from a cause, occurring prior to the commencement of the period of maintenance and for any loss or damage occasioned by the contractor in the course of any operations carried out by him for the purpose of complying with his obligations under clause.

a) The Works for the time being executed to the estimated current Contract value thereof, or such additional sum as may be specified together with the materials for incorporation in the works at their replacement value.

b) The constructional plant and other things brought on to the site by the contractor to the replacement value of such constructional plant and other things.

c) Such insurance shall be affected with an insurer and in terms approved by the SBI which approval shall not be unreasonably withheld and the contractor shall whenever require produce to the Architect / consultant the policy if insurance and the receipts for payment of the current premiums.

Damage to persons and property

The contractor shall, except if and so far as the contract provides otherwise indemnify the SBI against all losses and claims in respect of injuries or damages to any person or material or physical damage to any property whatsoever which may arise out of or in consequence of the execution and maintenance of the works and against all claims proceedings, damages, costs, charges and expenses whatsoever in respect of or in relation thereto except any compensation of damages for or with respect to:

a) The permanent use or occupation of land by or any part thereof.

b) The right of SBI to execute the works or any part thereof on, over, under, in or through any lands.

c) Injuries or damages to persons or properties which are unavoidable result of the execution or maintenance of the works in accordance with the contract

d) Injuries or damage to persons or property resulting from any act or neglect of the SBI their agents, employees or other contractors not being employed by the contractor or for or in respect of any claims, proceedings, damages, costs, charges and expenses in respect thereof or in relation thereto or where the injury or damage was contributed to by the contractor, his servants or agents such part of the compensation as may be just and equitable having regard to the extent of the responsibility of the SBI, their employees, or agents or other employees, or agents or other contractors for the damage or injury.

Contractor to indemnify SBI

The contractor shall indemnify the SBI against all claims, proceedings, damages, costs, charges and expenses in respect of the matters referred to in the provision sub-clause 25.2 of this clause.

Contractor's superintendence

The contractor shall fully indemnify and keep indemnified the SBI against any action, claim, or proceeding relating to infringement or use of any patent or design or any alleged patent or design rights and shall pay any royalties which may be payable in respect of any article or part thereof included in the contract. In the event of any claim made under or action brought against SBI in respect of such matters as aforesaid the contractor shall be immediately notified thereof and the contractor shall be at liberty, at his own expenses to settle any dispute or to conduct any litigation that may arise there from, provided that the contractor shall not be liable to indemnify the SBI if the infringement of the patent or design or any alleged patent or design right is the direct result of an order passed by the Architect / consultant in this behalf.

Third Party Insurance

Before commencing the execution of the work the contractor but without limiting his obligations and responsibilities under clause 24.0 of GCC shall insure against his liability for any material or physical damage, loss, or injury which may occur to any property including that of SBI, or to any person, including any employee of the SBI, by or arising out of the execution of the works or in the carrying out of the contract, otherwise than due to the matters referred to in the provision to clause 24.0 thereof.

Minimum amount of Third-Party Insurance

Such insurance shall be affected with an insurer and in terms approved by the SBI which approval shall not be reasonably withheld and for at least the amount stated below. The contractor shall, whenever required, produce to the. Architect / consultant the policy or policies of insurance cover and receipts for payment of the current premiums.

The minimum insurance cover for physical property, injury, and death is Rs.5 Lakh per occurrence with the number of occurrences limited to four. After each occurrence contractor will pay additional premium necessary to make insurance valid for four occurrences always.

Accident or Injury to workman:

The SBI shall not be liable for or in respect of any damages or compensation payable at law in respect or in consequence of any accident or injury to any workmen or other person in the employment of the contractor or any sub-contractor, save and except an accident or injury resulting from any act or default of the SBI or their agents, or employees. The contractor shall indemnify and keep indemnified SBI against all such damages and compensation, save and except as aforesaid, and against all claims, proceedings, costs, charges and expenses whatsoever in respect thereof or in relation thereto.

Insurance against accidents etc. to workmen

The contractor shall insure against such liability with an insurer approved by the SBI during the whole of the time that any persons are employed by him on the works and shall, when required, produce to the Architect / consultant such policy of insurance and receipt for payment of the current premium. Provided always that, in respect of any persons employed by any sub-contractor the contractor's obligation to insured as aforesaid under this sub-clause shall be satisfied if the sub-contractor shall have insured against the liability in respect of such persons in such manner that SBI is indemnified under the policy but the contractor shall require such sub-contractor to produce to the Architect /consultant when such policy of insurance and the receipt for the payment of the current premium.

Remedy on contractor's failure to insure

If the contractor fails to effect and keep in force the insurance referred to above or any other insurance which he may be required to effect under the terms of contract, then and in any such case the SBI may effect and keep in force any such insurance and pay such premium or premiums as may be necessary for that purpose and from time to time deduct the amount so paid by the SBI as aforesaid from any amount due or which may become due to the contractor, or recover the same as debt from the contractor.

Without prejudice to the others rights of the SBI against contractors. In respect of such default, the employer shall be entitled to deduct from any sums payable to the contractor the amount of any damages costs, charges, and other expenses paid by the SBI and which are payable by the contractors under this clause. The contractor shall upon settlement by the Insurer of any claim made against the insurer pursuant to a policy taken under this clause, proceed with due diligence to rebuild or repair the works destroyed or damaged. In this event all the monies received from the Insurer in respect of such damage shall be paid to the contractor and the Contractor shall not be entitled to any further payment in respect of the expenditure incurred for rebuilding or repairing of the materials or goods destroyed or damaged

26.0 **Commencement of Works:**

The date of commencement of the work will be reckoned as the date, fifteen days from the date of award of letter by the SBI/Architects.

27.0 **Time for completion**

Time is essence of the contract and shall be strictly observed by the contractor. The entire work shall be completed within a period of **105 Days** from the date of commencement. If required in the contract or as directed by the Architect / consultant. The contractor shall complete certain portions of work before completion of the entire work. However, the completion date shall be reckoned as the date by which the whole work is completed as per the terms of the contract.

28.0 **Extension of time**

If, in the opinion of the Architect/consultant, the work be delayed for reasons beyond the control of the contractor, the Architect/consultant may submit a recommendation to the SBI to grant a fair and reasonable extension of time for completion of work as per the terms of contract. If the contractor needs an extension of time for the completion of work or if the completion of work is likely to be delayed for any reasons beyond the due date of completion as stipulated in the contract, the contractor shall apply to theSBI through the Architect' Consultant in writing at least 30 Days before the expiry of the scheduled time and while applying for extension of time he shall furnish the reason in detail and his justification if any', for the delays. The Architect/consultant shall submit their recommendations to the SBI in the prescribed format for granting extension of time. While granting extension of time the contractor shall be informed the period extended time which will qualify for levy of liquidated damages. For the balance period in excess of original stipulated period and duly sanctioned extension of time by the provision of liquidated damages as stated under clause 8.0 shall become applicable. Further the contract shall remain in force even for the period beyond the due date of completion irrespective whether the extension is granted or not.

29. **Rate of progress**

Whole of the materials, plant and labour to be provided by the contractor and the mode, manner and speed of execution and maintenance of the works are to be of a kind and conducted in a manner to the satisfaction of the Architect / consultant should the rate of progress of the work or any part thereof be at any time be in the opinion the. Architect / consultant too Slow to ensure the completion of the whole of the work the prescribed time or extended time for completion the Architect / consultant shall thereupon take such steps as considered necessary by the Architect / consultant to expedite progress so as to complete the works by the prescribed time or extended time. Such communications from the Architect / consultant neither shall relieve the contractor from fulfilling obligations under the contract nor will he be entitled to raise any claims arising out of such directions.

30.0 **Work during nights and holidays**

Subject to any provision to the contrary contained in the contract no permanent work shall save as herein provided be carried on during the night or on holidays without the permission in writing of the Architect / consultant, save when the work is unavoidable or absolutely necessary for the saving of life or property or for the safety of the work in which case the contractor shall immediately advise the Architect / consultant. However, the provisions of the clause shall not be applicable in the case of any work which becomes essential to carry by rotary or double shifts in order to achieve the progress and quality of the part of the works being technically required / continued with the prior approval of the

Architect / consultant at no extra cost to the SBI.

All work at night after obtaining approval from competent authorities shall be carried out without unreasonable noise and disturbance.

31.0 **No compensation or restrictions of work**

If at any time after acceptance of the tender SBI shall decide to abandon or reduce the scope of work for any reason whatsoever and hence not required the whole or any part of the work to be carried out. The Architect / consultant shall give notice in writing that effect to the contractor and the contractor shall act accordingly in the matter. The contractor shall have no claim to any payment of compensation or otherwise what so ever on account of any profit or advantage which he might have derived from the execution of the Work fully but which he did not derive in consequence of the foreclosure of the whole or part of the work.

Provided that the contractor shall be paid the charges on the cartage only of materials actually and bona-fide brought to the site of the work by the contractor and rendered surplus as a result of the abandonment, curtailment of the work or any portion thereof and then taken back by the contractor, provided however that the Architect / Consultant shall have in such cases the option of taking over all or any such materials at their purchase price or a local current rate whichever is less.

"In case of such stores having been issued from SBI stores and returned by the contractor to stores, credit shall be given to him at the rates not exceeding those at which were originally issued to the contractor after taking into consideration and deduction for claims on account of any deterioration or damage while in the custody of the contractor and in this respect the decision of Architect / consultant shall be final.

32.0 **Suspension of work**

i) The contractor shall, on receipt of the order in writing of the Architect / consultant (whose decision shall be final and binding on the contractor) suspend the progress of works or any part thereof for such time and in such manner as Architect /consultant may consider necessary so as not to cause any damage or injury to the work already done or endanger the safety thereof for any of following reasons:

a) On account any default on the part of the contractor, or

b) For proper execution of the works or part thereof for reasons other than the default the contractor, or

c) For safety of the works or part thereof.

The contractor shall, during such suspension, properly protect and secure the works the extent necessary and carry out the instructions given in that behalf by the Architect / consultant.

i) If the suspension is ordered for reasons (b) and (c) in sub-para (i) above:
The contractor shall be entitled to an extension of time equal to the period of every such suspension. No compensation whatsoever shall be paid on this account.

33 **Action when the whole security deposit is forfeited**

In any case in which under any clause or clauses of this contract, the Contractor shall have rendered himself liable to pay compensation amounting to the whole of his security deposit the Architect / consultant shall have the power to adopt any of the following

course as they may deem best suited to the interest of the SBI:

a) To rescind the contract (of which rescission notice in writing to the contractor by - Architect / consultant shall be conclusive evidence) and in which case the security, deposit of the contractor shall be forfeited and be absolutely at the disposal of SBI

b) To employ labour paid by the SBIand to supply materials to carry out the work, or part of the work, debiting the contractor with the cost of the labour and materials cost of such labour and materials as worked out by the Architect/consultant shall final and conclusive against the contractor) and crediting him with the value of the work done, in all respects in the same manner and at the same manner and at the same rates as if it had been carried out by the contractor under the terms of this contract certificate of Architect /consultant as to the value of work done shall be final conclusive against the contractor.

c) To measure up the work of the contractor, and to take such part thereof as shall unexecuted, out of his hands, and to give it to another contractor to complete in which case any expenses which may be incurred in excess of the sum which would have been paid to the original contractor, if the whole work had been executed by him (The amount of which excess the certificates in writing of the Architects / consultant shall final and conclusive) shall be borne by original contractor and may be deducted f any money due to him by SBI under the contract or otherwise, or from his security deposit or the proceeds of sale thereof, or sufficient part thereof.

In the event of any of above courses being adopted by the SBI the contractor shall have no claim to compensation for any loss sustained by him by reasons of his having purchased or procured any material or entered into any engagements or make any advances on account of, or with a view to the execution of the work or the performance of the contract and in case the contract shall be rescind under the provision aforesaid, the contractor shall not be entitled to recover or to be paid any sum or any work thereto for actually performed under this contract, unless, and until the Architect / consultant will have certified in writing the performance of such work and the value payable in respect thereof, and he shall only be entitled to be paid the value so certified.

34.0 **Owner's right to terminate the contract**

If the contractor being an individual or a firm commit any 'Act of insolvency' or shall be adjusted an insolvent or being an incorporated company shall have an order for compulsory winding up voluntarily or subject to the supervision of Govt. and of the Official Assignee of the liquidator in such acts of insolvency or winding up shall be unable within seven days after notice to him to do so, to show to the reasonable satisfaction of the Architect / Consultant that he is able to carry out and fulfill the contract, and to dye security therefore if so required by the Architect / Consultant or if the contractor (whether an individual firm or incorporated Company) shall suffer execution to be issued or shall suffer any payment under this contract to be attached by or on behalf of any of the creditors of the contractor.

Or shall assign or sublet this contract without the consent in writing of the SBI through the Architect/Consultant or shall charge or encumber this contract or any payment dueto which may become due to the contractor there under:

a) has abandoned the contract; or

b) has failed to commence the works, or has without any lawful excuse under these conditions suspended the progress of the works for 14 days after receiving from the SBI through the Architect / consultant written notice to proceed, or

c) has failed to proceed with the works with such diligence and failed to make such due progress as would enable the works to be completed within the time agreed upon, or
has failed to remove the materials from the site or to pull down and replace work within seven days after written notice from the SBI through the Architect / Consultant that the said materials were condemned and rejected by the Architect/consultant under these conditions; or has neglected or failed persistently to observe and perform all or any of the acts matters or things by this contract to be observed and performed by the contactor for seven days after written notice shall have been given to the contractor to observe or perform the same or has to the detriment of good workmanship or in defiance of the SBI or Architect's / consultant's instructions to the contrary subject any part of the contract. Then and in any of said cases the SBI and or the Architect / consultant, may not withstanding any previous waiver, after giving seven days' notice in writing to the contractor, determine the contract, but without thereby affecting the powers of the SBI or the Architect / consultant or the obligation and liabilities of the contractor the whole of which shall continue in force as fully as if the contract had not been determined and as if the works subsequently had been executed by or on behalf of the contractor. And, further the SBI through the Architect / consultant their agents or employees may enter upon and take possession of the work and all plants, took scaffoldings, materials, sheds, machineries lying upon the premises or on the adjoining lands or roads use the same by means of their own employees or workmen in carrying on and completing the work or by engaging any other contractors or persons to the work and the contractor shall not in any was interrupt or do any act, matter or thing to prevent or hinder such other contractor or other persons employed for complement and finishing or using the materials and plant for the works.

When the works shall be completed or as soon thereafter as convenient the SBI or Architect / consultant shall give a notice in writing to the contractor to remove his surplus materials and plants and should the contractor fail to do so within 14 days after receive thereof by him the SBI sell the same by publication, and after due publication, and shall, adjust the amount realized by such auction. The contractor shall have no right to question any of the act of the SBI incidental to the sale of the materials etc.

35.0 **Certificate of payment**

The contractor shall be entitled under the certificates to be issued by the Architect / consultant to the contractor within 10 working days from the date of certificate to payment from SBI from time to time. The SBI shall recover the statutory recovering other dues including the retention amount from the certificate of payment.

Provided always that the issue of any certificate by the Architect / consultant during progress of works or completion shall not have effect as certificate of satisfaction relieve the contractor from his liability under clause.

The Architect / consultant shall have power to withhold the certificate if the work or in part thereof is not carried out to their satisfaction.

The Architect / consultant may by any certificate make any corrections required previous certificate.

The SBI shall modify the certificate of payment as issued by the Architect / consultant from time to time while making the payment

The contractor shall submit interim bills only after taking actual measurements and properly recorded in the Measurement Book (M. B.)

The Contractor shall not submit interim bills when the approximate value of work done by him is less than Rs. 5.00 Lakh.

The final bill may be submitted by contractor within a period of one month from the date of virtual completion and Architect / consultant shall issue the certificate of payment within a period of two months. The SBI shall pay the amount within a period of three months from the date of issue of certificate provided there is no dispute in respect of rates and quantities.

The contractor shall submit the interim bills in the prescribed format with all details.

36.0 **A. Settlement of Disputes and Arbitration**

Except where otherwise provided in the contract all questions and disputes to the meaning of the specifications, design, drawings and instructions herein before mentioned and as to the quality of workmanship or materials used on the work or as to any other question , claim, right, matter or thing whatsoever in any way arising out of or relating to the contract, designs, drawings specifications, estimates, instructions orders or these conditions or otherwise concerning the work or the execution or failure to execute the same whether arising during the progress of the work or after the cancellation, termination, completion or abandonment thereof shall be dealt with as mentioned hereinafter:

i) If the contractor considers that he is entitled to any extra payment or compensation in respect of the works over and above the amounts admitted as payable by the Architect or in case the contractor wants to dispute the validity of any deductions or recoveries made or proposed to be made from the contract or raise any dispute, the contractor shall forthwith give notice in writing of his claim, or dispute to the Assistant General Manager (Premises & Estate Department), SBI, Local Head Office, Bhopaland endorse a copy of the same to the Architect, within 30 days from the date of disallowance thereof or the date of deduction or recovery. The said notice shall give full particulars of the claim, grounds on which it is based and detailed calculations of the amount claimed and the contractor shall not be entitled to raise any claim nor shall the Bank be in any way liable in respect of any claim by the contractor unless notice of such claim shall have been given by the contractor to the Assistant General Manager (Premises & Estate Department)/Dy. General Manager (Premises),in the manner and within the time as aforesaid. The Contractor shall be deemed to have waived and extinguished all his rights in respect of any claim not notified to the Assistant General Manager (Premises & Estate Department),/Dy. General Manager (Premises), in writing in the manner and within the time aforesaid.

B. Settlement of Disputes and Arbitration

The Assistant General Manager (Premises & Estate Department) /Dy. General Manager (Premises), shall give his decision in writing on the claims notified by the receipt of the contractor may within 30 days of the receipt of the decision of the Assistant General Manager (Premises & Estate Department) /Dy. General Manager (Premises) Submit his claims to the conciliating authority namely the Circle Development Officer/General Manager (Corporate Services) for conciliation along with all details and copies of correspondence exchanged between him and the Assistant General Manager (Premises & Estate Department) /Dy. General Manager (Premises).

i) If the conciliation proceedings are terminated without settlement of the disputes, the contractor shall, within a period of 30 days of termination thereof shall give a notice to the

concerned Chief General Manager/Dy. Managing Director & Corporate Development Officer of the SBI for appointment of an arbitrator to adjudicate the notified claims falling which the claims of the contractor shall be deemed to have been considered absolutely barred and waived.

ii) Except where the decision has become final, binding and conclusive in terms of thecontract, all disputes or differences arising out of the notified claims of the contractor as aforesaid and all claims of the Bank shall be referred for adjudication through arbitration by the Sole Arbitrator appointed by the Chief General Manager/Dy.Managing Director &Corporate Development Officer. It will also be no objection to any such appointment that the Arbitrator so appointed is a Bank Officer and that he had to deal with the matters to which the Contract relates in the course of his duties as Bank Officer. If the arbitrator so appointed is unable or unwilling to act or resigns his appointment or vacates his office due to any reason whatsoever another sole arbitrator shall be appointed in the manner aforesaid by the said Chief General Manager/Dy.Managing Director &Corporate Development Officer. Such person shall be entitled to proceed with the reference from the stage at which it was left by his predecessor.

It is a term of this contract that the party invoking arbitration shall give a list of disputes with amounts claimed in respect of each dispute along with the notice for appointment of arbitrator.

It is also a term of this contract that no person other than a person appointed by such Chief General Manager as aforesaid should act as arbitrator.

The conciliation and arbitration shall be conducted in accordance with the provisions of the Arbitration & Conciliation Act 1996 or any or any accordance modification or re-enactment thereof and the rules made there under.

It is also a term of the contract that if any fees are payable to the Arbitrator these shall be paid equally by both the parties. However, no fees will be payable to the arbitrator if he is a SBI Officer.

It is also a term of the contract that the Arbitrator shall be deemed to have entered on the reference on the date he issues notice to both the parties calling them to submit their statement of claims and counter statement of claims. The venue of the arbitration shall be such place as may be fixed by the arbitrator in his sole discretion. The fees, if any of the arbitrators shall, if required to be paid before the award is made and published, be paid half and half by each of the parties. The Cost of the reference and of the award (including the fees, if any of the arbitrator) shall be in the discretion of the arbitrator who may direct to any by whom and din what manner, such costs or any part thereof, shall be paid and fix or settle the amount of costs to be so paid.

37.0 **Water Supply**

The contractor shall make his own arrangements for water required for the work and nothing extra will be paid for the same. This will be subject to the following condition.

i) That the water used by the contractor shall be fit for construction purposes to the satisfaction of the Architect / consultant’s.

ii) The contractor shall make alternative arrangements for the supply of water if the arrangement made by the contractor for procurement of water in the opinion of the Architect / consultant is unsatisfactory.

The contractor shall construct temporary well / tube well in SBI land for taking water for construction purposes only after obtaining permission in writing from the SBI. The contractor has to make his own arrangements for drawing and distributing the water at his own cost. He has to make necessary arrangements. To avoid any accidents or damages caused due to construction and subsequent maintenance of the wells. He has to obtain necessary approvals from local authorities, if required, at his own cost. He shall restore the ground to its original condition after wells are dismantled on completion of work or hand over the well to the SBI without any compensation as directed by the Architect / consultant.

38.0 **Power Supply**

The contractor shall make his own arrangements for power and supply / distribution system for driving plant or machinery for the work and for lighting purpose.

39.0 **Treasure Trove etc.**

Any treasure trove, coin or object antique which may be found on the site shall be the property of SBI and shall be handed over to the bank immediately.

40.0 **Method of Measurement**

Unless otherwise mentioned in the schedule of quantities or in mode of measurement, the measurement will be on the net quantities or work produced in accordance with up to date rules laid down by the Bureau of Indian Standards. In the event any dispute / disagreement the decision of the Architect / consultant shall be final and binding on the corrector.

41.0 **Maintenance of Registers**

The contractor shall maintain the following registers as per the enclosed perform at site of work and should produce the same for inspection of SBI/Architect / consultant whenever desired by them. The contractor shall also maintain the records / registers as required by the local authorities / Govt. from time to time.

I) Register for secured advance
ii) Register for hindrance to work
iii) Register for running account bill
iv) Register for labour

Force Majeure

Neither contractor nor SBI shall be considered in default in performance of the obligations if such performance is prevented or delayed by events such as but not war, hostilities revolution, riots, civil commotion, strikes, lockout, conflagrations, epidemics, accidents, fire, storms, floods, droughts, earthquakes or ordinances or any act of or for any other cause beyond the reasonable control of the party affected or prevents or delayed. However, a notice is required to be given within 30 days from the happening of the event with complete details, to the other party to the contract, if it is not possible to serve a notice, within the shortest possible period without delay.

As soon as the cause of force majeure has been removed the party whose ability perform its obligations has been affected, shall notify the other of such cessation and the actual

delay incurred in such affected activity adducing necessary evidence in support thereof.

From the date of occurrence of a case of force majeure obligations of the party affected shall be suspended during the continuance of any inability so caused. With the caused itself and inability resulting there from having been removed, the agreed time completion of the respective obligations under this agreement shall stand extended a period equal to the period of delay occasioned by such events.

Should one or both parties be prevented from fulfilling the contractual obligations by state of force majeure lasting to a period of 6 months or wore the two parties, shall each other to decide regarding the future execution of this agreement.

43.0 **Local laws, Acts Regulations:**

The contractor shall strictly adhere to all prevailing labour laws inclusive at contract labour (regulation and abolition act of 1970) and other safety regulations. The contractors should comply with the provision of all labour legislation including the latest requirements of the Acts, laws, any other regulations that are applicable to the execution of the project.

i) Minimum wages Act 1948 (Amended)
ii) Payment of wages Act 1936 (Amended)
iii) Workmen's compensation Act 1923 (Amended)
iv) Contractlabour regulation and abolition act 1970 and central rules 1971 (Amended)
v) Apprentice act 1961 (amended)
vi) Industrial employment (standing order) Act 1946 (Amended)
vii) Personal injuries (Compensation insurance) act 1 963 and any other modifications
viii) Employees' provident fund and miscellaneous provisions Act 1952 and amendment hereof
ix) Shop and establishment act
x) Any other act or enactment relating thereto and rules framed there under from time to time.
xi) Prevailing Indian Electricity rules & act.

44.0 **Accidents**

The contractor shall immediately on occurrence of any accident at or about the site or in connection with the execution of the work report such accident to the Architect / consultant. The contractor shall also such report immediately to the competent authority whenever such report is required to be lodged by the law and take appropriate actions thereof.

45.0 **Workers' Accommodation**

The work is to be carried out in the bank's residential complex. Hence, no worker shall be permitted to stay within the premises. However, one guard may be permitted to safeguard the materials procured by the contractor, at contractor's risk and cost.

Prior permission of the guard may be obtained by submitting the necessary details to the bank and seeking the permission from bank's authorized person.

ARTICLES OF AGREEMENT

(On non-judicial Stamp Paper of Rs. 1500/- or as per latest Govt. Rules)

ARTICLES OF AGREEMENT made the_____date of_____between SBI, having its office at Bhopal hereinafter called "the Service Provider" of the One Part and _____

_____

WHEREAS the State Bank of India is desirous of _____

_____and has caused specifications describing the work to be done to be prepared by SBI.

AND WHEREAS the said Drawings numbered_____to_____inclusive, the Specifications and the Schedule of Quantities have been signed by or on behalf of the parties hereto.

AND WHEREAS the Contractor has agreed to execute upon and subject to the Conditions set forth herein and to the Conditions set forth herein in the Special Conditions and in the Schedule of Quantities and Conditions of Contract (all of which are collectively hereinafter referred to as "the said conditions") the works shown upon the said Drawings and / or described in the said Specifications and included in the Schedule of Quantities at the respective rates therein set forth amounting to the sum as therein arrived at our such other sum as shall become payable there under (hereinafter referred to as "the said Contract Amount.)

NOW IT IS HEREBY AGREED AS FOLLOWS:

1) In consideration of the said Contract Amount to be paid at the times and in the manner set forth in the said Conditions, the Contractor shall upon and subject to the said Conditions execute and complete the work shown upon the said Drawings and described in the said Specifications and the priced Schedule of Quantities.

2) The Employer shall pay to the Contractor the said Contract Amount, or such other sum as shall become payable, at the times and in the manner specified in the said Conditions.

3) The term "The Architects" in the said Conditions shall mean the SBI, or in the event of their ceasing to be the Architects for the purpose of this Contract for whatever reason, such other person or persons as shall be nominated for that purpose by the Employer, not being a person to whom the Contractor shall object for reasons considered to be sufficient by the Employer, PROVIDED ALWAYS that no person or persons subsequently appointed to be Architects under this Contract shall be entitled to disregard or overrule any previous decisions or approval or direction given or expressed in writing by the outgoing Architects for the time being.
4) The said Conditions and Appendix thereto shall be read and construed as forming part of this Agreement, and the parties hereto shall respectively abide by submit themselves to the said Conditions and perform the Agreements on their part respectively in the said Conditions contained.
5) The Plans, Agreements and Documents mentioned herein shall form the basis of this Contract.

6) This Contract is neither a fixed lump-sum contract nor a piece work contract but a contract to carry out the work in respect of the entire building complex to be paid for according to actual measured quantities at the rates contained in the Schedule of Quantities and Rates or as provided in the said Conditions.

7) The Contractor shall afford every reasonable facility for the carrying out of all works relating to civil works, installation of lifts, Telephone, electrical installations, fittings air-conditioning and other ancillary works in the manner laid down in the said Conditions, and shall make good any damages done to walls, floors, etc. after the completion of his work.

8) The SBI reserves to itself the right of altering the drawings and nature of the work by adding to or omitting any items of work or having portions of the same carried out without prejudice to this Contract.

9) Time shall be considered as the essence of this Contract and the Contractor hereby agrees to commence the work soon after the Site is handed over to him or from 14th day after the date of issue of formal work order as provided for in the said Conditions whichever is later and to complete the entire work within 6 months subject to nevertheless the provisions for extension of time.

10) All payments by the SBI under this Contract will be made only at Bhopal.

11) All disputes arising out of or in any way connected with this Agreement shall be deemed to have arisen at Bhopal and only the Courts in Bhopal shall have jurisdiction to determine the same.

12) That the several parts of this Contract have been read by the Contractor and fully understood by the Contractor.

IN WITNESS WHEREOF THE SBI and the Contractor have set their respective hands to these presents and two duplicates hereof the day and year first herein above written.

SIGNATURE CLAUSE

SIGNED AND DELIVERED by the

_____By the
(Employer)

hand of Shri _____

(Signature of Employer)

_____
(Name and Designation)

In the presence of:

1) Shri / Smt. _____

(Signature of Witness)

Address _____

_____

(Witness)

SIGNED AND DELIVERED by the

_____by the

(Contractor) (Signature of Contractors)

In the presence of:

Shri / Smt._____ (Signature of Witness)

Address _____

_____

(Witness)

SAFETY CODE

1. First aid appliances including adequate supply of sterilized dressing and cotton wool shall be kept in a readily accessible place.

2. An injured person shall be taken to a public hospital without loss of time, in cases when the injury necessitates hospitalization.

3. Suitable and strong scaffolds should be provided for workmen for all works that cannot safely be done from the ground.

4. No portable single ladder shall be over 8 meters in length. The width between the side rails shall not be less than 30 cm. (clear) and the distance between two adjacent running shall not be more than 30 cm. When a ladder is used an extra mazdoor shall be engaged for holding ladder.

5. The excavated material shall not be placed within 1.5 meters of the edge of the trench half of the depth of trench whichever is more. All trenches and excavations shall be provided with necessary fencing and lighting.

6. Every opening in the floor of a building or in a working platform be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be one meter.

7. No floor, roof or other part of the structure shall be so overloaded with debris or material as to render it unsafe.

8. Workers employed on mixing and handling material such as asphalt, cement, mortar, concrete and lime shall be provided with protective footwear and rubber hand gloves.

9. Those engaged in welding works shall be provided with welders' protective eye shield and gloves.

10. (i) No paint containing lead or lead products shall be used except in the form of paste readymade paint.
(ii) Suitable facemasks should be supplied for use by the workers when the paint applied in the form of spray or surface having lead paint dry rubbed and scrapped.

11. Overalls shall be supplied by the contractor to the painters and adequate facilities shall be provided to enable the working painters to wash during cessation of work.

12 Hoisting machines and tackle used in the works including their attachments anchor and supports shall be in perfect condition.

13. The ropes used in hoisting or lowering material or as a means of suspension shall be durable quality and adequate strength and free form defects.

SPECIAL CONDITIONS OF CONTRACT

- **Scope of Work**

  1. The scope of work is to carry out **AIR-CONDITIONING WORK AT SBI, 5TH FLOOR, LOCAL HEAD OFFICE BUILDING LHO BHOPAL M.P.**

- **Address of Site**

  The site is located at ***Existing Premises of SBI LHO BUILDING 5TH FLOOR BHOPAL M.P.***

- **Dimension and Levels**

  All dimensions and levels shown on the drawing shall be verified by the contractor on the site and he will be held responsible for the accuracy and maintenance of the entire dimension and the levels. Figured dimensions are in all cases to be accepted and no dimension shall be scaled. Large-scale details shall take precedence over small – scale drawing. In case of discrepancy the contractor shall ask for clarification from the ARCHITECT before proceeding with the work.

- **Notice of Operation**

  The contractor shall not carryout any important operation without the consent in writing from the Architect.

- **Construction Records**

  The contractor shall keep and provide to the Architect. full and accurate records of the dimension and positions of all new work and any other information necessary to prepare complete drawings recording details of the work as constructed.

- **Safety of adjacent Structures and Trees**

  The contractor shall provide and erect to the approval of the Architect. such supports as may be required to protect effectively all structures and protective guards to trees which may be endangered by the execution of the works or otherwise take such permanent measures as may be required by the Architect. to protect the trees and structures.

- **Temporary Works**

  Before any temporary works are commenced, the contractor shall submit at least 7 days in advance to the Architect. for approval complete drawings of all temporary works he may require for the execution of the works. The contractor shall carry out the modifications relating to strength, if required by the Architect. may require in accordance with the conditions of contract at his own cost. The contractor shall be solely responsible for the stability and safety of all temporary works an unfinished works and for the quality of the permanent works resulting from the arrangement eventually adopted for their execution.

- **Temporary Roads**

The contractor shall provide access roads to the site from the nearest main road at no extra cost and as directed by the Architect. The contractor shall also responsible for proper maintenance of this access road and would take all care to see that existing services, if any, are maintained in working order at his own cost. The laying and maintaining the temporary roads within the site area shall be the contractor's responsibility and the contractor shall take such measures that are necessary and as directed by the Architect.

- **Water, Power and Other Facilities**

a) The rate quoted by the contractor shall include all expenses that are required for providing all the water required for the work and the contractor shall make his own arrangements for the supply of good quality water suitable for the construction and good quality drinking water for their workers. If necessary, the contractor has to sink a tube well / open well and bring water by means of tankers at his own cost for the purpose. The SBI will not be liable to pay any charges in connection with the above.

The rate quoted in the tender shall include the expenses for obtaining and maintaining power connections and shall pay for the consumption charges.

The contractors for other trades directly appointed by the SBI shall be entitled to take power and water connections from the temporary water and power supply obtained by the contractor. However, the concerned contractor shall make their own arrangements to draw the supply and pay directly the actual consumption charges at mutually agreed rates between them. All municipal charges for drainage and water connection for construction purposes shall be borne by the contractor and charges payable for permanent connections, if any, shall be initially paid by the contractor and the SBI will reimburse the amount on production of receipts.

b) The SBI as well as the Architect shall give all possible assistance to the contractors to obtain the requisite.

c) Permission from the various authorities, but the responsibility for obtaining the same in time shall be of the contractor.

- **Office Accommodation**

a) The contractor shall provide and maintain all necessary offices, workshops, stores, shelters, sanitary facilities, canteens and other temporary structures for themselves in connection with the work at the site own cost after getting the approval from the Architect.

b) All temporary buildings and facilities as mentioned above shall be removed on completion of the work or at any other earlier date as directed by the Architect.

All the expenses for obtaining statutory approvals and maintenance of the above facilities as well as running expense shall be borne by the contractor at no extra cost. It is also the responsibility of the contractor to obtain statuary approvals for providing the above facilities.

- **Facilities for Contractors' Employees**

The contractor shall make his own arrangement for the housing and welfare of his staff and workmen including adequate drinking water facilities. The contractor shall also make his arrangements at his own cost for transport where necessary for his staff and workmen to and from site of work at his own cost.

- **Lighting of Works**

The contractor shall at all times provide adequate and approved lighting as required for the proper execution and supervision and inspection of works.

- **Fire Fighting Arrangements**

1) The contractor shall at all times provide suitable arrangements for the fighting at his own cost. For this purpose he shall provide requisite number of fire extinguishers and adequate number of buckets, some of which are of be always kept filed with sand and some with water. These equipments shall be provided at suitable prominent and easily accessible places and shall be properly maintained.

2) Any deficiency in the fire safety or unsafe conditions shall be corrected by the contractor at his own cost and to the approval of the relevant authorities. The contractor shall make the following arrangements at his own cost but not limited to the following :

   a) Proper handling, storage and disposal of combustible materials and waste.

   b) Worked operations which can create fire hazards.

   c) Access for the fire fighting equipments.

   d) Types, number and location of containers for the removal of surplus materials and rubbish.

   e) Type size, number and location of fire extinguishers or other fire fighting equipment.

   f) General housekeeping.

- **Site Order Book.**

  A site order book shall be maintained at site for the purpose of quick communication between the Architect. Any communication relating to the works may be conveyed through Records in the site order book. Such a communication from one party to the other shall be deemed to have been adequately served in terms of contract. Each site order book shall have machine numbered pages in triplicate and shall carefully maintain and preserved by the contractor and shall be made available to the Architect as and when demanded. Any instruction which the Architect may like to issue to the contractor or the contractor may like to bring the Architect may like to issue to the Contractor or the Contractor may like to bring to the Architect two copies of such instructions shall be taken from the site order book and one copy will be handed over to the party against proper acknowledgment and the second copy will be retained for their record.

- **Site Meetings**

  Site meetings will be held to review the progress and quality evaluation. The contractors shall depute a senior representative alongwith the site representative staff of approved sub-contractors and suppliers as required to the site meetings and ensure all follow MP actions. Any additional review meetings shall be held if required by the Architect.

- **Disposal of Refuse**

  The contractor shall cart away all debris, refuse etc. arising from the work from the site and deposit the same as directed by the SBI/ Architect at his own cost. It is the responsibility of the contractor to obtain from the locate authorities concerned to the effect that all rubbish arising out of contractor's activities at the construction site or any other off-site activities borrow pits has been properly disposed off.

- **Contractor to Verify Site Measurement**

The contractor shall check and verify all site measurements whenever requested by other specialist contractors of other sub contractors to enable them to prepare their own shop drawings and pass on the information with sufficient promptness as will not in any way delay the works.

- **Displaying the Name of the Work**

The contractor shall put MP a name board of suitable size as directed by the Architect indicating therein the name of the project and other details as given by the Architect at his own cost remove the same on completion of work.

- **Bar Bending Schedule**

The contractor shall prepare a detailed bar bending schedule for all reinforced concrete works and got them approved by the Architect well in advance.

- **As Built Drawings**

1) For the drawing issued to the contractor by the Architect. The Architect will issue two sets of drawings to the contractor for the item for which some changes have been made. From the approved drawings as instructed by the SBI. The Contractor will make the changes made on these copies and return these copies to the Architect for their approval. In case any revision is required or the corrections are not properly marked the Architect will point out the discrepancies to the contractor. The contractor will have to incorporate these corrections and /or attend to discrepancies either on the copies as directed by the Architect and resubmit to him for approval. The Architect will return one copy duly approved by him.

2) For the drawings prepared by the Contractor, the Contractor will modify the drawing prepared by him wherever the changes are made by the SBI. And submit two copies of such modified drawings to the Architect for approval. The Architect will return one copy of the approved drawing to the Contractor.

- **Approved Make**

The Contractor shall provide all materials form the list of approved makes at his own cost. The Architect may approve any make / agency within the approved list as given in the tender after inspection of the sample / mock MP.

- **Procurement of Materials**

The Contractor shall make his own arrangements to procure all the required materials for the work. All wastage's and losses in weight shall be to the contractors account.

- **Excise Duty, Taxes, Levies etc.**

The contractors shall pay and be responsible for payment of all taxes except GST, duties, levies, royalties, fees cess, or charges in respect of the works including but not limited to sales tax, tax on works contract excise duty, and octroi, payable in respect of materials, equipments plant and other things required for the contact. All of the aforesaid taxes except GST, duties, levies, fees and charges shall be to the contractors account and the SBI shall not be required to pay any additional or extra amount on this account. Variation of taxes, duty fees, levies etc if any, till completion of work shall be deemed to be included in the quoted in the quoted rates and no extra amount on this account. Variation of taxes, duties, fees, levies, etc if any till completion of work shall be deemed to be included in the quoted rates and no extra claim on this account will in any case be entertained. If a new tax or

duty or levy or cess or royalty or octroi is imposed under as statue or law during the currency of contract the same shall be borne by the contractor.

- **Acceptance of Tender**

  The SBI shall have the right to reject any or all tenders without assigning any reason. They are not to bound to accept the lowest or any tender and the tenderer shall have no right to question the acts of the SBI. However, the adequate transparency would be maintained by the SBI.

Signature of Contractor & Seal

SPECIFICATIONS OF HVAC WORKS WORKS

1. General:

1.1 Without forgoing the requirements of the Conditions of Tender and the Conditions of Contract the works in general shall confirm to the "Latest Specifications" published by CPWD, New Delhi and the "Specifications for Works" stated in this tender. In case of items not covered by the General Specifications referred above, reference shall be made to the appropriate I.S. Code. If there is any difference in the particular specifications of individual item of work and the description of item as given in the Schedule of Quantity, the latter shall prevail. In case of any work for which there is no specification in I.S. Specifications or in the specifications forming part of tender documents or in case there is any variation, such work shall be carried out in all respects in accordance with the instructions to be issued by the ARCHITECTs. The term Department shall mean the Employer. Any reference to ISI shall also mean reference to its successor Bureau of Indian Standards. All corrections to "Latest Specifications" or revisions of I. S. shall be deemed to apply to this contract.

1.2 Materials bearing ISI certification mark shall be given highest preference for use in the works.

1.3 Where the Contractor is required to do, perform, execute (etc.) any work or service or the like, it shall be deemed to be at his own cost. Absence of terms providing supplying, installing, fixing, etc. shall not even remotely entitle the Contractor to any additional payment thereof.

1.4 The rates accepted in the Schedule of Quantities apply to all floors, heights, depths, leads, lifts, spans, sizes, shapes, locations, etc. unless a distinction has been included in the very Schedule.

1.5 The Specifications and the Schedules may have been divided into various sub-heads for convenience only. This does not limit applicability of one to the other nor it absolves the Contractor of his responsibility to complete any trade/item of work as reasonably inferred from one or more of such sub-heads.

1.6 The Schedule of Quantities is not necessarily based on "Schedule of Rates" later/earlier versions. Hence the Schedule of Quantities shall be read and construed according to explanations given herein and intentions gathered therefrom. A mere parallel drawn from the said Schedule of Rates shall therefore not form a basis for a variation and, or additional payment.

1.7 All work under this contract is deemed to be performed above subsoil water level. However, removal of water collected from rains and the like shall be treated as part of contractual risk/obligation.

1.8 Screws, bolts, nuts, washers, hold fasts, lugs, anchors, clamps, plugs, suspenders, brackets, straps and fasteners of the like are deemed to be included in the rates of various items unless the Schedule of Quantities expressed a different intention.

1.9 Resetting any displacements, making good holes/chases and such other incidental jobs are included in rates of respective items for which these are required.

1) **Concrete Work (Plain or Reinforced):**

1) Centering, shuttering, staging, form work, strutting, propping (their provision and removal) shall not be paid for separately unless exclusion thereof is specifically described in the item.

2) The rates of concrete work do not include rendering or plastering but hacking and preparing surface for receiving the finishes shall be done as early as possible.

3) Any chamfers, grooves, drips, etc. which are generally and customarily required shall be provided in the concrete work integrally or otherwise without extra charges as directed by the Architect.

3.0 Steel Work:

3.1 The measurement of railing shall be the length of top wood/steel section as per situation along the center line.

3.2 Painting in relation to steel work shall be two or more coats of approved synthetic enamel plus a coat or primer including preparation of surfaces, fillers etc. The priming coat shall be measured & paid separately in the relevant item.

3.3 Circular work, bends, stepping are not payable extra.

3.4 The steel work in single sections of R.S. Joists, flats, Tees Angles fixed independently with or without connecting plate, is described in these clauses.

(a) Fabrication

The steel section as specified shall be straightened and cut square to correct lengths and measured with a steel tape. The cut ends exposed to view shall be finished smooth. No two pieces shall be welded or otherwise jointed to make MP the required length of a member.

All straightening and shaping to form, shall be done by pressure. Bending or cutting shall be carried out in such a manner as not to impair the strength of the metal.

(b) Painting

All surfaces which are to be painted, oiled or otherwise treated shall be dry and thoroughly cleaned to remove all loose rust. Surfaces not in contact but inaccessible after shop assembly, shall receive the full specified protective treatment before assembly. This does not apply to the interior of sealed hollow sections. Part to be encased in concrete shall not be painted or oiled. A priming coat of approved steel primer i.e. Red Oxide Zinc chrome primer conforming to IS: 2074 shall be applied before any member of steel structure are placed in position or taken out of workshop.

(c) Welding

Welding shall generally be done by electric arc process as per IS: 816 and IS: 823. The electric arc method is usually adopted and is economical. Where electricity for public is not available generators shall be arranged by the contractor at his own cost unless otherwise specified. Gas welding shall only be resorted to using oxyacetylene flame with specifiic approval of the Architect. Gas welding shall not be permitted for structural steel work. Gas welding requires heating of the members to be welded along with the welding rod and is likely to create temperature stresses in the welded members. Precautions shall therefore be taken to avoid distortion of the members due to these temperatures stresses.

The work shall be done as shown in the shop drawings which should clearly indicate various details of the joints to be welded, type of welds, shop and site welds as well as the types of electrodes to be used. Symbol for welding on plane and shops drawings shall be according to IS: 813.

As far as possible every efforts shall be made to limit the welding that must be done after the structure is erected so as to avoid the improper welding that is likely to be done due to heights and difficult positions on scaffolding etc. apart from the aspect of economy. The maximum dia of electrodes for welding any work shall be as per IS: 814 and appendix B' of IS: 823. Joint surfaces which are to be welded together shall be free from loose mill scale, rust, paint, grease or other foreign matter, which adversely affect the quality of weld and workmanship.

SPECIFICATIONS FOR SERVICES

1) General

1.1 The drawings for services are diagrammatic but shall be followed as closely as actual construction permits. Any deviations from the drawings shall be in conformity with structural drawings. The dimensions designated by the manufacturers shall take precedence over the drawings.

a. At completion of work the Contractor shall submit one set of tracings and two sets of prints of "As-Built-Drawings". These drawings shall, among others, include invert levels, pipe runs, diameters, location of valves, access panels, layout of equipment, piping connections and such other information for maintenance & future extensions. Guarantees given by manufacturers shall be assigned to the Employer along with names & addresses of manufacturers, suppliers and information about spare parts.

b. All site test shall be carried out with prior intimation to the Bank Engineer / Architect. All defects shall be rectified and tests conducted again to the satisfaction of the Bank Engineer / Architect. In addition to the test required by the specifications, the Contractor shall also conduct tests required by the Architect and by the Municipal or other Authorities.

c. All work shall be executed by competent and licensed persons. The contractor shall maintain liaison with Municipal and other controlling Authorities. He shall obtain their approvals and certificates as required by the bye – laws at appropriate stages.

d. No cutting / chasing shall be done in load bearing structural members without prior approval of the Architect. Sleeves and openings shall be provided during the progress of construction in preference to cutting at later date.

e. The Architect may require typical mock MP(s) to be installed in advance for approval. Undamaged materials from the mock MP shall be allowed to be reused in the work.

f. Unless otherwise described in the item CI / SCI pipes and fittings shall be a spigot and socket type.

g. G.I. pipe spouts shall be paid as per item of G.I. pipes (internal work). Cutting and making good is included. The free ends may be skew-cut.

h. Wherever use of G.I. pipes is called for the same shall be medium class (class – B)

2) <u>Materials :</u>

2.1 The materials shall conform to the specifications and in absence thereof to Indian Standards. The products should bear the ISI Mark.

2.2 The makes of materials for use in this work are broadly approved as per list given below. The Contractor shall, however, get particular makes and samples approved before ordering:

2.3 Notwithstanding any interim or final approval the Contractor remains responsible for satisfactory performance of all fittings & fixtures. The liability of the Contractor is not limited by any approval of the make of materials.

2.4 The item rate of mirror includes extra packing piece of AC plain sheet, where required due to off set between plaster & glazed tiles surface.

3) <u>Testing</u>

1) The sand cast iron soil, waste and vent pipes and fittings including joints shall be tested by pumping smoke into the pipe at the lowest end.

2) All G.I pipes and fittings including joints shall be tested to hydraulic pressure of 6 kg / cm2 (60 meters) avoiding water hammer. The test pump having been stopped the test pressure should maintain without loss for at least half an hour. The pipes and fittings shall be tested in

sections as the work of laying proceeds keeping the joints exposed for inspection during the testing.

3) All stone ware pipes shall be tested with water pressure of 1.5m head of water at the highest point of the section under test.

SAFETY CODE

1. First aid appliances including adequate supply of sterilized dressing and cotton wool shall be kept in a readily accessible place.
2. An injured person shall be taken to a public hospital without loss of time, in cases where the injury necessitates hospitalization.
3. Suitable and strong scaffolds should be provided for workmen for all works that cannot safely be done from the ground.
4. No portable single ladder shall be over 8 meters in length. The width between the side rails shall not be less than 30 cm (Clear) and the distance between two adjacent rungs shall not be more than 30 cm. When a ladder is used an extra mazdoor shall be engaged for holding ladder.
5. Every opening in the floor of a building or in a working platform be provided with suitable means to prevent to fall of persons or materials by providing suitable fencing or railing whose minimum height shall be one meter.
6. No floor, roof or other part of the structure shall be so overloaded with debris or materials as to render it unsafe.
7. Workers employed on mixing and handling material such as asphalt, cement mortar or concrete and lime mortar shall be provided with protective footwear and rubber hand-gloves.
8. Those engaged in welding works shall be provided with welder's protective eye-shields and gloves.
9. I) No paint containing leads or lead products shall be used except in the form of paste or readymade paint.

   ii) The workers should supply suitable facemasks for use when the paint is applied in the form of spray or surface having lead paint dry rubbed and scrapped.
10. Overalls shall be supplied by the contractor to the painters and adequate facilities shall be provided to enable the working painters to wash during the periods of cessation of work.
11. Hoisting machines and tackle used in the works, including their attachments, anchorage and supports shall be in perfect condition.
12. The ropes used in hoisting or lowering material or as a means of suspension shall be of durable quality and adequate strength and free from defects.

PROFORMA FOR RUNNING ACCOUNT BILLS

C E R T I F I C A T E

The measurements on the basis of which the above entries for the Running Bill_____

were made have been taken jointly on _____ and are recorded at pages _____of

Measurement BookNo._____.

Date & Signature of Contractor.

Date & Signature of SBI's Representative

(Seal).

Date & Signature of Site Engineer

The work recorded in the above mentioned measurements has been done at the site satisfactorily as per tender drawings, conditions and specifications.

BANK's ENGINEER

RUNNING A/C BILL

Name of Contractor/Agency: _____

Name of Work: _____

Sr. No. of this Bill: _____

No. and Date of Previous Bill. _____

Reference to Agreement No. _____

Date of Written Order to Commence._____

Date of Completion as per Agreement._____

Sr. No.	Item description	Unit	Rate (Rs.)	As per Tender		upto Previous R/A Bill		upto Date (Gross)		Present Bill		Remarks
				Qty.	Amt. (Rs.)	Qty.	Amt. (Rs.)	Qty.	Amt. (Rs.)	Qty.	Amt. (Rs.)	
1.	2.	3.	4.	5.		6.		7.		8.		9.

Note: 1. If Part Rate is allowed for any Item, it should be Indicated with reasons for allowing such a Rate. Net value since Previous Bill.

2. If Adhoc Payment is made, it should be mentioned specifically.

Date & Signature of Contractor.

PERFORMA FOR APPLICATION BY CONTRACTOR FOR EXTENSION OF TIME

1. Name of the Contractor
2. Name of the Work as given in the Agreement
3. Agreement W O
4. Tender Amount
5. Date of Commencement of Work
6. Period allowed for Completion as per Agreement
7. Date of Completion as per Agreement
8. Period for which Extension of Time has been given

		Date	**Month**	**Year**
a)	1st Extension vide Bank's Letter No			
b)	2nd Extension vide Bank's Letter No			
c)	3rd Extension vide Bank's Letter No			

9. Reasons for which extensions have been previously given (Copies of the previous applications should be attached)

10. Period for which extension is applied for and the reasons thereof including hindrances, time for extra work assigned, if any etc.

Signature of Contractor & Seal

PERFORMA OF HINDERANCE REGISTER

Name of Work : Date of State of Work :

Name of Contractor : Period of Completion :

Agreement No : Date of Completion :

Sr No	Nature of Hindrance	Date of occurrence of Hindrance	Date of which Hindrance was removed	Period of Hindrance	Signature SE / PE	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**

SE = Site Engineer

PE = Project Engineer

ACCOUNT OF SECURED ADVANCE, IF ADMISSIBLE ON MATERIALS HELD AT SITE BY THE CONTRACTOR

No.	Item	Quantity	Unit	Amount	Remarks
1	2	3	4	5	6
Total Value of Materials at Site					
Secured Advance @……% of above Value					B

CERTIFIED (I) That the materials mentioned above have actually been brought by the contractor to the site of the work and no advance on any quantity of any of this item is outstanding on their security, (ii) that the materials are of imperishable nature and are all required by the contractor for use in the work in connection with the items for which rates of finished work have been agreed upon.

Dated Signature of
Site Engineer
preparing the Bill

Designation_____

Dated Signature of
Bank's Engineer

_____

Dated signature of Contractor

HVAC TECHNICALSPECIFICATION

Contents Page No

CHAPTER-1

(VARIABLE REFRIGERANT VOLUME (VRV / VRF) SYSTEMS)

I) Supply, Installation, Testing, Commissioning & Holding Performance Responsibility of the system as per duty conditions & capacity ratings

a) Type: Inverter type VRV / VRF systems (Heat pump).
b) Capacity & Duty: As per BOQ / Schedule of Quantities
c) Mandatory: Refer detailed specification & BOQ Requirements

II) Scope:

The scope of this section comprises the supply, erection testing and commissioning of Variable Refrigerant Volume/ flow System conforming to these specifications and in accordance with the requirements of Drawing and Schedule of Quantities.

III) Type:

Units shall be air cooled, variable refrigerant volume heat pump, consisting of one /multiple outdoor unit and single / multiple indoor units all connected in single refrigerant Piping circuit. Each indoor units shall be capable to cool/heat independently as per the requirement of the rooms. The systems will operate either on cooling or heating duty.

The indoor units on any circuit can be of different type and also controlled individually. Following type of indoor units (Depending upon the type specified in the drawings and the BOQ) shall be connected to the system:

- Ceiling mounted cassette type,
- Multi flow-standard Ceiling mounted cassette type,
- Multi flow-compact Ceiling mounted Low static, Duct type
- Ceiling mounted high static Duct type Ceiling suspended,
- Exposed type High Wall mounted type

IV) OUTDOOR UNIT:

The outdoor unit shall be factory assembled, weather proof casing, constructed from heavy gauge galvanized steel panels and powder coated. The unit should be completely factory wired tested with all necessary controls.

All outdoor units shall have hermetically sealed scroll/twin rotary compressors, DC inverter driven, and shall be able to operate even in case one of compressor is out of order.

Outdoor unit should also be provided with duty cycling and starting sequence changing facility for multiple inverter compressor and multiple outdoor units working in one system.

The outdoor unit shall be modular in design and should be allowed for side by side installation the unit shall be provided with its own microprocessor control panel with provision for integration with Building management system using BACNET/MODBUS-Protocol.

The outdoor units should have anti-corrosion paint free steel plate for easy mounting of unit. The outdoor unit should be fitted with low noise, aero spiral design fan with grill for spiral discharge airflow to reduce pressure loss and should be fitted with DC fan motor to better efficiency. The unit should also be capable to deliver 55 Pa external static pressure to meet long exhaust duct connection requirement.

All outdoor units must be equipped with night time quite operation feature. The condensing unit shall be designed to operate safely when connected to multiple fan coil units.

The Noise level shall not be more than 65 dbA at anechoic chamber, measured horizontally 1m away and 1.5m above ground level.

The outdoor units shall be suitable for three phase, 415 V, 50c/s AC Supply. Each outdoor units shall be provided with suitable capacity MCB/MCCB in water proof enclosure. All power & control wiring between multiple outdoor unit connected to a single circuit with adequate rating MCB/MCCB shall be done by HVAC contractor.

a) **Compressor :**

The compressor shall be highly efficient scroll / twin rotary type and capable of all inverter control & capable of working on 415+/- 10% volts. It shall change the speed in accordance to the variation in cooling /heating load requirement: All outdoor units shall have multiple steps of capacity control to meet load fluctuation and indoor unit individual control. All parts of compressor shall be sufficiently lubricated stock. For oil recovery, every compressor shall have oil separator for stable operation. Forced lubrication may also be employed for better oil management. Oil heater shall be provided in the compressor casing

b) **Heat Exchanger:**

The heat exchanger shall be constructed with copper tubes mechanically bonded to aluminum fins to form a cross fin coil. The aluminum fins shall be covered by anti-corrosion resin film. The unit should be with bye- pass heat exchanger type for good efficiency of condenser. The unit shall be provided with necessary number of direct driven low noise level propeller type fans arranged for vertical discharge. Each fan shall have a safety guard.

c) **Refrigerant :**

The refrigerant circuit shall include liquid & gas shut-off valves and a solenoid valves at condenser end. All necessary safety devices shall be provided to ensure the safely operation of the system.

d) **Safety Devices :**

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

Following safety devices shall be part of outdoor unit; high pressure switch, fuse, fan drive overload protector, fusible plug, over load relay, overload protection for inverter Anti-corrosion treatment
Outdoor units should be designed with anti-corrosion specifications as detailed below for use in area, which are subject to salt damage and atmospheric pollution

The portions of machines like side panel, outer panel, bottom frame, which are exposed to corrosive atmosphere, should be of alloyed hot-dip zinc coated steel plate, coated with corrosion protection powder polyester resin coating on both inner and outer surfaces in thickness of 64micron or more. Finned coil protection net should have coating of resin coating containing ultraviolet ray absorbent. Fan and its fan protective net should be with weather resistant polypropylene resin.

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

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

When running power and control wires parallel to each other, either run them in separate conduits or maintain a suitable distance between them.

All control wiring shall be two core, shielded wire (outdoor to outdoor, indoor to indoor,

outdoor to indoor) to prevent noise.

e) **Oil Recovery System:**

Unit shall be equipped with an oil recovery system to ensure stable operation with long refrigeration piping lengths.

V) **INDOOR UNIT:**

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

While all indoor units shall be suitable for single phase, 220 V,50 c/s AC supply, or as mentioned in BOQ, all outdoor units shall be suitable for three phase, 415 V, 50 c/s Ac supply.

Indoor units shall be either ceiling mounted cassette type, or ceiling mounted ductable type or floor standing type or wall mounted type or other as specified in BOQ. Each unit shall have electronic expansion valve to control refrigerant flow rate respond to load variations of the room. The address of the indoor unit shall be set automatically in case of individual and group control. In case of centralized control, it shall be set by liquid crystal remote controller. The fan shall be dual suction, aerodynamically designed turbo, multi blade type, statically & dynamically balanced to ensure low noise and vibration free operation of the system. The fan shall be direct driven type, mounted directly on motor shaft having supported from housing. The cooling coil

shall be made out of seamless copper tubes and have continuous aluminum fins. The fins shall be spaced by collars forming an integral part. The tubes shall be staggered in the direction of airflow. The tubes shall be hydraulically/mechanically expanded for minimum thermal contact resistance with fins. Each coils shall be factory tested at 21kg/sqm air pressure under water. Unit shall have cleanable type filter fixed to an integrally moulded plastic frame. The filter shall be slide away type and neatly inserted. Each indoor unit shall have computerized PID control for maintaining design room temperature. Each unit shall be provided with microprocessor thermostat for cooling or cooling and heating. Each unit shall be cable of being controlled by wired/LCD type remote controller. The remote controller shall memorize the latest malfunction code for easy maintenance

The controller shall have self-diagnostic features for easy and quick maintenance and service. The controller shall be able to change fan speed and angle of swing flap individually as per requirement.

a) **Ceiling Mounted cassette type:**

The unit shall be ceiling mounted type. The unit shall include pre-filter, fan section. The Cassette Type housing of the unit shall be powder coated galvanized steel. The body shall be light in Unit weight shall be able to suspend from four corners. The fan shall be aerodynamically (MULTI FLOW TYPE) designed diffuser turbo fan type. Unit shall have an external attractive panel for supply and return air. Unit shall have four-way supply air grilles on sides and return air grille in center.

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

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

b) **Ceiling Mounted ductable type:**

Unit shall be suitable for ceiling mounted type. The unit shall include pre-filter, fan Ductable section & DX coil section. The housing of unit shall be light weight powder coated galvanized steel. Type Unit The unit shall have high static fan for Ductable arrangement.

c) **High Wall mounted type:**

The units shall be wall-mounted type. The unit includes pre filter, fan section & DX coil Mounted unit section. The housing of unit shall be light weight powder coated galvanized steel. Unit shall have an attractive external casing for supply and return air.

d) **Refrigerant Piping:**

All refrigerant piping for the air conditioning system shall be Constructed from soft seamless up to 19.1mm and hard drawn copper refrigerant pipes for above 19.1 mm with copper fittings and copper-soldered for copper joints & silver -soldered for copper to other material joints. The refrigerant piping arrangements shall be in accordance with good practice within the air-conditioning industry, and are to include charging connections, suction line insulation and all other items normally forming part of proper refrigerant circuits. Refrigerant pipe fitting while include Y/Refnet joints and headers as per OEM design for correct distribution of refrigerant.

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

After the refrigerant piping installation has been completed, the refrigerant piping system shall be pressure tested using nitrogen at pressure of low side. Pressure shall be maintained

in the system for 24 hours. The system shall then be evacuated to minimum vacuum if 700mm hg and held for 24 hours.

The air-conditioning system supplier shall design pipe sizes and erect proper interconnections of the complete refrigerant circuit.

The thickness of copper piping shall not be less than mentioned below:

Pipe Size in mm (OD)	Wall Thickness in mm
54.1	1.5
41.3	1.3
34.9	1.3
28.6	1.2
25.4	1.2
22.2	1.0
19.1	1.0
15.9	1.0
12.7	0.8
9.5	0.8
6.4	0.8

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

VI) PIPE INSULATION

a) Refrigerant Pipe :

Entire liquid and suction refrigerant lines including all fittings, valves and strainer bodies, etc. shall be insulated with 19mm /13 mm thick elastomeric, class O, nitrile rubber as specified in BOQ. For outdoor duty, if exposed to sun, to protect from degradation from UV rays, the insulation shall be covered with 7 miles thick glass cloth & two coats of UV coating/26G almunium sheet clading of approved shade & colour.

b) Drain Pipe :

Drain pipes carrying condensate water shall be insulated with 6 mm thick Elastomeric insulation nitrile. For proper drainage of condensate, U Trap shall be provided in the drain piping (wherever required). All pipe supports shall be of pre fabricated & pre painted slotted angle supports, properly installed with clamps etc.

B) SPLIT HI-WALL/DUCTABLE UNITS

Air cooled split units shall be as per approved make, energy efficient **INVERTER TYPE** hermitically or semi hermitically rotary/scroll compressor complete with vibration isolators & factory installed controls (like HP & LP cut outs, inter locking Fan & Compressor, Thermostat with selector switch etc.) & accessories including wiring. Efficient cooling coil shall be selected for low velocity with 3/8"/1/2" OD copper tubing having extended aluminium fins. Hydraulic expansion of tubes assures tight bonding between tubes & fins for high heat transfer. Tubes shall be arranged in a staggered design for best air contact thus giving low bypass. The cooling coil circuits are fed with liquid refrigerant through the

thermostatic expansion valve and a distributor. Blower of an evaporating unit shall be statically and dynamically balanced and shall be selected to give required airflow as identified in the drawings. Filters shall be minimum 25mm thick synthetic type or equivalent wire aluminium frame. Drain pan shall be of 18 gauge insulated with expanded polyethylene sheet. Casing shall be heavy gage factory painted to provide better protection against rusting.

Remote air cooled condensing unit shall have to be most efficient condenser coils made out of copper tubing with extended aluminium fins. Tubes shall be arranged in a staggered design for better efficiency. Condenser fans shall be selected to operate quietly for required CFM to keep condensing temperature low. The compressor may be in the indoor unit or with the outdoor unit, but, it should be capable of operating continuously even at high ambient of 46 deg C (115 deg F). The condensing unit shall be installed with steal base frame, along with cushy foot mounting vibration isolation pads.

Interconnected refrigerant piping between outdoor unit & indoor unit shall be of heavy gauge copper complete with thermostatic expansion valve, liquid line strainer, drier, shut off valves, high & low pressure gauges including insulated suction line. 25mm thick neoprene rubber pads shall be supplied for each indoor/outdoor units. The units shall be tested in accordance with IS:1391.

i **HIGH WALL MOUNTED UNITS**

The units shall be wall-mounted type. The units includes pre-filter, fan section and DX coil section. The housing of units shall be light weight powder coated galvanized steel. Units shall have an attractive external casing for supply and return air.

ii **INSTALLATION**

The units shall be mounted on ribbed rubber pads for vibration isolation. The contractor shall supply the required charge of refrigerant, lubricant and other consumables, for commissioning and testing of the equipment.

All the equipment shall be thoroughly tested and checked for leaks. All safety controls shall be suitably set and a record of all setting shall be furnished to the project supervisor.

iii TESTING

Unit capacity in tons Refrigeration, shall be computed from the temperature readings and air-flow measurements. Flow measurements shall be preferably by a hot-wire anemometer or a velometer. Computed results shall conform to the specified capacities and the power consumption shall conform to the figures furnished by the manufacturer.

iv PAINTING

Shop coats of paint that have become marred during transportation or erection shall be cleaned off with mineral spirits, wire brushed and spot primed over the affected areas, then coated with enamel paint to match the finish over the adjoining shop- painted surfaces.

v CONDENSATE DRAIN PIPING

All pipes to be used for cold water (makeup), drain, and condensate drain shall be PVC pipe 16 Kg/m^2 conforming to IS: 4985 - Class I & all joints should be Gluing or solvent cementing as per manufacturer recommendation.

vi REFRIGERANT PIPING

a. All refrigerant pipes and fittings shall be type `L' hard drawn copper tubes and wrought copper fitting suitable for connection with silver solder phos copper.

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

c. Refrigerant lines shall be sized to limit pressure drop between evaporator and condensing unit to lessthan 0.2 kg per Sq.cm.

d. Removable type combination drier and filter shall be installed in liquid line of the refrigeration system incorporating a three way valve bypass. After ninety days of operation, liquid line drier and filter cartridges must be replaced.

e. After the refrigerant piping installation has been completed the refrigerant piping system shall be pressure tested using, Freon mixed with nitrogen/carbon dioxide at a pressure of 20 Kg per Sq. cm. (High side) and 10 Kg per Sq. cm (Low side) pressure shall be maintained on the system for a minimum of 12 hours. The system shall then be evacuated to a minimum vacuum of 70 cm. of mercury and held for 24 hours, during which time, change in vacuum shall not exceed 12 cm of mercury. Vacuum shall be checked with vacuum gage.

f. All refrigerant piping shall be installed strictly as per the instructions and recommendations of air conditioning equipment manufacturers.

vi TESTING & BALANCING

a. All piping shall be tested to hydrostatic test pressure of at least two and half times the maximum operating pressure, but not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified and gotten approved at site.

b. Piping repaired subsequent to the above pressure test shall be retested in the same manner.

c. System may be tested in sections and such sections shall be securely capped, then retested for entire system.

d. The contractor shall give sufficient notice to all other agencies at site, of his intention to test a section or sections of piping and all testing shall be witnessed and recorded by Owner's site representative.

e. The contractor shall make sure that proper noiseless circulation of fluid is achieved through all coils and other heat exchange equipment in the system concerned. If proper circulation is not achieved the contractor shall rectify the defective connection. He shall bear all expenses for carrying out the above rectifications, including the tearing up and refinishing of floors and walls as required.

f. The contractor shall provide all materials, tools, equipment, instruments, services and labour required to perform the test.

g. Complete certified report shall be submitted for evaluation and approval. Upon approval, four copies of the balancing report shall be submitted with complete drawings and documents.

CHAPTER- 2

FACTORY BUILT AIR HANDLING UNIT (AHU), FAN COIL UNIT (FCU) AND OTHER AIR DISTRIBUTION SYSTEMS

SCOPE

This chapter covers the detailed requirements of factory built double skin air handling unit (AHU), single skin fan coil unit (FCU) and other air distribution systems like chilled beam, floor radiant cooling, and variable air volume systems for central air-conditioning system as well as for central heating systems.

FACTORY BUILT AIR HANDLING UNIT (AHU)Type

The air handling unit shall be of double skin construction, draw through type in sectionalized construction consisting of blower section, coil section, humidification section (where specified), filter section and insulated drain pan. Unless otherwise specified, the unit shall be horizontal type.
Vertical type units are generally used whenever there is a space constraint.

The use of Ceiling Suspended AHUs should be discouraged due to maintenance problems.

Rating

i) The capacity of the cooling/heating coil, the air quantity from the blower fan and static pressure of blower fan shall be as laid down in the tender documents. Where these parameters as calculated by the tenderer exceed the specified values, the coils and the blower fan shall satisfy these calculated values.

ii) The coil shall be designed for a face velocity of air not exceeding 155 m/min.

iii) The requisite static pressure demanded by the air circuit shall be developed by the fan at the selected operating speed. The static pressure value shall not in any case be less than 40 mm water gauge in normal cases, not less than 65 mm water gauge where microvee filters are also used and not less than 100 mm water gauge where absolute filters are also used. The fan motor HP shall be suitable to satisfy these requirements and the drive losses.

iv) The air outlet velocity from the blower fan shall not exceed 610m/min.

v) Noise level at a distance of 2M from AHU shall not exceed 75dBA.

Material and Construction

Housing/ Casing

i) The housing/ casing of the air handling unit shall be of double skin construction. The housing shall be so made that it can be delivered at site in total/ semi knocked down conditions depending upon the requirements. The main framework shall be of extruded aluminium hollow structural sections. The entire framework shall be assembled using mechanical joints to make a sturdy and strong framework for various sections. For 100% fresh air application framework shall be made of thermal break hollow extruded aluminium profile.

ii) Double skin panels shall be 25mm thick, made of 0.8mm pre- plasticized and pre-painted with PVC guard, GSS sheet on outside and 0.8mm galvanized sheet inside with Polyurethane foam insulation of density not less than 38 kg/cu. m injected in

between by injection moulding machine. These panels shall be bolted from inside/ screwed from outside on to the framework with soft rubber gasket in between to make the joints airtight. The gaskets shall be inserted within groove in extruded aluminium profile of the framework. For units installed outdoor, the thickness of double skin panels shall be minimum 40mm.

iii) Frame work for each section shall also be bolted together with soft rubber gasket in between to make the joints air tight. Suitable doors with nylon handles, aluminium die-cast powder coated hinges & latches shall be provided for access to various panels for maintenance. However, AHU in the form of complete single unit shall also be acceptable with access door(s) for maintenance to various sections. The entire housing shall be mounted on galvanized steel channel frame work made out of G.I. sheet of thickness not less than 2mm. For higher capacity AHUs hot dip galvanized steel channel framework made of minimum 3 mm thick G.S. sheet shall be used.

Drain Pan

Drain pan shall be made out of minimum 1.25 mm **stainless steel** sheet externally insulated with 10mm thick closed cell Polyethylene foam insulation **or nitrile rubber or PUF** with necessary dual slope to facilitate fast removal of condensate. Necessary supports will be provided to slide the coil in the drain pan.

Cooling / Heating coil

iv) The coil shall be made from seamless solid drawn copper tubes. The minimum thickness of tube shall be 0.5 mm for cooling / heating / heating-cum-cooling coils.

v) The depth of the coil shall be such as to suit the requirements, viz. re-circulated air applications, or 100 % fresh air applications and the bypass factor required shall be specified in the tender specifications. The coil shall be 4 or 6 rows deep for normal re- circulated air application and 8 rows deep for all outdoor air application, unless otherwise specified in the tender specifications. In case of 8 rows deep coils, it shall be made of 2x4 rows deep coils with a spacing of 200mm between the two coils, access door and independent drain pan.

vi) U bends shall be of copper, jointed to the tubes by brazing, soft soldering shall not be used.

6.2.4

i) Each section of the coil shall be fitted with flow and return headers to feed all the passes of the coil properly. The headers shall be of copper and shall be complete with water in/out connections, vent plug on top and drain at the bottom. The coil shall be designed to provide water velocity between 0.6 to 1.8 m/s in the tubes.

ii) The fins shall be of aluminium. The minimum thickness of the fins shall be 0.15 mm nominal. The no. of fins shall not be less than 4.7 per cm length of coil. Fins may be of either spiral or plate type. The tubes shall be mechanically expanded to ensure proper thermal contact between fins and tubes. The fins shall be evenly spaced and upright. The fins bent during installation shall be carefully realigned. For coastal areas fins shall be phenolic coated and for 100% F.A. application fins shall be hydrophilic type.

iii) The coil shall be suitable for use with the refrigerant specified or with water

as the case may be. Refrigerating coils shall be designed for the maximum working pressure under the operating conditions. Water coils shall be designed for a maximum working pressure of 10 kg./sq.cm.

iv) Shut off and regulating valves at the inlet and outlet of water shall be provided. In the case of DX coils, solenoid valve and expansion valves shall be provided at the inlet of coil.

Supply Air Fan and Drive

v) The supply air fan shall be AMCA certified centrifugal type with forward/ backward curved blades double inlet double width type. For static pressure up to 65mm forward curved blades shall be used and for higher sizes backward curved blades shall be used.

vi) The fan housing of Galvanized sheet steel and the impellers shall be fabricated from heavy gauge steel sheet as per approved manufacturer's standard. The side plates shall be die formed for efficient, smooth airflow and minimum losses. Fan impeller shall be mounted on solid shaft supported to housing using heavy duty ball bearings. Fan housing and motor shall be mounted on a common extruded aluminium base mounted inside the fan section on anti- vibration spring mounts or cushy- foot mount. The fan outlet shall be connected to casing with the help of fire retardant fabric.

vii) The fan impeller assembly shall be statically and dynamically balanced.

viii) The fan shall be fitted with vee belt drive arrangement consisting of not less than two evenly matched belts. Belts shall be of oil resistant type. Adequate adjustments shall be provided to facilitate belt installation and subsequent belt tensioning by movement of the motor on the slide rails. A readily removable door guard shall be provided.

ix) The fan motor shall be totally enclosed fan cooled squirrel cage induction motor with IP-54 protection & selected for quiet running. The motor shall be suitable for operation on 415$\pm$10%V,3phase,50Hz.,A.C. supply. The fan motor shall be premium efficiency IE3 class, as per IS 12615. The motor shall be suitably designed for use with variable frequency drive. Motor starter shall be as per electrical chapter

vi) All AHU fan motors shall be provided with variable frequency drive where VAVs (Variable Air Volume control) are provided in the ducts.

vii) For energy efficiency of system, where VAVs (Variable Air Volume control) are provided in the ducts, VFD, in place of starter shall be provided in Air Handling Units. VFD with harmonics filters should be specified. Whenever VFD is fitted, direct shaft driven motors are normally used.

Air Filters

The air used in an air-conditioning system must be filtered to maintain a clean atmosphere in the conditioned space. The concentration of contaminants in the air and the degree of cleanliness required in the conditioned space will determine the type of filter or filters that must be used.

i) Pre-filters:

Cleanable metallic viscous type filter made out of aluminium wire mesh or of dry cleanable synthetic type minimum 50mm thick, shall be provided on the suction side of AHU as a standard equipment with the unit. These filters shall have the efficiency of 90% down to 10 micron particle size. When these filters become loaded or full of dirt, it is removed from service and replaced by another filter. The dirty filter can then be washed in a cleaning solution in a tank, dried and then given a bath of viscous oil. Face velocity across these filters shall not exceed 155 MPM.

General Construction of filters

i) Each AHU shall be provided with a factory assembled filter section containing pre-filters made of cleanable metal viscous filters made of corrugated aluminium wire mesh, or dry cleanable synthetic filters. These shall be minimum 50 mm thick with a frame work of aluminium.

ii) The filter area shall be made up of panels of size convenient for handling. The filter panels shall be held snugly within suitable aluminium framework made out of minimum 1.6 mm aluminium sheet with sponge neoprene gaskets by sliding the panels between the sliding channels so as to avoid air leakage.

iii) Each filter shall carry test certificate from manufacturer.

Instruments and Valves

The following instruments shall be provided at the specified locations in the AHUs for the chilled water / hot water system: -

i) Pressure gauges at the inlet and outlet of the coil with tubing and gauge cock.
ii) Stem type thermometers at the inlet & outlet of coil with tubing & gauge cock.
iii) Butterfly valve at the inlet and outlet ofcoil.
iv) Balancing valve at the outlet of coil.
v) Y-strainer at the inlet of coil.
vi) Motorized -way diverting/ mixing valve along with proportionate thermostat.

Controls

These shall be as per details given under chapter 12 `Controls'.

Installation

The air handling unit shall be so installed as to transmit minimum amount of vibration to the building structure. Adequate vibration isolation shall be provided by use of rubber/ neoprene pads and/or vibration isolation spring mountings.

FAN COIL UNITS

General

The fan coil units shall be floor/ wall/ ceiling mounted draw through type complete with finned coil, fan with motor, insulated drain pan, cleanable air filters and fan speed regulator and other controls as described.

Casing

The casing shall be fabricated out of minimum 1.25mm thick G.S.S. sheet.

Cooling coil

The coil shall be of seamless copper tubes with aluminium fins. The fins shall be

uniformly bonded to the tubes by mechanical expansion of the tubes. The coil circuit should be sized for adequate water velocity but not exceeding 1.8 m/s. The air velocity across the coil shall not exceed 155 m/min.

Fan

This shall consist of two light weight aluminium impellers of forward curved type, both statically and dynamically balanced, along with properly designed GI sheet casings.

The two impellers shall be directly mounted on to a double shaft, single phase multiple winding motor capable of running at three speeds.

Drain Pan

Drain pan shall be fabricated out of minimum 1.00 mm thick stainless steel sheet covering the whole of coil section and extended on one side for accommodating coil connection valve etc. and complete with a 25mm drain connection. The drain pan shall be insulated with 10mm thick closed cell polyethylene foam insulation and jacketed from outside with single piece molded FRP tray.

Air Filter

The filter shall be cleanable type 15mm thick with 90% efficiency down to 10 micron of dry cleanable synthetic type to be mounted behind the return air grill in the unit casing.

Speed control

A sturdy switch shall be provided with the unit complete with wiring, for ON/OFF operation and with minimum three speed control of the fan.

Automatic controls

Each unit shall have a room type thermostat and a solenoid valve. The valve shall be fixed at a convenient location. The thermostat shall be mounted along with the speed control switch on a common plate. The plate shall clearly indicate the fan positions.

The water valves on inlet line shall be of gun metal ball type with internal water strainers, having BSP female pipe thread inlet and flare type male pipe thread outlet connection. The valves on return line shall be as above, but without the water strainer.

Water Connections

The water lines shall be finally connected to the coil of the fan coil unit, by at least 300mm long, type `L` seamless solid drawn copper tubing, with flare fittings and connections.

INSULATION

The drain pan shall be insulated as per insulation specification.

PAINTING

All equipment shall be supplied as per manufacturer`s standard finish painting.

VARIABLE AIR VOLUME SYSTEM

The Variable air volume system uses Variable speed drives for fan volume control providing a great deal of flexibility for multiple zones in temperature control and efficiency, good control of ventilation air quantities, and opportunity for higher

levels of filtration.

VAV Diffusers

The modules shall vary the supply air volume to provide both VAV heating and VAV cooling in individual rooms controlled through a room temperature sensing thermostat in each room. It shall sense room temperature and vary the supply air when cooling.

CHAPTER-3 DUCTINGS

SCOPE

This chapter covers the general requirements for sheet metal ductwork for air distribution with associated items such as air outlets and inlets, fresh air intake and fire dampers.

MATERIAL

Ducts

i) All ducts shall be fabricated either from Galvanised Sheet Steel (GSS) conforming to IS: 277 or aluminium sheets conforming to IS:737. The steel sheets shall be hot dip galvanized with MAT finish with coating of minimum 120 grams per square meter (GSM) of Zinc, GI sheets shall be lead free, eco friendly and RoHS compliant

ii) The thickness of sheets for fabrication of rectangular ductwork shall be as under. The thickness required corresponding to the longest side of the rectangular section shall be applicable for all the four sides of the ductwork.

Longest side (mm)	Minimum sheet thickness	
	For GSS	For Aluminum
750 mm and below	0.63	0.80
751 mm to 1500 mm	0.80	1.00
1501 mm to 2250 mm	1.00	1.50
2251 mm & above	1.25	1.80

(iii) Thickness of sheet for RoundDucts

Diameter of duct, mm	**Thickness of Sheet, mm**	
	GI sheets	Aluminum Sheets
150 to 500	0.63	0.80
501 to 750	0.80	0.80
751 to 1000	0.80	1.00
1001 to 1250	1.00	1.50
1251 and above	1.25	1.80

iii) All sheet metal connections, partitions and plenums required for flow of air through the filters, fans etc. shall be at-least 1.25mm thick.galvanized steel sheets, in case of G.I. sheet ducting or 1.8 mm thick aluminium sheet, in case of aluminium sheet ducting and shall be stiffened with 25 mm x 25 mm x 3 mm angle iron braces.

iv) Circular ducts, where provided shall be of thickness as specified in IS: 655 as amended upto date.

v) Aluminium ducting shall normally be used for clean room applications, hospitals works and wherever high cleanliness standards are functional requirements.

Associated Items

i) Supply/ return air outlets, F.A. grilles and accessories shall be constructed from extruded aluminium sections.

ii) Flanges for matching duct sections, stiffening angles (braces) and supporting angles shall be of rolled steel sections, and shall be of the following sizes.

Application	**Duct Width**	**Angle size**
Flanges	Upto 1000 mm	35 mm x 35 mm x 3 mm
-do-	1001 mm to 2250 mm	40 mm x 40 mm x 3 mm
-do-	More than 2250 mm	50 mm x 50 mm x 3 mm
Bracings	Upto 1000 mm	25 mm x 25 mm x 3 mm
-do-	More than 1000 mm	40 mm x 40 mm x 3 mm
Support angles	Upto 1000 mm	40 mm x 40 mm x 3 mm
-do-	1001 mm to 2250 mm	40 mm x 40 mm x 3 mm
-do-	More than 2250 mm	Size and type of RS section shall be decided in individual cases

iii) Hanger rods shall be of mild steel and of at least 10 mm dia for ducts upto 2250 mm size, and 12 mm dia for larger sizes.

iv) All nuts, bolts and washers shall be zinc plated steel. All rivets shall be galvanized or shall be made of magnesium - aluminium alloy. Self tapping screws shall not be used.

CONSTRUCTION

Ducts

i) Ducts shall be fabricated at site or factory fabricated and shall be generally as per IS: 655 "Specifications for metal air ducts", unless otherwise deviated in these General Specifications.

ii) The interior surfaces of the ducting shall be smooth.

iii)All the ducts upto 600 mm longest side shall be cross broken between flanges by a single continuous breaking. Ducts of size 600 mm and above shall be cross broken by single continuous breaking between flanges and bracings. Alternatively, beading at 300 mm centres for ducts upto 600 mm longest side, and 300 mm centres for ducts above 600 mm size shall be provided for stiffening.

iv) As far as possible, long radius elbows and gradual changes in shape shall be used to maintain uniform velocity accompanied by decreased turbulence, lower resistance and minimum noise. The ratio of the size of the duct to the radius of the elbow shall be normally not less than 1:1.5.

v) Flanged joints shall be used at intervals not exceeding 2500 mm. Flanges shall be welded at corners first and then riveted to the duct.

vi) Stiffening angles shall be fixed to the sides of the ducts by riveting at 1.25 meters from joints for ducts of size 600 mm to 1500 mm, and 0.6 mm from joints for ducts of size larger than 1500 mm. Bracings for ducts larger than 1500 mm

can alternatively be by diagonal angles.

vii) Plenums for filters shall be complete with suitable access door of size 450 mm x 450mm.

viii) All factory fabricated duct shall be supplied in L sections, the length of any piece shall not be more than 1800 mm for duct with longest side of cross section as 600 mm and above and 3000 mm for rest.

Air Outlet and Inlets (Supply and Return)

i) All air outlets and intakes shall be made of extruded aluminium sections & shall present a neat appearance and shall be rigid with mechanical joints.

ii) Square and rectangular wall outlets shall have a flanged frame with the outside edges returned or curved 5 to 7 mm and fitted with a suitable flexible gasket between the concealed face of the flanges and the finished wall face. The core of supply air register shall have adjustable front louvers parallel to the longer side to give upto 22.5 degrees vertical deflection and adjustable back louvers parallel to the shorter side to achieve a horizontal spread air pattern to at least 45 degrees. Return air grilles shall have only front louvers. The outer framework of the grilles shall be made of not less than 1.6 mm thick aluminium sheet. The louvers shall be of aerofoil design of extruded aluminium section with minimum thickness of 0.8mm at front and shall be made of 0.8mm thick aluminium sheet. Louvers may be spaced 18 mm apart.

iii) Square and rectangular ceiling outlets/intakes shall have a flange flush with the ceiling into which it is fitted or shall be of anti smudge type. The outlets shall comprise an outer shell with duct collar and removable diffusing assembly. These shall be suitable for discharge in one or more directions as required. The outer shell shall not be less than 1.6 mm thick extruded section aluminium sheet. The diffuser assembly shall not be less than 0.80 mm thick extruded aluminium section.

iv) Circular ceiling outlets/intakes shall have either flush or anti smudge outer cone as specified in the tender specifications. Flush outer cones shall have the lower edge of the cone not more than 5 mm below the underside of the finished ceiling into which it is fitted. Anti smudge cones shall have the outer cone profile designed to reduce dirt deposit on the ceiling adjacent to the air outlet. The metal sheet used for construction of these shall be minimum 1.6 mm thick extruded aluminium sheet.

v) Linear diffusers shall have a flanged frame with the outside edges returned 3.5 mm and shall have one to four slots as required. The air quantity through each slot shall be adjustable. The metal sheet used for the construction of these shall be minimum 1.6 mm thick extruded aluminium sheet.

vi) Grilles and diffusers constructed of extruded aluminium sections shall have grille bars set straight, or deflected as required. These shall be assembled by mechanical interlocking of components to prevent distortion. These grilles and diffusers shall have a rear set of adjustable blades, perpendicular to the face blades for deflection purposes.

vii) All supply air outlets shall be fitted with a volume control device, made of extruded aluminium gate section. The blades of the device shall be mill finish/ block shade pivoted on nylon brushes to avoid rusting & rattling noise, which shall be located immediately behind the outlet and shall be fully adjustable from within the occupied space without removing any access panel. The volume control device for circular outlets shall be opposed blade radial/shutter type dampers, or two or more butterfly dampers in

conjunction with equalizing grid. Opposed blade dampers shall be used for square and rectangular ceiling/wall outlets and intakes.

viii) All the products supplied by contractor should supplement in performance by selection curves of product ratings from the manufacturer.

ix) Laminar supply air diffusers shall be made of 2mm thick powder coated aluminium sheet duly insulated with 5mm thick closed cell polyethylene foam insulation having factory laminated aluminium foil and joints covered with self adhesive aluminium tape and having holes 2/3 mm dia including framework.

Fresh Air Intakes

i) Fresh air intake grills shall be made of extruded aluminium sections.

ii) A flanged frame using RS sections shall be provided on front face to conceal the gap between the louvers and the adjoining wall face. Corners of frame shall be welded. The frame shall be made structurally rigid.

iii) Louvers made from extruded aluminium section shall be in modular panel form for ease of handling. These shall be free from waves and buckles. Vertical blades shall be truly vertical and horizontal blades shall be truly horizontal. Butt joints in blades shall not beaccepted.

iv) Additional intermediate equally spaced supports and stiffeners shall be provided to prevent sagging/ vibrating of the louvers, at not more than 750mm centres where the louver's length is longer than750mm.

v) A bird wire screen made of 12 mm mesh in 1.6 mm steel wire held in angle or channel frame shall be fixed to the rear face of the louver frame by screens.

FIREDAMPERS

i) Fire dampers shall be provided in all the supply air ducts and return air ducts (where provided), return air passage in the air-handling unit room and at all floor crossings. Access door will be provided in the duct before each set of fire dampers.

ii) Fire dampers shall be multi blade louvers type. The blade should remain in the air stream in open position & shall allow maximum free area to reduce pressure drop & noise in the air passage. The blades and frame shall be constructed with minimum 1.6mm thick galvanized sheet & shall be factory fitted in a sleeve made out of 1.6mm galvanized sheet of minimum 400mm long. It shall be complete with locking device, motorized actuator & control panel.

iii) Fire dampers shall be motorized smoke & fire dampers type. It shall be supplied with spring loaded UL stamped fusible link to close fire damper in the event of rise in duct temperature. Fire damper shall also close on receipt of fire alarm signal to cut off air supply instantaneously. An electric limit switch shall also be operated by the closing of fire damper, which in turn shall switch off power supply to AHU blower motor as well as strip heaters.

iv) Fire dampers shall be CBRI tested & certified for 90 minutes rating against collapse & flame penetration as per UL 555-1995.(Under writers laboratories)

v) Fire dampers shall be compatible with the fire detection system of building & shall be capable of operating automatically through an electric motor on receiving signal from fire alarm panel.

vi) Necessary wiring from fire alarm panel up to AHU electric panel shall be provided by the

department & further from AHU electric panel to fire damper shall be provided by air conditioning contractor.

VARIABLE AIR VOLUME (VAV) BOXES

i) These shall of the low velocity variable air volume boxes without re-heat coils, and shall be of open protocol as marketed by a firm specializing in this field. The contractor shall supply and install units to the quantity and locations as specified.

ii) The unit shall be complete with damper, airflow ring, and solid-state electronic controls to provide accurate room temperature control. The damper shall be aero foil type construction with bearings.

iii) Boxes shall be supplied with all internal attenuation treatment and acoustical damped casing necessary to achieve the required noise criteria. Casing shall be of 22G GSS minimum fitted with a completely sealed, easily removable means of access to all internal parts. Access to all boxes must be from the underside only.

iv) The actuator shall be of 24V AC Bi-directional, direct coupled to the damper shaft. The required transformer to step down of the voltage range from 230V to 24V shall be part of the unit. The power point with an isolator near the VAV will be provided by other agencies.

v) The unit shall be complete with transformer, access panel and other accessories as per the standard.

vi) The noise level shall be less than35dbA.

vii) Maximum allowable static pressure to the boxes for its satisfactory operation shall not exceed 0.10WG, otherwise fan and motor selections may be affected.

viii) Boxes shall be able to reset any air flow between 10% and the maximum air quantity that the boxes can handle without changing orifices or other parts. Air quantity limiters will not be accepted.

ix) A suitable device shall be provided for the field adjustment of minimum airflow. All boxes shall be initially factory set at minimum air quantity of 10% and maximum quantity of 110%of the design requirements.

x) Under shut-off conditions, all boxes shall not have air leakage more than 2% of the maximum air quantity at 75mm static pressure.

xi) The VAVs shall be used in standalone mode complete with its own temperature sensor and controller and shall perform the function of maintaining the temperature and airflow.

xii) Where ever specified, the VAVs shall be BMS compatible to enable to network the VAVs to a Network Control Unit and onto BMS. In this mode all VAV data shall be available at the BMS workstation and it shall be possible to change set points and flow settings from the BMS workstation. All such controllers used for the control of VAV boxes shall be compliant with BAC net/ MODBUS protocol and be freely communicable to third party BAC net/ MODBUS IP controllers.

xiii) All boxes shall be electrically controlled. The boxes shall be pressure independent.

xiv) VAV Box shall have provision to support from floor/ wall/ ceiling and in vertical/ horizontal condition.

ACOUSTIC LINING AND INSULATION

This shall be done as per details given in (Chapter 7).

FLEXIBLEDUCTING

Application

Flexible Duct is a round, flexible light weight duct and is preliminary used for

vi) Speedy completion of project

vii) Offers a high degree of flexibility, which allows it to be easily connected to any desired position.

viii) A quick and economical means of correcting misalignment between system components.

Allows ducting around obstacles where fabricated and fitted ducts would be difficult and costly to install.

Material

i) An un-insulated flexible duct shall be made of double lamination of metalized polyester film permanently bonded to a coated spring steel wire helix. Duct shall be in tear & puncture resistant construction.

ii) For insulated flexible duct where specified, inner core for the same should be made of double lamination of metalized polyester film permanently bonded to a coated spring steel wire helix. Fiberglass insulation of minimum 14 kg/cu.m density, 25 mm thickness shall be wrapped over the inner core & covered with strong outer jacket cum vapour barrier made of fibre glass reinforced metalized polyester film laminate.

iii) Care must be taken to install all the flexible duct in fully extended position & bends made with adequate radius as per manufacturer recommended practices.

INSTALLATION OF METALLIC DUCT

Ducting

i) The fabrication and installation shall be in a workmanlike manner. Duct work shall be rigid and straight without kinks.

ii) All exposed ducts within the conditioned space shall have slip joints. Flanged joints shall not be used.

iii) All joints shall be airtight.

iv) Ducts shall be supported independently from the building structure and adequately, to keep the ducts true to shape. The support spacing shall be not more than 2 m. where ducts cannot be suspended from ceiling, wall brackets or other suitable arrangements, as approved by the Engineer-in-charge shall be adopted. Neoprene or other vibration isolation packing of minimum 6 mm thickness shall be provided between the ducts and the angle iron supports/brackets. Vertical duct work shall be suitably supported at each floor by steel structural members.

v) Where metal ducts or sleeves terminate in woodwork, tight joints shall be made by means of closely fitting heavy flanged collars. Where ducts pass through brick or masonry openings, wooden frame work shall be provided within the openings and the crossing ducts shall be provided with heavy flanged collars on either side of the wooden frame work, so that duct crossing is made leak-proof.

vi) Duct connections to the air-handling unit shall be made by inserting a double canvas sleeve 100 mm long. The sleeve shall be securely bonded and bolted to the duct and unit casing.

vii) Dampers shall be provided in branch duct connections for proper volume control and balancing the air quantities in the system, whether indicated in the drawings or not. Suitable links, levers and quadrants shall be provided for proper operation, control and setting of the dampers. Every damper shall have an indicating device clearly showing the position of the dampers at all times.

viii) Where electrical heaters are mounted in the duct, these shall be of low temperature totally enclosed type fitted with radiation fins. A removable panel for access to the heaters shall be provided in the duct. Any hole in the duct for electrical wiring must be provided with suitable bushes to avoid leakage. 6 mm thick asbestos board lining shall be provided all around the inside of the duct for a distance of 30 cms. on either side of the electrical heaters. A manually reset thermostatic safety switch shall be provided near the

duct section having heaters. In addition, the heaters must be interlocked with the connected fan motor of the AHU.

Air Outlets and Inlets

i) The locations of the air outlets and intakes shall be shown in the tender drawings and necessary openings and the wooden framework for fixing the grilles shall be provided by the air conditioning contractor. The location of these outlets/ inlets is subject to change and the approval of the Engineer-in-Charge shall be obtained before finally fixing the grilles/diffusers in position.

ii) In installing fresh air intakes, no fixing device shall be visible from the face of the frame. Where louvers are to be fixed in masonry or concrete, fixing shall be with either expanding plugs or raw plugs. Where the louvers are to be fixed in steel or wood, non-ferrous screws or bolts shall be used.

iii) Supply air outlets and return air intakes shall be anodized/ powder coated aluminium to the desired colour to match the surroundings wall/ceiling. The fresh air intakes shall be anodized/ powder coated aluminium as approved by the Engineer-in-Charge. The paint colour shall be approved by the Engineer-in-Charge.

iv) All damages to the finish of the structure during the installation work shall be made good by the air-conditioning contractor before handing over the installation to the Department.

BALANCING

Air systems shall be balanced in a manner to minimize throttling losses. The entire air distribution system shall be balanced with the help of an anemometer. The measured air quantities at fan discharge and at the various outlets shall be within $\pm$ 5 percent of those specified/quoted. For fans greater than 0.75 KW (1.0 HP), fans must then be adjusted to meet design flow conditions. Branch duct adjustments shall be permanently marked after the air balancing is completed so that these can be restored to their correct position if disturbed at anytime.

CHAPTER – 4
INSULATION
WORK

SCOPE

This chapter covers the requirements of thermal insulation for chilled water / hot water piping, pumps and tanks, duct work, and acoustic lining in duct work and weather maker rooms. This does not cover exposed roof insulation and under deck insulation work.

MATERIAL-TYPES

The insulation material to be used for various applications shall be any of the following, as required:

i) For insulation of water piping, pumps and tanks:-

a) Expanded polystyrene(T.F. Quality)
b) Polyvinyl Nitrile (Closed cell rubber foam)

Expanded polystyrene (T.F. Quality) shall be used for pipe insulation like inside the A.C. plant room, exposed to outside or buried in ground. In the case of expanded polystyrene (TF quality

Polyvinyl Nitrile (Closed cell rubber foam) available in tube shapes for sliding on to the small dia. pipes can be used if successfully tested for fire retardant properties.

However, all shall need to be covered with vapour barrier and cladding with aluminium sheet.

ii) For Insulation of duct work:-
(a) Polyvinyl Nitrile (Closed cell rubber foam with glass cloth)

iii) For acoustic lining of duct work and AHU rooms:-
(a) Resin bonded glass wool.

iv) For suction line**, Chilled water pipe** and Chiller insulation:-

(a) Polyvinyl Nitrile (Closed cell rubber foam with glass cloth)
For double skinAHUs:

(a) Polyurethane foam (PUF insulation)

MATERIALSPECIFICATIONS

The insulation material shall satisfy the following requirements: -

i) For thermal application onpipes.

Material	Minimum Density (Kg/cu.m)	Maximum Thermal conductivity (K.cal/ hr. degree C/m at 10 Deg C mean temp.)
Polyvinyl Nitrile foam	50-55	0.034

ii) For thermal insulation of ducts:

Material Minimum Density (Kg / cu.m) Polyvinyl Nitrile foam 40 Fibre Glass Insulation used for duct insulation shall be factory faced with aluminium foil on one side reinforced with kraft paper & fused to the insulation material.

Polyvinyl Nitrile foam Insulation used for duct insulation shall be factory faced with glass cloth on one side.

iii) For acoustic lining:

Application Thickness	**Material**	**Minimum Density (Kg./Cu.M)**
Duct 25mm	Resin bonded glass wool	32
AHU room 50mm	Resin bonded glass wool/ Mineral wool	32/ 48

iv) The specification for resin bonded glass wool insulation & resin bonded mineral wool insulation shall conform to IS 8183 as amended upto date. The specification for expanded polystyrene shall conform to IS-4671 as amended upto date.

v) Expansion tank Insulation

Nittrile rubber insulation of density not less than 40kg per cu.m. shall be used. INSULATIONTHICKNESS The thickness of insulation shall be as indicated below unless specified otherwise in the tender specifications.

vi) For pipe insulation (for chilled water as well as hot water application

Pipe Size(mm)	**Nitrile rubber(mm)**
32& below	19
Above32	32

vii) For Duct insulation

Application	**Nitrile rubber(mm)**	**Thermal**
forACarea	**19**	
Thermal for NonAC area	25	

viii) For room acoustic lining

Resin bonded glass wool 50 mm

Duct Acoustic 25 mm

ix) For pumps:

Nitrile Rubber 32 mm

x) Chiller Insulation

Thickness of Nitrile rubber insulation used for chiller insulation shall not be less than 19mm.

xi) Expansion tank

Nitrile rubber insulation used shall not be less than 32mm.

APPLICATION OF INSULATION ON PIPES (including suction line insulation)

(i) The surface to be insulated shall be first cleaned and a coat of zinc chromate primer shall be given. The insulation shall be fixed tightly to the surface with cold setting adhesive CPRX compound. All joints shall be staggered and sealed. The second layer of insulation wherever required shall be similarly applied over the first layer.

(ii) Pipes shall be preferably pre insulated at factory, meeting the requirement or the insulation shall be finished at site asunder:

(a) For pipes laid inside the building, the insulation over the pipe work shall be finished with 0.63 mm thick aluminium sheet cladding over a vapour barrier of 120 gm/ sq.m. polythene sheet with 50 mm overlap and tied down with lacing wire and complete with type 3, grade-I roofing felt strip (as per IS 1322 as amended upto date) at the joints..

(b) For pipes outside the building laid above ground the finishing over the pipe insulation shall be finished with 0.63 mm G S sheet cladding over a vapour barrier of 120gm/ sq.m polythene sheet with 50 mm overlap and tied down with lacing wire and complete with type 3 grade I roofing felt strip applied by means of cold setting CPRX compound..

(c) For pipes outside the building laid underground the insulation shall be covered with 500 gauge polythene faced hessian, (the polythene facing outwards), with 50 mm overlap. All joints shall be sealed with bitumen. A layer of 0.50 mm x 20 mm G.I. wire mesh netting shall be provided over it butting all joints and it shall be laced down with GI wire, sand cement plaster (1:4) 20 mm. thick shall be provided in 2 layers of each 10mm and shall be water proofed by applying hot bitumen & fixing tar felt over the plaster. It shall be finally finished with a coat of hot bitumen.) In case of factory pre insulated pipes, buried underground, a water leakage sensing wire shall also be provided, to detect the location of water leakage at later date.

(d) In case of factory pre insulated pipes, all joints shall be properly insulated at site as per recommendation of manufacturer

(iii) All valves, fittings, strainers etc. shall be insulated to the same thickness and in the same manner as for the respective piping, taking care to allow operation of valves without damaging the insulation.

APPLICATION OF INSULATION ONPUMPS

Nitrile rubber 32 mm thicknesses shall be sandwiched between two aluminium sheets of 0.5mm thickness and properly clamped to pump in two semicircular sections.

APPLICATION OF INSULATION ON EXPANSIONTANK

Insulation of expansion tank shall be Nitrile rubber of thickness not less than 32mm. It shall be applied as under

i) Surface shall be thoroughly cleaned with wire brush and rendered free from all dust&grease.

ii) The two layers of hot bitumen shall be applied.
iii) The insulation slabs will then be fixed in one layer and joints shall be sealed with hot bitumen.
iv) The insulation slab then shall be covered with 0.63 mm x 19mm G.I. wire mesh netting which shall be fixed to insulation with brass / G.I. nails.
v) The insulation shall then finally be finished with aluminium cladding of thickness not less than 0.5mm or glass cloth.

APPLICATION OF INSULATION (THERMAL) ONDUCT

i) The surface of duct on which the external thermal insulation is to be provided shall be thoroughly cleaned with wire brush and rendered free from all dust and grease.

ii) Two coats of cold compound adhesive (CPRX compound) shall be applied over the duct.

(Any other adhesive recommended by the manufacturers may also be used with the approval of the Engineer-in- charge).

APPLICATION OF DUCT LINING (ACOUSTICINSULATION)

Where specified in the tender specifications, ducts shall be lined internally with acoustic insulation as detailed below:

i) The Inside surface of duct on which the acoustic lining is to be provided shall be thoroughly cleaned with wire brush and rendered free from all dust and grease.

ii) Then 25 x 25 sq.mm section of minimum 1.25 mm thick G.I. sheet shall be fixed on both ends of the duct piece.

iii) The insulation slabs shall then be fixed between these section of ducts using CPRX adhesive compound and stickpins.

iv) The insulation shall then be covered with Reinforced plastic/ fibre glass tissue **with proper overlap**, sealing all joints so that no fibre is visible.

v) The insulation shall finally be covered with minimum 0.5 mm thick perforated aluminium sheet having perforations between 20-40%.

APPLICATION OF ACOUSTIC LINING IN AHUROOMS

i) The wall/ roof surface should be thoroughly cleaned with wire brush.

ii) A 610x610 mm frame work of 25mm x50mm x 50mm x50mm x25mm shape channel made of 0.6mm thick G.S.S. shall be fixed to walls leaving 610mm from floor by means of raw plugs in walls and dash fasteners in ceiling. Similar frame work shall also be fixed on ceiling by means of dash fasteners.

iii) Resin bonded glass wool/ mineral wool as specified cut to size will be friction fitted in the frame work and covered with tissue paper.
iv) Aluminium perforated sheet having perforation between 20-40% of thickness not less than 0.8mm shall be fixed over the entire surface

neatly without causing sag/ depression in between and held with screws. Sheet joints should overlap minimum10mm.

v) Aluminimum beading of 25mm wide and thickness not less than 1.00 mm shall be fixed on all horizontal/ vertical joints by means of screws.

CHAPTER-5
ELECTRICALWORK

SCOPE

This chapter covers the requirements for the HVAC WORKS associated with heating, air conditioning, ventilation and cold room applications, namely, switch boards, power cabling, control wiring, earthing, p.f. capacitors and remote control-cum-indicating panels. Electric motors are not covered here, as these are covered as part of the respective equipment specifications.

GENERAL

i) Unless otherwise specified in the tender specifications, all equipments and materials for HVAC WORKS shall be suitable for continuous operations on 415 V / 240 V $\pm$ 10%(3 phase/single phase), 50 Hz. AC system. Where the use of high voltage equipments is specified in particular works, all the respective equipments shall be suitable for continuous operation on such specified high voltage.

ii) All HVAC WORKS shall be carried out complying with the Indian Electricity Rules, 1956 as amended to date.

iii) All parts of HVAC WORKS shall be carried out as per appropriate CPWD General specifications for HVAC WORKS, namely, Part I (Internal) 2013, Part II (External) 1994 work, and Part IV (Sub-station), 2013 all as amended to date.

iv) All materials and components used shall conform to the relevant IS specifications amended to date.

SWITCHBOARDS

i) The main switch board in the A.C. plant room shall be floor mounted, free standing cubical type and shall be factory built fabricated by one of the reputed switch board manufacturer. It shall be suitable for termination of the incoming cable(s)/ bus trunking from top/ bottom. The switchboards in air handling unit (AHU) rooms shall be wall mounted, or floor mounted as feasible at site and as approved by the Engineer-in- charge, but they shall be cubical design, unless otherwise specified and open able from front.

ii) The capacity of switch gear, starters etc. shall be suitable for the requirements of loads fed/controlled. Starting currents shall be duly considered in case of motor loads.

iii) Switch fuse units shall be used upto and including 63 A and fuse switch units shall be used for 100 A and above. ACB shall be used for 630 A and above ratings.

iv) All switch fuses/fuse switches dis-connector switches shall be of AC 23 duty as per IS: 4064-1978 as amended upto date. They shall be

complete with suitable HRC cartridge type fuses.

v) Switch boards controlling motors shall house starters for motors, unless otherwise specified. Independent single phasing preventors for each such starter shall be provided. The starter and SPP shall be located adjacent to the controlling switchgear.

vi) One volt meter with selector switch, a set of indicating lamps and fuses for voltmeter and lamps shall be provided at each switchboard. One ammeter with CTS, and selector switch shall be provided with each motor starter. Instruments shall be flush mounted with the panel and have a glass index not higher than 1.5. The instruments and accessories shall be provided whether or not specifically indicated in the tender specifications.

vii) The fabrication of switchboard shall be taken up only after the drawings for the fabrication of the same are approved by the Engineer-in-charge.

viii) Switchboards shall be fabricated as per specifications indicated in sub- para above.

ix) The layout of bus bars and cable alleys shall be designed for convenient connections and inter-connections with the various switchgear. Connections from individual compartments to cable alleys shall be such as not to shut down healthy circuits in the event of maintenance work becoming necessary on a defective circuit.

x) Care shall be taken to provide adequate clearances between phase bus bars as well as between phase bus bars, neutral and earth.

xi) Where terminations are done on the bus bars by drilling holes therein, extra cross section shall be provided for the bus bars. Alternatively, terminations may be made by clamping.

xii) Provision shall be made for proper termination of cables at the switchboards such that there is no strain either on the cables, or on the terminators. Cables connected to the upper tiers shall be duly clamped within the switch board.

xiii) Identification labels shall be provided against each switchgear and starter compartment, using plastic engraved labels.

xiv) Metallic danger board conforming to relevant IS shall be fixed on each electrical witch board.

xv) Switchboard housing only isolators near cooling towers shall be housed in weather proof enclosure. The mounting arrangement shall be as approved by the Engineer-in-Charge to suit the site conditions.

POWERCABLING

i) Unless otherwise specified, the power cables shall be XLPE insulated,

PVC outer sheathed aluminium conductor, armoured cables rated for 1100 V grade. The power cables shall be of 2 core for single phase, 4 core for sizes upto and including 25 sq.mm, 3-1/2 core for sizes higher than 25 sq.mm for 3 phase. Where high voltage equipments are to be fed, the cables shall be rated for continuous operation at the voltages to suit the same.

ii) Power cables shall be of sizes as indicated in the tender specifications. In all other cases, the sizes shall be as approved by the Engineer-in-Charge, after taking into consideration the load, the length of cabling and the type of load.

iii) Cables shall be laid in suitable metallic trays suspended from ceiling, or mounted on walls, or laid directly in ground or clamped on structures, as may be required. Cable ducts shall not be provided in plant rooms. Cable trays shall be fabricated from slotted angle/solid angles to make ladder type cable tray, designed with adequate dimensions for proper heat dissipation and also access to the cables. Alternatively, cable trays may be of steel sheet with adequate structural strength and rigidity, with necessary ventilation holes therein. In both the cases, necessary supports and suspenders shall be provided by the Air- conditioning Contractor as required.

iv) Cable laying work shall be carried out in accordance with 13.4 (iii) above. The scope of work for the Air-conditioning Contractor shall include making trenches in ground and refilling as required, but excludes any masonry trenches for the cable work.

CONTROLWIRING

i) Control wiring in the plant rooms and AHU rooms shall be done using ISI marked PVC insulated and PVC sheathed, 1.5 sq.mm copper conductor, 250 V grade, cables drawn in ISI marked steel or PVC conduits. Alternatively, armoured multi-core copper conductor cables may also be used for the purpose. The control cables interconnecting the plant room and the AHU rooms shall be of multi-core armoured type only, and suitable for laying direct in ground.

ii) The number and size of the control cables shall be such as to suit the control system design adopted by the Air-conditioning Contractor.

iii) ISI marked steel conduit pipes, wherever used, shall be of gauge not less than 1.6 mm thick for conduits upto 32 mm dia and not less than 2.0 mm thick for higher sizes. All conduit accessories shall be threaded type with substantial wall thickness.

iv) Control cables shall be of adequate cross section to restrict the voltage drop.

v) In the case of control wires drawn through steel conduits, the wire drawing capacity of conduits as specified under the CPWD General Specifications for Electrical Works (Part I) 1994 shall not be exceeded.

vi) Runs of control wires within the switchboard shall be neatly bunched and suitably supported/clamped. Means shall be provided for easy identification of the control wires.

vii) Control wiring shall correspond to the circuitry/sequence of operations and interlocks approved by Engineer-in-Charge.

viii) In cold storage involving temperatures below zero deg. C, polythene cables shall be used instead of PVC cables.

EARTHING

i) Provision of earth electrodes and the type of earthing shall be as specified in the tender specifications.

ii) The earth work shall be carried out in conformity with CPWD Specifications for Electrical works (Part-I), Internal 1994.

iii) Metallic body of all medium voltage equipments and switch boards shall be connected by separate and distinct earth conductors to the earth stations of the installations; looping of such body earth conductors is acceptable from one equipment, or switch board to another.

iv) G.I. plate earthing shall be provided for PTAC plants and reciprocating central AC plants upto 100 TR capacity. Above 100 TR reciprocating units and centrifugal/ screw chilling units copper plate earthing shall be provided.

v) The size of earth conductors for body earthing of equipments shall be as under: -

Motors upto and including 10 HP rating 2 Nos. 3 mm dia copper wire/ 2 nos. 4mm dia GI wire

12.5 HP to 40HP :2 Nos. 4 mm dia copper wire/ 2 nos. 6mm dia GI wire

50 HP to 75 HP : 2 Nos. 6 mm dia copper wire/ 2 nos. 25x3mm GI strip

Above 75HP :2Nos. 25mm x 3mm copper strip/ 2 nos. 25x6mm GI Strip

Switch boards with incoming rating Upto 100: 2 Nos. 3 mm dia copper wire/ 2 nos. 4mm dia GI wire

125 A to 200A rating :2 Nos. 6mm dia copper wire/ 2 nos. 25x3mm GI strip

Above 200A rating :2 Nos. 25mm x 3mm copper strip/ 2nos.25x6 mm GI strip

vi) Armouring of cables shall be connected to the body of the equipments/switch board at both the ends. Compression type glands shall be used for all such terminations in the case of PVC cables.

POWER FACTOR CAPACITORS

i) PF capacitors shall be provided for all motor loads of 5 HP and above. These capacitors shall come into circuit when the respective motor load is switched on. For this purpose, necessary interconnections between the capacitors and the motors/starters shall be included in the scope of work of the Air-conditioning Contractor.

ii) The power capacitors shall be of such value as to improve the PF to 0.90 lagging when the motor is running at full load. In the case of large size motors, the capacitors may be made in suitable banks so that the required bank(s) of capacitors may be switched under partial load conditions. Such operations of individual banks shall be automatic.

iii) Where the PF capacitors are provided in banks, each bank shall be controlled by suitably rated switch gear with HRC fuses.

iv) The capacitor banks and the controlling switchgear may be fabricated in independent cubical or may form part of the switchboard in the installations. In the latter case, the capacitors are permitted to be mounted on the switchboard, if so desired.

REMOTE CONTROL CUM INDICATING PANEL

v) The remote control cum indicating panel shall be provided in the plant room. This panel shall have necessary push buttons for on and off controls and status indication of all electric motors except for small motors as of humidifiers of AHUs and FCUs. **However , if BMS system is provided , remote control-cum- indicating panel shall not be required.**

vi) In view of (i) above, push buttons need not be provided as part of the starters in the switch boards, except of the AHU blower motors. In the case of the AHU blower motors, push buttons shall be provided as part of the starters for local on and off operations.

vii) Back indication to show the status of operation of all the motors (except small motors as in humidifiers of AHUs and FCUs) and also of the electric strip heaters (AHU wise) shall be provided.

viii) Panel shall be fabricated from 1.6 mm thick steel sheet. This shall be of freestanding floor mounting type design. This shall be complete with necessary termination arrangements, multi core cables, tag blocks, control transformer, designation plastic labels, double earth studs etc. as required.

MOTOR STARTER

i) ThemotorstartershallconformtoIS:1822—Motorstartersofvoltage not

exceeding 1000 volts‖ and shall be air insulated and suitable for 415 volts, ± 10%, 50 Hz., 3 phase AC supply. Enclosures shall have protection of IP 42 for Indoor applications and IP 55 for outdoor applications.

ii) Starter for the motor shall be direct on line (D.O.L) for motors up to and including 7.5 H.P. rating and automatic star-delta close transition type for motors of higher ratings unless otherwise specified in the tender specifications. Starters shall be rated for intermittent duty. Starting current should not exceed two times the full load current.

iii) Reciprocating chiller shall be fitted with part winding starter and housed in chiller panel.

iv) The starter shall be mounted on the main electrical control panel/ unit mounted/ self mounted as specified.

v) Each starter shall be provided with the following protections:-
a) Thermal overload on all the three phases with adjustable settings,
b) Under voltage protection, and

c) Independent single phasing preventor. (current sensing type)

vi) Adequate number of extra NO/ NC contacts for interlocks, indicating lamps etc. shall be provided on the starter/contactor.

PAINTING

All panels shall be supplied with the manufacturer's standard finish painting or as indicated in the Schedule of Work.

MOTOR EFFICIENCY

1. All permanently wired poly-phase motors of 0.375 kW or more serving the building and expected to operate more than 1500 hours per year and all permanently wired poly phase motors of 50 kW or more serving the building and expected to operate more than 500 hours per year shall have a minimum acceptable nominal full load motor efficiency not less than IE3 class as per IS 12615 for Energy Efficient motors.
2. Motors of horsepower differing from those listed in the table shall have efficiency greater than that of the listed kW motor. See Annexure N.
3. Motor horsepower ratings shall not exceed 20% of the calculated maximum load.
4. Motor nameplates shall list the nominal full load motor efficiencies and the full load power factor.
5. Motor users should insist on proper rewinding practices for rewound motors. If the proper rewinding practices cannot be assured, the damaged motor should be replaced with a new, efficient one rather than suffer the significant efficiency penalty associated with typical rewind practices.
6. Certificates shall be obtained and kept on record indicating the motor efficiency. Whenever a motor is rewound, appropriate measures shall be taken

so that the core characteristic s of the motor is not lost due to thermal and mechanical stress during removal of damaged parts .After rewinding, a new efficiency test shall be performed and similar records shall be maintained.

7. Motors should be installed with soft start energy savers and Variable Speed drives based on the application required.

CHAPTER –6 MECHANICAL VENTILATION SYSTEM

SCOPE

This chapter includes supply air fan, exhaust air fan and evaporative type air cooling plant. Specification for all associated works such as ducting, plumbing, electrical works etc are same as for air-conditioning works covered under chapter 9, 10 and 13. For system design para 2.3 may be referred.

CENTRIFUGALFANS

i) Centrifugal fans shall be of double-width, double-inlet construction, with bearing on both sides, complete with access door, squirrel-cage induction motor, V-belt drive, belt guard etc.

ii) Housing shall be of heavy gauge sheet steel in welded construction. It shall be rigidly reinforced and supported by structural angles. Split casing shall be provided on larger sizes of fans. However neoprene/ asbestos packing shall be provided throughout split joints to make it airtight. 1.2 mm galvanised wire mesh inlet guard, of 5 cms sleeves shall be provided on both inlets. Housing shall be provided with access door with quick locking tension handles and neoprene gasket. Rotation arrow shall be clearly marked on the housing.

iii) Fan wheel shall be of GSS and backward curved non-overloading type unless otherwise specified. Fan wheel and housing shall be statically and dynamically balanced. Fan outlet velocity shall not exceed 610 meters per minute.

iv) Shaft shall be constructed of steel, turned, ground and polished.

v) Bearings shall be of the sleeve/ball bearing type mounted directly on the fan housing. Bearing shall be self-aligned, oil grease packed, pillow block type.

vi) Drive to fan shall be provided from 3 phase electric motor through belt with adjustable motor sheave and belt guard. Belt shall be of the oil resistant type. The number of belts shall be not less than two.

vii) Drive motor shall be in accordance with para 9.9

viii) Motor starter shall be in accordance with para 9.9.

AXIAL FLOWFANS

i) Casing shall be constructed of heavy gauge sheet steel. Casing shall be provided with hinged door enabling easy replacement of wheel, shaft and bearings. A small inspection door with handle and neoprene gasket shall also be provided. Casing shall have flanged connection on both ends for ducted applications. Support brackets for ceiling suspension shall be welded to the casing for connection to hanger bolts.

Straightening vanes shall be aerodynamically designed for maximum efficiency by converting velocity pressure to static pressure potential and minimizing turbulence. Casing shall be de- rusted, cleaned, primed and finish coated with enamel paint.

ii) Rotor hub and blades shall be of cast aluminium, or cast steel construction. Blades shall be die-formed aerofoil shaped for maximum efficiency and shall vary in twist and width from hub to tip to effect equal air distribution along the blade length. Fan blade mounting on the hub shall be statically and dynamically balanced. Extended grease leads for external lubrication shall be provided. The fan pitch control maybe manually readjust able at site, upon installation, for obtaining actual airflow values, as specified.

iii) Motor shall be of 3 phase squirrel-cage totally enclosed, fan cooled type. Motor and starter shall be in accordance with para 9.9. The speed of fan shall not exceed 1000 RPM for fans with impeller diameter above 450 mm, and 1450 RPM for fans with impeller diameter of 450 mm and less.

iv) <u>Drive:</u>

For Duct/Wall Mounted Fan:
For duct/wall mounted fans the impeller shall be mounted directly on the motor. Drive unit and impeller shall be totally enclosed inside the duct.

For Floor/Ceiling Mounted Fan:
The fan shall be provided with belt drive and adjustable motor sheave, standard sheet steel belt guard with vented front for heat dissipation. Belt shall be of the oil resistant type.

v) <u>Vibration Isolation</u>

Base shall be provided for each fan. Base for both fan and motor shall be built as an integral part and shall be mounted on a concrete foundation through cushy foot vibration isolators. The concrete foundations shall be at least 15 cm above the finished floor level and shall be further isolated from the structural floor through 5 cm. Thick layers of sand all around, topped with bitumen. In case ceiling hung fan within the ceiling shall be provided Vibration Isolation Suspension (VIS) shall be provided in each of string.

<u>PROPELLERFANS</u>

i) Propeller fans shall be direct-driven, three or four blade type, mounted on a steel mounting plate with orificering.

ii) Mounting plate shall be of heavy gauge sheet steel construction, streamlined venturi inlet (reversed) for supply applications. The size shall suit the fan size.

iii) Fan blades shall be constructed of aluminium or steel. Fan hub shall be of heavy welded steel construction with blades bolted to the hub. Fan blades and hub assembly shall be statically and dynamically balanced at

the factory.

iv) Motor shall be standard (easily replaceable) single phase, permanent split capacitor or shaded pole for small sizes, totally enclosed with pre-lubricated sleeves or ball bearings, designed for quiet operation with a maximum speed of 1000 RPM for fans of 3 cm. dia or larger and 1440 rpm for fans of 31 cm. dia and smaller. Motors for larger fans shall be suitable for 415
± 10% volts, 50 cycles, 3 phase, power supply. Motors shall be suitable for either horizontal or vertical services, as indicated in drawing/ schedule of quantities.

v) The following accessories may be required and provided with propeller fans, as indicated in the tender specifications.
a) Wire guard on inlet side and bird screen at the outlet.
b) Gravity operated louver shutters built into a steel frame.
c) Regulators for controlling fan speed for single phase fan motors.

PACKAGE TYPE AIR WASHERS:

The packaged type air washer shall be complete in all respect and shall generally comply with the following specifications given below.

AIR WASHERS

The packaged air washer shall be of GI sheet metal sectionalized construction and shall include fan section, cooling pad section, motor drive etc.

i) Fan Section:

The impellers of the fan or fan shall be of GI sheets, double inlet backward curved centrifugal design, both statically and dynamically balanced. The fan housing shall be of sturdy construction made from double skinned GSS casing having 0.6mm pre-coated GI sheet outside and plain 0.6mm thick GI sheet inside with 25 mm thick puff insulation with smooth air inlets. The fan shall be mounted on properly aligned shaft and mounted on self aligning bearing blocks. The casing of the cab section shall be made of 16 G (1.6mm) GI sheets suitably reinforced to provide rigidity. The frame work shall either be folded G.I. sheets or of hot dipped galvanized iron.
The fan section shall be complete with V belt drive, belt guard and motor mounting base.

ii) Cooling Pad:

The cooling pads shall be of honey comb design to provide extended and sufficient wetted surface to give a water absorbing efficiency of at least 80% at an air velocity of 3.0 m/sec.
The cooling pads shall be made of either acetate paper or high impact PVC. The cross section and depth shall be sufficient for specified efficiency. The cooling pad section shall be of 16 G (1.6mm) G.I. sheet similar to fan section. It shall be complete with galvanized supports for mounting the pads and a water distribution through the uniform supply of water over the entire surface.

iii) Water Sump:

The water sump below the pad section shall be of minimum 1mm SS 304. The tank shall be complete with makeup, overflow and drain connections. A float valve shall be provided for makeup water line.
The pump set shall be of construction, with end suction and top discharge with flanged connections, bronze impeller and casing all mounted directly on a squirrel cage, drip proof induction motor of suitable capacity.

iv) MOTORS:

The motor for each blower shall be totally enclosed, fan cooled, squirrel cage induction type and conform to specifications, class F insulation with IP 55 protection.

v) MISCELLANEOUS:

Necessary accessories shall be provided wherever necessarily required for proper operation and shall also include:

i) Necessary GI piping for water circulation
ii) Vibration isolations pads for the blowers and pumps
iii) Canvass connections at the outlet of each fan
iv) Nuts, bolts, shims etc. as required for the grouting of the equipment
v) Float valves in the air washer tank, along with quick fill connection

vi) LIMITATIONS:

The air velocity limits are as follows:
i) Average velocity across air washer filters shall not exceed 2.5 m/sec (500FPM)
ii) Velocity at blower outlet shall not exceed 10 m/sec (2000FPM)

AIR SCRUBBER (DRY TYPE) General

Air Cleaning System utilizing Industrial Electrostatic Air Cleaners (and Odour Removal system) shall be incorporated with the Kitchen Exhaust System to remove Cooking exhaust contaminants (such as grease, cooking fumes, oil mist and smoke) and odor to comply with NEA requirements.

The Industrial Electrostatic Air Cleaners (IEAC) shall be installed ideally along the duct after the cooker hood. If this proposed location is not feasible, the contractor / tenant shall propose alternative location subject to the approval of the landlord.

The IEAC shall be interlocked to the kitchen exhaust air fan.
The Kitchen Exhaust Air Treatment shall consist of a 2 stage process.
A. Industrial Grade Electrostatic Air Cleaner (IEAC)
The first stage shall be an Industrial Grade Electrostatic Air Cleaner. The supplier must have at least 10 years experience with good track record.

i) **Equipment Description:**

The Industrial Electronic Air Cleaning System shall be supplied as a one-piece factory joined assembly of individual section(s) selected to treat oil mist, smoke, fume, grease & dust/ powder problems.

ii) **Unit Housing:**

Housing shall be constructed with minimum 1.4mm thick galvanized steel sheet (16 gauge) with reinforced structure & powder coated to protect against rust and corrosion. It shall have a hinged door for cell access, located one side of the unit. The door shall be gasketed to prevent air leakage. There shall be a safety interlock switch to cut off primary supply when the access door is opened.

iii) **Finish:**

The external finish shall be a durable industrial grade semi gloss epoxy coating.

iv) **Ionizing-Collecting Cells:**

Ionizing-Collecting cell(s) shall be of one-piece construction consisting of a series of repelling & collection plates. Both repelling and collector plates shall be aluminum alloy material, rigidly retained in place with tubular spacers and tie rods. Each plate shall be corrugated, perpendicular to airflow direction. Each cell shall weigh not more than 16 kg with at least 9 ionizing wires / 6 Stainless steel spiked ionizers and with maximum number of collection/repelling plates up 59 numbers/ 50 Aluminum collector plates per ESP cell for larger collection area.

v) **Ionizer:**

Ionizing electrodes / wires shall be of tungsten material, rigidly supported both vertically and laterally. Ionizing electrode to ground electrode spacing shall be 1.0" (25mm). High voltage support insulators shall be of Teflon/ self-glazing Cordierite ceramic material for dielectric strength.

vi) **Air Handling Capacity:**

Each Ionizing / Collecting Cell shall be capable of handling up to 3000cmh of air. There shall be one to four such Ionizing / Collecting Cells per module. Each module shall handle maximum up to 3000 CMH, 6000 CMH, 9000 CMH and 12000 CMH per module respectively @ minimum 90% efficiency. Multiple units of the same or different modules may be needed to handle higher air flow capacities.

vii) **Design Consideration:**

To achieve effective performance, the proposed IEAC shall fulfill the following design consideration:

a. **Test report**

The rated efficiency shall be up to 95% based on the NIOSH 5026 OIL MIST TEST/ASHRAE Test Report. Past on situ test reports of 90% to 95% of the said test method must be submitted.

The Industrial Electrostatic Air Cleaner must also be rated at 90% to 95% ASHRAE Std 52.2 and should meet MERV-15 rating at velocity of 2.5m/sec to a maximum of 3.8 m/sec, test report shall not be more 5 years old.

b. Contact time

The air velocity entering the IEAC's Ionizing & Collection Cell Section shall be at 2.5m/sec to a maximum of 3.8 m/sec, parallel pass. Ionizing & cell dimensions must be indicated and proper calculation shall be submitted prior to the installation of the equipment.
The contact time shall be at least more than 0.1 second.

viii) Power Supply:

Power supplies shall be 100% solid state, operate on 240 VAC, 50 HZ, 1 Phase input and provide a dual high voltage output of 12 to 13 KVDC for the ionizer and 6.0 to 6.5 KVDC for the collector, in normal operation conditions. Current output at the high tension shall be 12mA. A maximum power output for the solid state power supply shall be from 50 watts to up to 150 watts to maintain the specified collection efficiency.
Electrical interlocks shall be provided to prevent access to the high voltage components without first interrupting the primary input power. The power supply shall operate over a temperature range of -32 degrees F to 140 degrees F and shall have self protect overload cut off switch. They shall have 01 LED lights to indicate the performance status of the ionizing/collecting cell. High voltage output components in the power supply shall be sealed with epoxy for moisture resistance. Panel of each unit shall have inbuilt fan for panel cooling/ inbuilt heat sinks to dissipate heat and prevent dust entering the main power supply unit.

ix) Outstanding Features:

The power pack shall incorporate a short circuit arc protection with automatic power restoration system to prevent overload. Should arcing takes place (due to collection cells being loaded with contaminants or should there be a fault in the unit), the power pack shall be able to automatically cut off the supply to stop the arcing and reset after a few seconds. This is to prevent and drastically reduce the risk of fire from continuous arcing.

x) BMS (Building Management System) interface:

The power supply (pack) shall have a 2 wire dry contacts (NO/NC) for remote link to Building Management System. This is for performance indication of the air cleaning system. Should there be a fault or if service is required, the dry contacts close and a signal is sent to the building BMS System. Should there be multiple units, all the dry contacts can be looped into a set of signal. This ensures proper monitoring of the status of each unit.

xi) Performance Indicator Lights:

There shall be 1 LED lights installed on the access door of the unit to indicate status of the air cleaning system.

xii) Electrical:

Factory wiring will be in accordance with the National Electrical Code.

Required field wiring shall conform to the National Electrical Code and any local code requirements. The manufacturer shall be informed of any local variances to the National Electrical Code.

xiii) **Approval/Code Requirements**

The EAC shall be tested in accordance to CE/UL Certification. It shall comply with Directives

: 2006/95/EC Low Voltage: 2004/108/EC Electromagnetic Compatibility

xiv) **It shall also meet the following standards**

Standards : EN 60335-1:2012, EN 60335-2-65:2003+A11:2012
: EN 55014-1:2006+A2:2011, EN 550142:1997+A2:2008,
: EN 6100-3-2:2006+A2:2009, EN 61000-3-3:2013

Fan: The fan shall be Amca certified backward curved Direct Driven CENTRIFUGAL SISW Fan with integrated factory fitted VFD The wheel shall be fabricated from heavy gauge steel The fan impeller shall be mounted directly on motor shaft The fan shall be selected for a low noise level The impeller shall be statically and dynamically balanced Fan impeller with motor shall be mounted on a common extruded aluminum M S Epoxy coated base mounted inside the air handling housing on anti-vibration mounts The fan inlet shall be connected to casing with the help on fire retardant fabric acting as flexible connection for anti-vibration.

CHAPTER-7
INSPECTION, TESTING AND COMMISSIONING

12.1 SCOPE

This chapter covers initial inspection and testing of compressor, condenser, chiller & AHUs at manufacturer's works, initial inspection of other equipments/ materials on receipt at site, final inspection testing & commissioning of all equipment at site & description of testing requirements & procedure.

INITIAL INSPECTION AT MANUFACTURER'SWORKS

Centrifugal / Screw Compressor

i) Salient features such as model, capacity control, type of lubrication etc. shall be verified against the requirements visually without opening the compressors.

ii) Manufacturer's internal test certificates shall be scrutinized to check compliance with the requirements as specified in the contract.

iii) Free running test shall be carried out at the speed for which the motor is available with manufacturer but the speed shall not be less than that specified in contract. This test shall be carried out for 30 minutes in open space. During this running test following operations are to be noted:

a. Manual operation of capacity control
b. Lubrication oil pressure

iv) a. Pneumatic test pressure test at 21 Kgf/sq.cm for casing of compressor.
b. Vacuum test for the compressor for 0.5mm of Hg.

Condenser

v) Salient features like number of tubes, inside diameter of tubes (from which the gauge of the tube can be verified), no. of passes, material of fins, length of condenser, provision of fittings like safety valve, water, gas connection shall be verified during stage inspection. The tube thickness shall be checked.

vi) Manufacturer's internal test certificates shall be furnished and it shall be verified against contract requirements.

vii) Pneumatic pressure test at twice the normal condensing pressure for gas side of condenser shall be carried out.

viii) Hydraulic test at 10 Kgf/ sq.cm. for water side of the condenser shall be carried out.

Chiller

ix) Salient features like type of chiller, number and inside diameter of tubes (from which gauge of the tubes can be verified), material of tubes, type, material and the number of fins, wherever applicable, diameter and length of chiller and provision of fittings be verified against requirements specified in the contract during stage inspection. Tube thickness shall be checked.

x) Manufacturer's internal test certificate shall be furnished and same shall be checked as per contract requirements.

xi) Pneumatic pressure test at twice the normal condensing pressure for gas side of condenser shall be carried out.

xii) Hydraulic test at 10 Kgf/sq.cm. for the water side of chiller shall be carried out.

Chilling unit (Water cooled only)

Full load test shall be carried out to verify the capacity and IKW / Ton. (For air cooled chilling units this test shall be carried out at site)

Note: In case of imported centrifugal chilling machine, initial inspection shall be carried out at site before installation in respect of items needing physical inspection and verification. The test certificates for all the specified tests shall be produced which shall be accepted if found in order.

Factory Testing:

The complete unit shall be factory tested at 25%, 50%, 75% and 100% capacity at constant condenser water temperature and witnessed by *Representatives of the Department or as given in bid document* for performance at the rated conditions by simulating the actual design conditions. One unit of each capacity shall be tested.
All controls and switchgear shall be tested for proper functioning and set of design values.

The capacity in TR / kcal/hr shall be calculated from measurements of temperature difference and flow rate of water, in condenser and chiller. The power consumption shall be checked from current measurement of the motor. All calculated and checked results shall match the specified data within tolerances as stipulated by ARI.

All instruments and personnel for tests shall be provided by the contractor. Contractor shall inform the client about the chiller testing schedule min. 10 to 15 days before the chiller is ready for factory testing.

Air Handling Units :

xiii) Salient features such as model, size, physical dimensions, and other details of various sections, fan motor details, fan dia, static pressure etc. shall be verified against the contract requirements.

xiv) Manufacturer's internal test certificates for the motor and air handling unit shall be furnished and scrutinized as per contract requirements.

xv) Test certificate for static and dynamic balancing of the fan/ blower should be furnished. Fan balancing may be witnessed by Engineer-in-Charge or his authorized representative.

xvi) Salient features like, type, material, no. and gauge of fins and tubes and no. of rows of cooling coil shall be furnished and verified with reference to contract requirements during stage inspection.

xvii) Hydraulic pressure to the extent of 10 Kgf/sq.cm or pneumatic pressure of 21 kgf/ sq.cm shall be applied to cooling coil and this pressure should be maintained for 1 hour and no drop should be observed indicating any leaks.

INITIAL INSPECTION AT SITE

Ducting:

i) The sheet used for ducting shall be checked for physical test at site. The physical test should include the sheet thickness and bend test as per relevant IS specifications.

ii) Zinc coating of GSS sheet as mentioned in the tender documents may be got tested from a laboratory to verify that same meets the contract requirements.

Pumps:

i) Salient features such as model and make shall be checked as per contract requirements.

ii) The manufacturer's test certificates with Sr. No., head, discharge will be furnished and verified against contract requirements.

Cooling tower

i) Salient features such as make, model, dimensions, materials used, constructional details, number and size of nozzles, headers, size of tank, etc. should be verified against the requirements. Inspection of cooling tower in knocked down condition would be carried out at the site.

ii) Manufacturer's test certificate certifying the capacity of cooling tower and static balancing of fan should be furnished.

Switch Gear, Control Gear, and Measuring Instruments

These should be of specified make. For air circuit breaker manufacturer's test certificate shall be furnished by contractor and the same shall be verified as per contract requirements.

Electric Motors

Electric motors should be of specified make, manufacturer's test certificate for electric motor shall be furnished.

Pipes and Valves

i) It should be checked that the same is as per makes specified in contract.

ii) Dimensions including weight shall be checked for pipes against the requirements of contract.

iii) Manufacturer's test certificates for valves for testing of pressure withstand.

Insulation and acoustic lining

i) Physical verification for thickness and make should be made as per contract before application of insulation.

ii) Manufacturer's test certificate for density **thermal conductivity, sound absorption and class of fire retardation wherever applicable** should be furnished.

Note: Accuracy of testing instruments shall be as mentioned in the final inspection procedure.

FINAL INSPECTION

i) After completion of the entire installation as per specification in all

respects, the AC contractor shall demonstrate trouble free running of the AC equipments and installation for a period of minimum 120 hours of running.

ii) After the trial run as in above para, the AC contractor shall offer the plant for the seasonal test, namely test for summer or monsoon season whichever occurs earlier. The test results as per Appendix G shall be furnished.

iii) The equipment capacity computations as per para `B' under notes of the Annexure `G' shall be carried out.

iv) The Input KW of the unit / TR at full load shall also be checked against contract requirements, if any.

v) Pressure drops across chiller and condenser at specified flow rates shall be checked against the contract requirements.

vi) All instruments for testing shall be provided by the AC contractor. These shall be as per Note `A' of Appendix G. The accuracy of the instruments shall be as follows:

a. Temperature: Liquid in glass thermometer having accuracy $\pm$ 1 deg. C as per IS: 4825.

b. Wet bulb Temperature: Sling psychrometer conforming to IS:6017. Scale Error:
For less than 0 deg.C:0.3 deg C $\pm$ 0.2 deg. C. For over 0deg.C:0.2 deg. C $\pm$ 0.1 deg.C.

c. Pressure Gauge: With the accuracy of $\pm$ 1% for maximum scale value from 10 to 90%, and $\pm$1.9% for maximum scale value for rest of the scale conforming to IS:3695.

d. Water flow meter : Water flow shall be measured using the arrangement installed as per schedule of work.

In case the tendering firms do not have testing instruments of the accuracy mentioned above, they should specify the accuracy of the instrument available with them for testing at the tender stage.

TESTING REQUIREMENTS AND PROCEDURES

1 Balancing of all air and water systems and all tests as called for in the specification shall be carried out by the HVAC contractor in accordance with the specifications and relevant local codes if any. Performance tests of individual equipment and control shall be carried out as per manufacturer's recommendation. All tests and balancing shall be carried out in the presence of Engineer-in-charge or his authorized representative. The whole system balancing shall be tested with microprocessor based hi-tech instruments with an accuracy $\pm$0.5%.
The instrument shall be capable of storing data and then down loading into a P.C. The HVAC contractor shall provide a minimum but not limited to the following instruments:

i) Microprocessor based calculation meter to measure DB and WB temperature, RH and Dew point

ii) Velo meter to measure air volume and air velocity

iii) Pitottube

iv) Electronic rotary vane Anemometer

v) Accu balance flow measuring hood

The contractor shall be responsible to provide necessary sockets and

connections for fixing of the testing instruments, probes etc.

2 Air Systems:

Systems are to be balanced by first adjusting the total flow at the fan, then by adjusting main dampers and branch dampers. Only final minor adjustments are to be made with register and diffuser dampers. Balancing of the air system shall be accomplished without causing objectionable air noise. Baffles and orifice plates required for proper air balance shall be furnished and installed by the contractor. Basically the following tests and adjustments are required.

i) Test all fan systems to provide proper cfm/cmh.

ii) Adjust fresh air, return air and exhaust dampers to provide proper air quantities in all modes of control.

iii) Test and record fresh air, return air and mixed air temperature at all air handling units. Test and record data at all coils after air and hydronic systems are balanced. Measure wet and dry bulb temperature on cooling coils.

iv) Make point tube transverse at all main supply and return ducts to set proper air quantities. Adjust all zone and branch dampers to proper cfm/cmh.

v) Test and adjust each register, grills, diffuser or other terminals equipment to within 5% of design air quantity. Each opening shall be defined on the test report by size, manufacturer`s model, room location, design cfm and actual cfm. Outlets shall be adjusted to minimize objectionable drafts.

vi) Test and record static pressure drop across all filters and major coils.

vii) High velocity duct systems shall be tested for leakage. If excessive or audible leakage is detected, the defect shall be repaired by the contractor. Sufficient static pressure readings shall be taken from the air handling units to the terminal units to establish system static pressure.

3 Water System:

Systems are to be balanced by opening all valves, closing all by-pass and setting all mixing valves to full coil flow. Water systems shall be cleared of air. Verify that the system has been properly cleaned, flushed and treated before testing. Basically, the following tests and adjustments are required.

i) Test and adjust all pumps to deliver the proper gpm. Record rpm, motor amperage, discharge and suction pressure. Pumps shall operate without objectionable noise or cavitation. Plot actual pump and system performance points on manufacturer`s pump curves.

ii) Check all expansion tanks for proper filling pressurization. Verify operation of automatic fill and relief valves.

iii) Check the operation of all automatic valves.

iv) Test and adjust correct water flow through chiller, major items of equipment and main water circuits. The balancing valves, provided on the equipment shall be used for adjustment.

v) Check capacity output of chillers and set water flow rate for proper data.

vi) Check and adjust each coil to provide proper gpm. Record water and air temperature changes and water pressure drop.

vii) Set pressure drops across coil by-pass to match coil full-flow pressure drop.

4 Unit capacity in Tons Refrigeration shall be computed from the temperature readings, pressure readings and water/ brine flow measurements. Flow measurements shall be preferably through flow

meters. Pumps shall be tested for the discharge head, flow and BHP. Where it is not possible to measure the flow, atleast the discharge head and BHP (on the input side) shall be field tested.

5 Balancing **Tolerance:**

Systems shall be balanced within the following tolerances ;

i) Duct leakage Rates (at operating pressures):

Low pressure ducts	5% of full flow (0 to 0.5kPa)
Medium Pressure Ducts	1% of full flow (0.5 to 3kPa)
High Pressure Ducts	1% of full flow (Greater than 3kPa)

ii) Air flow rates:

Under 70 L/S	10% of flow
Over/ at70L/S	5% of flow

iii) Water flow rates:

ChilledWater	2% offlow
Other	5% offlow

iv) Heat flow rates:

Heat exchangers	5% of design capacity Procedure:

Review all pertinent plans, specifications, shop drawings and other documentation to become fully familiar with the systems and their specified and intended performance.

Furnish equipment and instruct sheet metal trade on proper use for conducting duct leakage tests. Conduct first test as a way of instructing the above trades in the presence of the Department's representative.

Test relative barometric pressures in various building area, as deemed necessary by the Department's representative and at least in all areas served by different systems.

Test performance and continuously record on a 24 hour basis, temperature and humidity levels where control equipment is provided for that purpose in certain critical areas.

Before commissioning of the equipment, the entire electrical installation shall be tested in accordance with relevant BIS codes and test report shall be furnished by a qualified and authorized person.

6 Reports

Provide 3 copies of the complete balancing and testing reports to the department. Report shall be neatly typed and bound suitable for a permanent record. Report forms shall contain complete test data and equipment data as specified and safety measures provided

7 Final documentation

The contractor shall leave the system operating in complete balance with water and air quantities as shown on drawings. Set stops on all balancing valves and lock all damper quadrants in proper position. Secure all automatic damper and valve linkages in proper positions to provide correct operating ranges. Proper damper positions shall be marked on ducts with permanent indication. Notify the department of any areas marginal or unacceptable system performance.

The above tests and procedures are mentioned herein, for general guidance and information only, but not by way of lamination to the provisions of conditions of contract and design/ performance criteria.

Upon commissioning and final handover of the installation, the HVAC contractor shall submit (within 4 weeks) to the engineer-in-charge/

department 6 (six) portfolios of the following indexed and bound together in hard cover ring binder (300 x 450 mm) in addition to the completion drawings

i) Comprehensive operation and maintenance manual
ii) Test certificates, consolidated control diagram and technical literature on all controls.
iii) Equipment warranties from manufacturers.
iv) Commissioning and testing reports
v) Rating charts for all equipment
vi) Log books as per equipment manufacturers standard format
vii) List of recommended spares and consumables

Any special tools required for the operation or the maintenance of the plant shall be supplied free with the plant.

At the close of the work and before issue of final certificate of completion by the Engineer-in- charge, the contractor shall furnish a written guarantee indemnifying the department against defective materials and workmanship for the Defects liability period. The contractor shall hold himself fully responsible for reinstallation or replace free of cost to the department.

i) Any defective material or equipment supplied by the contractor

ii) Any material or equipment supplied by the department which is proved to be damaged or destroyed as a result of defective workmanship by the contractor.

APPENDIX –A

LIST OF RELEVENT INDIAN STANDARDS

I.S.3615 Glossary of Terms Used in Refrigeration & Air Conditioning.
I.S.325 Three phase Induction Motors
I.S.1822 Motor Starters of voltage Not Exceeding 1000volts
I.S.3624 Bourden Tube Pressure and Vacuum Gauges
I.S.2372 Timber for cooling towers
I.S.7403 Gode of practice for selection of standard worm and helical gearboxes
I.S.1620 Horizontal centrifugal pumps for clear, cold, freshwater
I.S.996 Single phase small A.C. and Universal motors
I.S.1239 Mild steel tubes, tubulars and other wrought steel fittings
I.S.3589 Electrically welded steel pipes for water, gas and sewage,
I.S.6392 Steel pipe flanges
I.S.778 Gun metal gate, globe and check valves for general purpose
I.S.2592 Recommendation for methods of measurement of fluid flow by mean plates and nozzles
I.S.277 Galvanised steel sheets
I.S.737 Wrought aluminium and aluminium alloy sheet and strip for general en purposes.
I.S.655 Metal air ducts
I.S.732 Code of practice for electrical wiring and fittings for buildings
I.S.2516 A.C. circuit breakers
I.S.900 Code of practice for installation and maintenance of induction motors
I.S.1248 Direct acting electrical indicating instruments
I.S.2516 A.C. circuit breakers for voltages not exceeding 1000volts
I.S.4047 Heavy duty air break switches and composite units of air break swit fuses for voltage not exceeding 1000volts.
I.S.2208 HRC cartridge fuse links upto 650volts
I.S.1554 (PART I) PVC insulated (heavy duty) electric cables for working voltage including 1100 volts
I.S.8183 Specification for bonded glass wool/ mineral wool
I.S.4671 Specification for expanded polystyrene for thermal insulation purposes.
I.S.11561 Code of practice for testing of

cooling towers.

I.S.7896 Data for outside design conditions for air conditioning for summer mont I.S.8148 Packages air conditioners

I.S.2370 Sectional cold rooms walk-in type) I.S.5111 Testing of refrigerant compressors I.S.10594 Thermostatic Expansion Valve

IS 12615 Energy efficient induction motors

Energy Conservation Building Code 2007

National Building Code of India 2005

APPENDIX – B

PROFORMA FOR SCHEDULE OF TECHNICAL PARTICULARS

(A) COMPRESSOR:

For Centrifugal/screw units

1. Manufacturer
2. Model
3. Type
4. (a) Refrigerant
   (b) Weight of refrigerant per unit
5. Operating speed(RPM)
6. Type of drive and speed ratio
7. No. of impellers/ No. of stages
8. Out put in TR and input power consumption in KW, at the selected operating conditions

   % of Load TR Input 100% load 75 % load 60%load 50%load 40%load 25% load
9. Type of capacity control
10. Capacity control range
11. Type of lubrication
12. Material of bearing
13. Operating weight(Kg.)
14. Overall dimensions of the machine
15. Compressor motor
    i) Make
    ii) Rated output
    iii) Working voltage range
    iv) Type of enclosure
    v) Class of insulation
    vi) Speed
    vii) Full load current
    viii) Starting current
    ix) Efficiency
    x) Power factor
    xi) Temperature rise over ambient of 45 deg C.
16. List of Safeties/protection provided in the chiller unit (Whether provided)
    i) Motor over current
    ii) Over voltage
    iii) Under voltage
    iv) Single cycle dropout/ intermitent power loss
    v) Baring oil high temperature
    vi) Low evaporator refrigerant temperature
    vii) High condenser refrigerant pressure
    viii) High motor temperature (For sealed/ semi hermetic chiller units only)
    ix) Prolonged surge in compressor
    x) Compressor starter faults

xi) Star-to-start and stop-to-stop timers for motor protection against rapid recycling
xii) Low lubricating oil pressure

17. Details of all the functions of Microprocessor control system are to be enclosed. Whether enclosed- Yes/ No.

(B) CONDENSER

1. Manufacturer
2. Shell dia(mm)
3. Type of fins, if any, in tubes
4. No. of passes
5. Water flow(L.P.M.)
6. Water velocity(M.P.S.)
7. Pressure drop at above velocity (M. of water)
8. Condensing Temp (degC)
9. Tube material
10. Tube outside diameter(mm)
11. Tube thickness(mm)
12. Tube length(mm)
13. No. of tubes
14. Tube surface, inside(sq.m.)
15. Tube surface, outside(sq.m.)
16. Water temperature:

i) entering –degC
ii) leaving – degC

(C) CHILLER

1. Manufacturer
2. Type
3. Shell dia(mm)
4. Tube length(mm)
5. No. of tubes
6. Tube material
7. Tube diameter(mm)
8. Tube surface inside(sq.m.)
9. Tube surface outside(sq.m.)
10. Type off in
11. Refrigerant temp. (degC)
12. No. of passes
13. Water flow(LPM)
14. Water velocity(MPS)
15. Pressure drop (M. of water)
16. Temperature of water:

(i) entering –degC
(ii) leaving – degC

(D) REFRIGERANTPIPING

1. Material for pipes
2. Pipe wall thickness(mm)

3. Material of fittings
4. Material of valves
5. Make of TX valve if provided
6. Make of refrigerant float if provided

(E) AIR HANDLING UNIT

1. General
(i) Manufacturer
(ii) Type of unit
(iii) Overall diamensions (mm)
(iv) Operating weight(including wt. Of water/ refrigerant in circulation (kg)
(v) Noise level
2. Material and thickness of drain pan
3. Fan Section:
(i) Manufacturer
(ii) Type of fan
(iii) Fan speed(RPM)
(iv) No. of fans
(v) Fan wheel diameter(mm)
4. Drive arrangement
5. No. of belts in case of belt drive
6. Material and thickness of fan wheel and blades
7. Material and thickness of housing
8. Fan outlet area (sq.m.)
9. Outlet velocity (MPM)
10. Total air quantity (CuM./ Min.)
11. Static pressure at outlet (mm of water)
12. Whether statically and dynamically balanced
13. Type of bearings.
14. Cooling Coil :
(i) Manufacturer
(ii) Type
(iii) Material of tubes
(iv) Material of fins
(v) Tube diameter
(vi) Tube thickness
(vii) Fin thickness
(viii) Method of bonding of tube and fins
(ix) No. of fins/cm.
(x) No. of row deep
(xi) Total tube surface, outside(sq.m.)
(xii) Test pressure
(xiii) Coil face area
(xiv) Flow rate of water/ refrigerant (kg./Min. orL.P.M.)
(xv) Vol. Of water/ refrigerant through tube(MPS)
(xvi) No.of circuits
(xvii) Pressure drop in coil (Kg/ Sq/ cm. Of M. of water)
15. Air filters:
(i) Manufacturer

(ii) Type of medium
(iii) Filter medium
(iv) Material of frame work and its thickness(mm)
(v) Face area(Sq.m)
(vi) Face velocity across filters(MPS)
(vii) Pressure drop across filters (mm. of water)

16. Humidification arrangement:

(i) Type
(ii) Spray water rate(LPM)
(iii) Rating of spray pump, if provided(FHP)
(iv) Make and size of solenoid valve where provided
(v) Material of nozzles
(vi) No. of nozzles

17. Spray arrangement : (For sprayed coils only)

(i) Pump casing
(ii) Rating of spray pump
(iii) Rate of spray (LPM/ SQ.M. of coil face area)
(iv) Spray density
(v) Material of nozzles
(vi) No. of nozzles

18. Electric strip heaters

(i) Manufacturer
(ii) Type
(iii) Material of sheath
(iv) Material offins
(v) Power rating (KW)

(F) COOLING TOWER:

1. Manufacturer
2. Type
3. Model
4. Overall dimensions (mm)
5. Weight with water (kg.)
6. No. of fans
7. CMH perfan
8. Outlet velocity (Mts. Permin)
9. Tip speed (Mts permin)
10. Drift loss(LPH)
11. Total water loss(LPH)
12. Approach to the design wet bulb (degC)

(G) CENTRIFUGAL PUMPS:

(Give separate particulars for each application)

1. Manufacturer
2. Type
3. Model
4. Overall dimensions
5. Weight(Kg)
6. Size of foundations(mm)
7. Material:

(i) Pump casing
(ii) Impeller
(iii) Shaft

(iv) Shaft sleeve
(v) Base plate
8. Type of bearings
9. Type & material of seal
10. Speed(rpm)
11. Discharge(LPM)
12. Head (Mtr.)
13. Efficiency
14. Performance curves (whether enclosed with the tender)

(H) WATER PIPING:

1. Material for pipes
2. Material for fittings
3. Pipe wall thickness
4. Material for valves
5. Pressure gauges:

(i) Make
(ii) Range
(iii) Dial size

6. Flow meter type and make
7. Size of flow meter

(I) ELECTRICAL

1. Motors (Give separate particulars for each application)

(i) Manufacturer
(ii) Type and frame reference
(iii) Rated output(KW)
(iv) Range of working voltage(V)
(v) No. of phases
(vi) Rated frequency
(vii) Rated speed(RPM)
(viii) Full load current(amps)
(ix) Class of insulation
(x) Efficiency and power factor at the following loadings 100%, 75%, 50% 25%ofRated full load.
(xi) Type of bearings

2. Motor starters (Give separate particulars for each application):

(i) Manufacturer
(ii) Type
(iii) Rating
(iv) Whether the following protections are provided–
(a) Over load
(b) Under voltage
(c) Single phase prevention (for 3 phase motor starters)

3. Switch board:

(i) Manufacturer
(ii) Type

4. Circuit Breaker

(i) Manufacturer
(ii) Type
(iii) Rated normal current(amps)
(iv) Short circuit ratting(MVA)
(v) Whether following are provided –

(a) O/L trip
(b) E/F trip
(c) Under voltage trip
5. Measuring Instruments:
(i) Manufacturer
(ii) Range
(iii) Dial size
(iv) Glass Index
6. Iron clad switch gears:
(i) Manufacturer
(ii) Make of HRC fuse provided

(J) CONTROLS:

1. Make and type of thermostats
2. Make and type of humidistat
3. Make and type of damper motor
4. Make and type of other control components

(K) DUCTING

1. Material
2. Manufacturer
3. Whether ducting is as per IS: 655

(L) INSULATION (For each application)

1. Manufacturer
2. Material and density
3. `K' value at 10 deg C mean temperature
4. Thickness.

APPENDIX – D

PROFORMA FOR TEST RESULTS &

NOTES ON TEST INSTRUMENTS AND CAPACITY COMPUTATIONS

Sl.No.	Item	Test Results	
1.	Ambient conditions	D.B. Temp W.B.Temp %RH	- degC - degC
2.	Compressors	R.P.M Suction pressure Discharge pressure Oil pressure	- Kg/sq.cm -Kg/sq.cm -Kg/sq.cm
3.	Compressor Motors	R.P.M. Voltage Current (i) at 100%load (ii) at partial load (a) (b) (c)	- Volts - amps
4.	Water Chillers	Water flow rate Water temperature Entering Leaving Water pressure Entering Leaving	- LPM - degC - degC -Kg/sq.cm -Kg/sq.cm
5.	Condensers	Water flow rate Water temperature Entering Leaving Water pressure Entering Leaving	- LPM - degC - degC -Kg/sq.cm -Kg/sq.cm
6.	Pumps	R.P.M. Motor current Discharge pressure Suction pressure	-amps -Kg/sq.cm -Kg/sq.cm
7.	Cooling Towers	Water temperature Entering Leaving Wet bulb approach Fan motor current Fan motor voltage Fan motor R.P.M	- degC - degC - degC - amps - volts
8.	Air handling units	Total air quantity across coil Coil face area Air temperature Entering (D.B.) Entering (W.B.) Leaving (D.B.) Leaving (W.B.) Water pressure Entering	- cu.m /min - Sq.m. - degC - degC - degC - degC -Kg/sq.m

		Leaving Water temperature Entering Leaving Water flow rate	-Kg/Sq.m - degC - degC - LPM
9.	Fresh air intakes	Face area Air quantity	- Sq.m - Cu.m/min
10.	Room conditions at the working plane (No. of readings shall be taken and averaged out)	Temperature D.B. W.B.	 - degC - degC
11.	Controls	Function of each control shall be tested and report furnished	

A. <u>Test Instruments</u>

NOTES

1. All instruments for testing shall be provided by the air conditioning contractor.
2. Thermometers used for measurement of temperature of water/ refrigerant shall have graduation of 0.1 deg C and shall be got calibrated from N.P.L. or any recognized test house before hand.
3. Thermometers used in the psychrometers shall have graduations of 0.2 deg C and shall be calibrated as at (2)above.
4. Pressure gauges shall also be got calibrated before hand from a recognised test house.
5. Orifice type of flow meters shall be used for measuring flow rate through the condensers and chillers.

B. CAPACITYCPMPUTATIONS

1. Condensing unit :
   The capacity shall be computed from the water temperatures and water flow rate measurements of the condenser water and the compressor motor current readings. A reference may be made, if necessary to the manufacturer's motor performance characteristics for arriving at the B.H.P. consumption.
2. Water chilling unit:
   The capacity shall be computed from the water temperature and water flow rate measurements of the chiller. Heat rejection from the condenser shall be computed from the water temperature and water flow rate measurements at the condenser.
3. Cooling Tower :
   Water quantity measured at the condenser and the temperature of water at the cooling tower shall be recorded. Wet bulb approach shall be checked against design data recorded in the tender documents.
4. Air handling unit (chilled water type):
   The capacity shall be computed from the water temperature and water flow rate measurement. A tolerance of $\pm$ 5% from the tender documents value shall be acceptable in the capacity so computed. Air quantity shall be measured in the supply duct and checked with the quantity specified in the tender documents. a tolerance of $\pm$ 10% in the air quantity shall be acceptable. The enthalpy difference of air entering and leaving the coil shall be computed from air temperature and recorded.
5. Air handling unit (Dx type);
   the capacity shall be computed from the air quantity measured in the supply air duct and the enthalpy difference between the air entering and leaving coil. Air quantity measured shall be checked with that recorded in the tender documents . A tolerance of $\pm$ 10% from the tender documents value shall be acceptable.

6. For the purpose of system capacity, the refrigeration tonnage obtained from the main refrigeration plant will be accepted.
7. If due to any reason, internal load mentioned in the tender specifications is not available psychrometric computations for actual load conditions will be done and the plant, if found satisfactory will be accepted.

APPENDIX – E

MAINTENANCE

The section covers the maintenance schedule during warranty period and 5 yrs subsequent to the warranty period.
The maintenance provided during the warranty period shall be fully comprehensive and shall include but not limited to all equipments, labour part and emergency calls providing and site response within 24 hours. However during the maintenance period after the warranty is over, the materials shall be arranged by the department if any replacement is warranted. However consumable materials shall be arranged by the department during 6 yrs period including that of warranty period.
The maintenance shall also include a minimum of 12 monthly preventive maintenance visits by qualified personnel who are thoroughly familiar with the type of equipment and system provided for this project.

Chiller	Monthly Inspection and Service	1. Check refrigerant level, leak test with electronic Leak detector. If abnormal, trace and rectify as necessary, Inform department in writing rectification. 2. Inspect level and condition of oil. If abnormal, trace fault and rectify as necessary. Inform department in writing on the rectification. 3. Check the liquid line sight glasses for proper flow. 4. Check all operating pressure and temperature. 5. Inspect and adjust, if required, all operating safety controls. 6. Check capacity control, adjust if necessary. 7. Lubricate vane/ linkage/bearings. 8. Visually inspect machine and associated components, and listen for unusual sound or noise for evidence of unusual conditions. 9. Check lock bolts and chiller spring mount. 10. Review daily operating log maintained by department's operating personnel. 11. Providing written report to Department, outlining services carried out, adjustment made, rectification carried out and if the deficiency is of a major nature, arrange with department for shut- down to rectify equipment.
Chiller	Annual Inspection Prior to expiry of warranty period	1. Perform all functions for monthly check 2. Check all flanges for tightness 3. Change oil in oil sump 4. Replace filter 5. Check oil temperature control 6. Check motor terminals 7. Check connections in starter

		Please note that oil filter gasket replacement shall deem to be included in the contract. 1. Check motor earthing, meggar motor and connection wiring on each leg 2. Check motor temperature cut-out, tighten motor terminals. 3. Check starter contacts, arc shield, transformer. 4. Check dashpot oil, clean dashpot and replace oil when necessary 5. Test and calibrate over load setting. 6. Inspect, calibrate and adjust to original specifications all gauges, safety and operating controls including low temperature and high pressure cutout, oil pressure switch, load limit relay and electrical interlocks. 7. For water cooled condenser systems, inspect condenser tubes for fouling. If fouling exceeds original specifications, the contractor shall carry out cleaning of the tubes at his own expense. 8. For air-cooled condenser coils, dust should not be allowed to accommodate on the condenser coil surfaces. Cleaning should be as often as necessary (approximately every three months) to keep coil clean. Exercise care when cleaning the coil, so that the coil fins are not damaged. Under no circumstances this unit be cleaned with acid based cleaner.
Water pumps	Monthly Inspection	1. Inspect all water pumps 2. Check all seals, glands and pipelines for leaks and rectify as necessary. 3. Re-pack and adjust pump glands as Necessary. 4. Check all pump bearings and lubricate with oil or grease as necessary. 5. Check the alignment and condition of all rubber couplings between pumps and drive motors and rectify as necessary. 6. Check all bolts and nuts for tightness and tighten as necessary.
Water pumps	Annual Inspection prior to expiry of warranty period	1. Perform all function for monthly checks 2. Check motor earthing, meggar Motor and connection wiring on each leg. 3. Tighten motor terminals 4. Check starter contacts 5. Test and calibrate overload setting.

Expansion tank	Annual inspection prior to expiry of warranty period	1. Inspect expansion tank, Drain, clean and flush out tanks as necessary
Air handling units and fancoil units	Monthly inspection	1. Inspect all air handling and fan coil units. 2. Check all air filters and clean or change filters as necessary. 3. Check all water coils, seals and pipelines for leaks and rectify as necessary. 4. Check and re-calibrate modulating valves and controls. Adjust and rectify as necessary to ensure compliance to the original specifications. 5. Purge air from all water coils. 6. Check all fan bearings and lubricate with grease as necessary. 7. Check the tension of all belt drives and adjust as necessary. 8. Check and clean all the condensate pans, trays and drains. 9. Check measure and re-calibrate all sensors if necessary. 10. Check, clean and service smoke detectors. Carry out a system test to ensure that the smoke detector will trip the AHU's. 11. Check spring vibration isolators for vibration. Rectify if necessary. 12. Coil to be cleaned by (a) spray of high-pressure clean water (not exceeding 30 psi (b) with chemical spray, if necessary.
Air handling units and fan coil units	Annual Inspection prior to expiry of warranty period	1. Perform all functions for monthly checks. 2. Tighten motor terminals 3. Check starter contacts. 4. Test and calibrate overload settings.

Air cooled packaged units and precision-computer air-condition equipment	Monthly check	1. Check condenser fan motor load ampere. 2. Check fan and motor mounting brackets. 3. Check shafts and bearings. Lubricate with grease as necessary. 4. Check the tension of all belt drives and adjust as necessary. 5. Check for refrigerant leaks with electronic leak detector. 6. Check electrical terminals and contactors operation and connection for tightness. 7. Check compressor motor current. 8. Check refrigerant line driers and moisture indicators.
Air cooled packaged units and precision-ac equipment	Annual inspection prior to expiry of period.	Perform all functions listed in the monthly checks.
Air distribution system	Monthly and annual inspection prior to expiry of warranty period	1. Check operation of all modulating and fixed dampers controlling air flow through unit. Lubricate all damper bearings and linkages as necessary. 2. Carry out space temperature checks on air-conditioned areas with thermo hydrograph. Balance air flow as necessary to compliance with requirements of original specifications. These checks include the calibration of sensors, thermostat, etc. 3. Check noise level of discharged air from diffusers.
Ventilation	Monthly check and inspection priorto expiry of warranty period	1. Check adjust as necessary the air flow of all fans are in compliance with the original specifications. 2. Check the tension of all belt drives and adjust as necessary. 3. Check and lubricate all fan bearings. 4. Tighten motor terminals. 5. Check starter contacts. 6. Test and calibrate overload settings. 7. A system check shall be carried out for all Mechanical ventilation (MV), Pressurisation and Exhaust system to verity the performance of the systems.

Switch board	Six-monthly and annual inspection prior to the expiry of the warranty period	1. Clean and adjust all switch gear, contactors, relays and associated equipment at intervals not exceeding six months. 2. Check and prove operation of thermal over load and protection devices. 3. Check and ensure tightness of all equipment fastenings and cable terminations within switchboards. 4. Vacuum clean all switch board cubicles.
Piping system	Monthly and annual inspection prior to expiry of warranty period	1. Check all piping system for leaks and repair these where they have occurred. 2. Check for damage & deterioration of insulation or sheathings. Rectify as necessary

	Consumable materials	The department shall supply the following consumable materials as and when required :- 1. All oils and greases required for lubrication of compressors, fan bearings, motors bearings, pivots and other moving parts. 2. All refrigerant required for topping up. Refrigerant loss if due to manufacturing defect or due to negligence shall be made good by the contractor. 3. All consumable filter elements/rolls. 4. All chemicals for the correct chemical treatment of the cooling tower and chilled water system. 5. All carbon brushes required to replace worn brushes in electric motors. 6. All electric contact points required to replace worn electric contact points in switchgears, motor starter gears, electronic control gears and electric relays. 7. All electric fuses required to replace blown fuses. Just before the expiry of the warranty of the contract, the contractor shall carry out a complete system operability test on all the systems or sub-systems as called for in the contract. The purpose of the test is to verify that the performance of all the systems or sub-systems in the contract is in accordance to the specifications. All test shall be carried out in the presence of the Engineer-in- Charge or his representative. The warranty period is deemed to be over if the department or his representative is completely satisfied with the system performance during the test.

LIST OF APPROVED BRANDS / MAKES

One of the following make of the material shall be used. The contractor will have to get the sample approved from the Architect/ Bank's Engineer whose decision shall be binding on the contractor. The condition is also applicable for any material, not mentioned in the specification or schedule of work. No deviations are allowed in these even during/ after Tender:

LIST OF APPROVED MAKES AIR CONDITIONING WORKS		
SL	**ITEM**	**COMPANY**
1	GSS SHEET	JINDAL / TATA / SAIL
2	FACTORY MADE DUCTS	ROLLASTAR/ DUSTECH
3	PROPELLER FANS	GE ALSTHOM / CROMPTON/ CARRYAIRE
4	FLEXIBLE PIPE CONNECTION	RESISTOFLEX / DUNLOP
5	EXTRUDED ALUMINIUM GRILLES /DIFFUSER	AIRTECH/AIR COOLING SYSTEM/TRISTAR /CARRYAIRE
6	FIREDAMPER / VOLUME CONTROL DAMPER	AIRTECH/AIR COOLING SYSTEM/TRISTAR /CARRYAIRE
7	FLEXIBLE INSULATED DUCTS	CARYAIRE / ATCO/ MAPRO
8	FIBRE GLASS	OWENS CORNING/ UP TWIGA
9	EXTRUDED POLYSTYRENE BOARD	SUPREME/PARAMOUNT/CAANI
10	CROSS LINKED POLYETHYLENE	SUPREME/PARAMOUNT/CAANI
11	CLASS 'O' NITRILE RUBBER INSULATION	SUPREME /K-FLEX / SUPERLON / EUROBATEX / ARMACELL/A- FLEX
12	COPPER PIPE	RAJCO / MANDEV / MAXFLOW
13	PVC PIPE	SETIA/ FINOLEX/ PRAKASH/ SURYA
14	CONDUIT FOR ELECTRICAL WIRE	AKG, SETIA, BEC, SUPER
15	EXPANDED POLYSTYRENE	STYRENE PACKING / INDIAN PACKING
16	VIBRATION ISOLATION SPRING	DUNLOP / RESISTOFLEX
17	PAINTS	ICI / ASIAN
18	HVAC UNITS	(DAIKIN/MITSUBISHI ELECTRIC/ O-GENERAL/ BLUESATR/LG)

19	DASH FASTENERS	CANON / FISHER / TKS/HILTI
20	WELDING RODS	ADVANI / L&T
21	ACB, M.C.B. & MCCB	L& K / GE / CROMPTON/C&S
22	POWER/CONTROL CABLE	HAVELLS / POLYCAB/ KEI
23	CENTRIFUGAL / AXIAL FANS	ABB / KRUGER / COMFREI / NUAIRE (UK)
24	INLINE FANS	KRUGER / NUAIRE / OSTBERG / SYSTEMAIR/ CARRYAIRE

NOTE: - Above makes of equipment are approved subject to their meeting the specifications.

The contractor however shall seek approval of specific make from Consultant/ Bank's Engineer before commencing the work. The decision of Consultant/ Bank's Engineer shall & binding on the contractor in this respect. Any other make of the equipment not specified shall be got approved by the Architect/Bank's Electrical engineer in charge as per requirement.

HOWEVER, THE ARCHITECT/ CONSULTANT/ BANK RESERVE THE RIGHT TO SELECT ANY OF THE APPROVED MAKE OF THESE ITEMS, WHERE MORE THAN ONE MAKE IS MENTIONED.

NB. 1) The contractor should obtain prior approval from Employer / Consultants before placing order for any specific materials. Employer may / delete any of the makes or brands out of the above list.

2) All materials should conform to relevant standards and codes of BIS.

3) Materials with I.S.I. mark shall be used duly approved by the SBI Engineer / Architect.

Note: - If any material is found to be not up to the mark, the contractor will have to produce original bills/certificate from the manufacturer or his authorised Distributor for authenticity and genuineness of the material for consideration and as per make approved by the SBI. The same will not be considered for payment.

BILL OF QUANTITY

PREAMBLE:

TO BE READ ALONG WITH DRAWINGS.

1. RATES TO BE QUOTED BOTH IN FIGURES AND WORDS.
2. ALL PAGES TO BE SIGNED AND STAMPED BY THE TENDERER.
3. THE RATE OF THE ITEMS SHALL BE APPLICABLE FOR ANY FLOOR LEVEL/ ANY NUMBER OF FLOORS, OR ANY QUANTITY.
4. THE SPECIFICATION OF THE ITEMS SHALL BE AS PER LATEST INDIAN STANDARD CODES UNLESS OTHERWISE SPECIFIED.
5. ALL MATERIALS SHALL BE AS PER APPROVED LIST AND SHOULD BE OF Ist QUALITY UNLESS OTHERWISE SPECIFIED.

6. THE RATES ARE INCLUSIVE OF ALL DUTIES AND TAXES (EXCEPT GST) OF ALL GOVERNMENT, MUNICIPAL OR ANY OTHER STATUTORY BODY APPLICABLE FROM TIME TO TIME.
7. RATES SHALL BE FOR ITEMS COMPLETE IN ALL RESPECTS AS PER DRAWING, INSTRUCTIONS AND APPROVAL OF THE ARCHITECT/ BANK'S ENGINEER.
8. THE QUANTITIES ARE APPROXIMATE AND TENTATIVE WHICH MAY VARY DURING COURSE OF EXECUTION. THE RATES QUOTED AGAINST PARTICULAR ITEM SHALL NOT BE CHANGED WITH VARIATION IN QUANTITIES.
9. MAKING OF ANY CUTOUT / OPENING FOR ELECTRICAL / AIR – CONDITIONING WIRING / FITTING IN ANY OF THE ITEM OF FALSE CEILING, PARTITIONS, PANELING MASONRY WORK ETC. AND FINISHING EDGES JAMBS / CILLS / SOFFITS OF THE OPENING SHALL NOT BE PAID EXTRA.
10. THE TENDERER SHALL VISIT THE SITE AND SHALL SATISFY HIMSELF AS TO CONDITIONS UNDER WHICH THE WORK IS TO BE PERFORMED. HE SHALL ALSO CHECK, ASCERTAIN THE LOCATIONS OF ANY EXISTING STRUCTURES OR EQUIPMENT OR ANY OTHER SITUATION WHICH MAY AFFECT THE WORK. NO EXTRA CLAIM AS A CONSEQUENCE OF IGNORANCE OR ON GROUND OF INSUFFICIENT DESCRIPTION WILL BE ALLOWED AT A LATER DATE.
11. THE QUOTED PRICE FOR ITEMS SHALL INCLUDE ALL ACCESSORIES, CONSUMMABLES ETC. AS REQUIRED TO MAKE THE ITEM COMPLETE IN ALL RESPECTS, COMPATIBLE WITH OTHER RELATED / ASSOCIATED ITEMS AND FULLY FUNCTIONAL.
12. CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR ANY ERROR, DIFFICULTY IN EXECUTION / DAMAGES INCURRED OWING TO DISCREPANCY IN DRAWINGS WHICH HAS BEEN OVERLOOKED BY HIM AND HAS NOT BEEN BROUGHT TO THE NOTICE OF THE ARCHITECT.
13. THERE ARE NUMBER OF ITEMS GIVEN IN THE TENDER WHERE IN BASIC RATES INCLUDING ALL TAXES EXPECTED HAS BEEN MENTIONED IN THE TENDER. THESE ITEMS SHALL BE PURCHASED BY THE CONTRACTOR FROM THE MARKET ONLY AFTER THE APPROVAL OF QUALITY AND RATES BY THE ARCHITECT.
14. ALL HIDDEN SURFACES OF BOARD / PLY / WOOD WORK TO BE PAINTED WITH ANTI BACTERIAL PAINT FROM NAV AIR INTERNATIONAL FR 881 (VIPER) (WHITE COLOUR AS PER MANUFACTURER'S SPECIFICATIONS ON WOOD / BOARD).
15. CONTRACTOR SHALL APPOINT TECHNICALLY QUALIFIED FULL TIME SITE SUPERVISOR TO MONITORING THE DAY TO DAY PROGRESS OF WORK AT SITE ON THEIR OWN COST.