



TENDER DOCUMENT

FOR

Supply, installation, testing and commissioning of HVAC system are using Variable Refrigerant Flow (VRF) system at vertical expansion (2nd to 6th floors) of IWAI office cum R & D complex at A-13, Sector-1, Noida.

TENDER NO. : IWAI/PR/Bldg./42/2011 (Vol. - III)

INLAND WATERWAYS AUTHORITY OF INDIA

(MINISTRY OF SHIPPING, GOVT. OF INDIA)

A - 13, SECTOR - 1

NOIDA - 201301 (U.P.)

Phone : 0120-2521704, 2521744, Fax : 0120- 2543973,

Website : www.iwai.nic.in ; E-mail : iwainoi@nic.in



INLAND WATERWAYS AUTHORITY OF INDIA

(Ministry of Shipping, Government of India)

A-13, SECTOR-1

NOIDA – 201 301 (U.P)

Phone : 0120-2521704, 2521744, Fax : 0120- 2543973,
Website: www.iwai.nic.in ; E mail : iwainoi@hub.nic.in

Tender No : IWAI/PR/Bldg./42/2011 (Vol. - III)

Issued to : M/s

Date :

Sub: Supply, installation, testing and commissioning of HVAC system are using Variable Refrigerant Flow (VRF) system at vertical expansion (2nd to 6th floors) of IWAI office cum R & D complex at A-13, Sector - 1, Noida.

Ref : Your letter no.

Dated :

Sir,

With reference to your letter cited on the above mentioned subject, please find enclosed herewith one set of tender document for the subject work. You are requested to go through the terms and conditions carefully and also visit/inspect the site to familiarize and submit your tender as per procedure explained in the tender document.

The last date for receipt of tender is 10.01.2013 upto 3:00 PM at IWAI, Noida and tender (Part-1 only) will be opened on 10.01.2013 at 3:30 PM at IWAI, Noida.

Issuance of tender document will not construe that such bidders are automatically considered qualified.

Dy. Director
IWAI, Noida



Supply, installation, testing and commissioning of HVAC system are using Variable Refrigerant Flow (VRF) system at vertical expansion (2nd to 6th floors) of IWAI office cum R & D complex at A-13, Sector - 1, Noida.

PART – I

TECHNICAL BID



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INLAND WATERWAYS AUTHORITY OF INDIA
(Ministry of Shipping, Govt. of India)
A-13, SECTOR-1
NOIDA – 201301 (U.P)

NOTICE INVITING TENDER
Tender no. IWAI/PR/Bldg./42/2011 (Vol. - III)

IWAI invites sealed tenders in two cover system from the eligible firm for following work:

Name of work	Estimated cost (Rs.)	EMD (Rs.)	Time for completion	Last Date of sale of Tender Document	Last date and time of receipt & opening of tender.
Supply, installation, testing and commissioning of HVAC system are using Variable Refrigerant Flow (VRF) system at vertical expansion (2 nd to 6 th floors) of IWAI office cum R & D complex at A-13, Sector - 1, Noida.	140.30 lakhs	2.81 lakhs	3 Months	08.01.2013	10.01.2013 3:00 PM 10.01.2013 3:30 PM

ELIGIBILITY CRITERIA:-

- (a) The firm shall have valid registration in appropriate class with CPWD, MES, Railways or any Central/State Govt. Organization and satisfactory completion of at least three similar works each of value not less than Rs. 56.00 lakhs or two similar works each of value not less than Rs. 70.00 lakhs or one work of value not less than Rs. 112.00 lakhs in last 7 years (year ending March, 2012). Similar work shall mean works of Supply, installation, testing and commissioning of HVAC system are using Variable Refrigerant Flow (VRF) system in multistoried building.

OR

Satisfactory completion of at least three similar works each of value not less than Rs. 56.00 lakhs or two similar works each of value not less than Rs. 70.00 lakhs or one work of value not less than Rs. 112.00 lakhs of CPWD, MES, Railways or any Central/State Govt. Organization in last 7 years (year ending March, 2012). Similar work shall mean works of Supply, installation, testing and commissioning of HVAC system are using Variable Refrigerant Flow (VRF) system in multistoried building.

- (b) The firm should have average annual financial turnover of Rs. 50.00 lakhs of Supply, installation, testing and commissioning of HVAC system are using Variable Refrigerant Flow (VRF) system.
- (c) The firm should not have incurred loss for more than 2 years during preceding five years ending 31st March, 2012.
- (d) The firm shall be working in the field of Supply, installation, testing and commissioning of HVAC system are using Variable Refrigerant Flow (VRF) system works for the past 3 years consistently.
- (e) The firm should have valid registration for service tax VAT and should have Permanent Account Number (PAN).

Parties fulfilling the above indicative eligibility criteria can purchase tender document from office of the Dy. Director IWAI, A - 13, Sector - 1, Noida - 201301 by paying Rs. 500/- (Rupees five hundred only) in the form of non-refundable demand draft in favour of 'IWAI Fund' payable at Noida/New Delhi at any nationalized/scheduled bank on any working day from Monday to Friday during office hours between 9:30 to 18:00 hours up to the last date of issue of tender as indicated above. The tender document can also be downloaded from the IWAI's website "www.iwai.nic.in". Site can be inspected on all the working days during office hours. IWAI reserves the right to reject any or all the tender without assigning any reason thereof.

Sd/-
Dy. Director



INLAND WATERWAYS AUTHORITY OF INDIA
(Ministry of Shipping, Govt. of India)
A-13, SECTOR-1 NOIDA – 201301 (U.P)

No. IWAI/PR/Bldg./42/2011

NOTICE INVITING TENDER

IWAI invites sealed tenders in two cover system from the firm having valid registration in appropriate Class with CPWD, MES, Railways or any Central / State Govt. Organization for the following work:-

Name of work	Estimated cost (Rs.)	EMD (Rs.)	Time for completion	Last Date of sale of Tender Document	Last date and time of receipt & opening of tender.
Supply, installation, testing and commissioning of HVAC system are using Variable Refrigerant Flow (VRF) system at vertical expansion (2 nd to 6 th floors) of IWAI office cum R & D complex at A-13, Sector - 1, Noida.	140.30 lakhs	2.81 lakhs	3 Months	08.01.2013	10.01.2013 3:00 PM 10.01.2013 3:30 PM

Detailed NIT eligibility criteria and tender document alongwith Instruction to the Bidders can be seen at IWAI's website i.e. www.iwai.nic.in

Dy. Director



FORM OF TENDER

To,

The Dy. Director,
Inland Waterways Authority of India,
A-13, Sector-1,
Noida – 201301 (U.P.)

Name of Work: Supply, installation, testing and commissioning of HVAC system are using Variable Refrigerant Flow (VRF) system at vertical expansion (2nd to 6th floors) of IWAI office cum R & D complex at A-13, Sector - 1, Noida.

Sir,

1. Having visited the site and examined the General, Special and other Conditions of contracts, General specifications and Detailed specifications, Schedules and Bill of Quantities alongwith all appendix and annexure for the above work, I/We offer to execute the above said work in conformity with the said Conditions of Contract, Specifications, Schedule of quantities for the sum as stated in Bill of quantities of this tender Document or such other sum as may be ascertained in accordance with the said conditions of contract.

2. I/We undertake to complete and deliver the whole of the work comprised in the tender within the time as stated in the tender and also in accordance with the specifications, conditions and instructions as mentioned in the tender documents.

3. I/We have independently considered the amount of Liquidated Damages shown in the tender hereto and agree that it represents a fair estimate of the loss likely to be suffered by IWAI in the event of works not being completed in time.

4. I/We agree to abide by this tender. I/We agree to keep the tender open for a period of 90 days from the date of opening of price bids or extension thereto as required by the IWAI and not to make any modifications in its terms and conditions.

5. A sum or Rs.....(Rupees)
is hereby forwarded in the form of Demand Draft no..... dated issued by (name & branch of bank)
payable at as earnest Money. I/We agree, if I/We fail to keep the validity of the tender open as aforesaid or I/we make the modifications in the terms and conditions of my/our tender or I/we fail to commence the execution of the works as above than I/We shall become liable for forfeiture of my/our Earnest money, as aforesaid and IWAI shall without any prejudice to another right or remedy, be at the liberty to forfeit the said Earnest Money absolutely otherwise the said earnest money shall be retained by IWAI towards part of security deposit to execute all the works referred to in the tender documents upon the terms and conditions contained or referred to therein and to carry out such deviations as may be ordered. Should this tender be accepted, I/We agree to abide by and fulfill all the terms and conditions and provisions of this tender. No interest is payable on earnest money deposit and/or security deposit.

6. If this tender is accepted, I/We undertake to enter into, at my/our cost when called upon by the employer to do so, a contract agreement in the prescribed form. Unless and until a formal agreement is prepared and extended this tender together with your acceptance thereto shall constitute a binding contract.

7. I/We agree that if my/our tender is accepted, I/We am/are to be jointly and severally responsible for the due performance of the contract.

8. I/We understand that you are not bound to accept the lowest or any tender you may receive and may reject all or any tender without assigning any reason.

9. I/We are enclosing herewith "Time Activity Schedule" so as to complete the work within stipulated time.

10. I/We confirm that all statements documents, information submitted/given with this tender or in support of tender is/are true, genuine, authentic, legitimate and valid. I agree that at any time before award of work or after award to selected/successful bidder in case any of these statement document, information is/are found incorrect, false, willful misrepresentation or omission of facts or submission of false/forged documents, the EMD/Security deposit submitted by me/us shall be forfeited by IWAI.

11. I/We certify that the tender submitted by me/us is strictly in accordance with the terms, conditions, specifications etc. as contained in the tender document, and it is further certified that it does not contain any deviation to the aforesaid documents.

Date

Signature

Name

Designation

duly authorized to sign & submit tender for an on behalf of

(Name and address of firm)

M/s

.....

.....

Telephone Nos.

FAX No.

Witness:

Signature:

Name :

Occupation:

Address:

.....

Telephone nos.:

INSTRUCTION FOR SUBMISSION OF BID

1. All covering letters and information to be included in the bid shall be submitted along with the bid itself.
2. Tender should be submitted in two covers viz. separate sealed Envelope-1 (containing technical bid) and Envelope-2 (containing price bid) and both of these covers should be placed in an envelope duly super scribing clearly the name of the work **“BID FOR SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF HVAC SYSTEM ARE USING VARIABLE REFRIGERANT FLOW (VRF) SYSTEM AT VERTICAL EXPANSION (2nd TO 6th FLOORS) OF IWAI OFFICE CUM R & D COMPLEX AT A-13, SECTOR - 1, NOIDA.”** and **“TO BE OPENED BY THE ADDRESSEE ONLY”** written prominently. The full name, postal address and Telex/telegraphic address of the Bidder shall be written on the bottom left hand corner of the sealed envelope. Further envelope containing each part shall be superscripted as under:
3. The first cover/envelope containing Part-1 shall be submitted along with the following documents and the cover should be super scribed with **“ENVELOPE-1 : TECHNICAL BID FOR SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF HVAC SYSTEM ARE USING VARIABLE REFRIGERANT FLOW (VRF) SYSTEM AT VERTICAL EXPANSION (2nd TO 6th FLOORS) OF IWAI OFFICE CUM R & D COMPLEX AT A-13, SECTOR - 1, NOIDA.**
 - a) Original bid document duly filled in and completed in all respects except prices, signed with rubber seal on each page as a proof of acceptance.
 - b) Earnest Money Deposit (Demand Draft)
 - c) Memorandum of Association & Article of Association/Partnership deeds, as applicable.
 - d) Copy of document in proof of registration as air-conditioning contractor in appropriate Class with CPWD, MES, Railways or any Central / State Govt. Organization. Description of the bidders works experience of similar nature during last seven years along with documentary proof (ending March, 2012).
 - e) Balance Sheet and the Profit & Loss Account together with Tax Audit Report duly certified by a firm of Chartered Accountant for the last 3 financial years.
 - f) Bidder shall furnish list of the supervisory persons and other technical persons he wish to deploy in this job along with their experience details.
 - g) Letter of Authority for signing and negotiation of bid.
 - h) Document in the respect of PAN, service tax, VAT number/registration.
 - i) Solvency certificate from any nationalized /scheduled bank.
 - j) Receipted copy of the return of Income filed with Income Tax Authority for last 3 years.
 - k) Receipted copy of Return of Employees Provident Fund (EPF) for last three years.
 - l) Any additional relevant information to be furnished by the bidder.

The Second cover containing Part-2 shall be submitted along with the following documents and the cover should be super scribed with **“ENVELOPE-2:PRICE BID FOR SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF HVAC SYSTEM ARE USING VARIABLE REFRIGERANT FLOW (VRF) SYSTEM AT VERTICAL EXPANSION (2nd TO 6th FLOORS) OF IWAI OFFICE CUM R&D COMPLEX AT A-13, SECTOR-1, NOIDA.**

- a) Schedule of prices duly filled in.

It may please be noted that:-

- (a) The price bid part shall not contain any terms and conditions whatsoever. These, if any, must be brought out in Part- I only. Any condition given in the price bid will not be taken into account and it will be sufficient cause for rejection of bid.
 - (b) Price bids of only those bidders whose technical and commercial proposals are complete and found acceptable, shall be opened in the presence of bidders or their authorized representatives who may like to be present, on a suitable date to be intimated to such tenderers separately.
4. Bidders are advised to submit their offers strictly based upon the detail terms and conditions contained in “INSTRUCTION TO BIDDERS” being a part of this tender document and not to stipulate any deviations. Should it, however, become unavoidable, deviations should be stipulated in part – I of the tender. IWAI reserves the right to evaluate bids containing such deviations and accept or reject any part or whole of the same without showing any reason whatsoever.
 5. IWAI reserves the right to reject any or all bids without assigning any reasons.
 6. Bids received late at IWAI’s office after the stipulated last date and time for receipt of bids due to any reason whatsoever, will not be considered. Bids shall be adjudged as non-responsive due to any of the following reasons:
 - (a) Bids submitted after the due date and time.
 - (b) Bids submitted without Earnest money,
 - (c) Bids submitted without certificate(s) in respect of the financial and technical qualification criteria.
 - (d) Bids submitted without documents to establish the eligibility criteria.
 - (e) Bids submitted without photocopies of the receipted copies of VAT, IT and PF Returns from the respective Competent Authority.
 - (f) Qualified Price Bid.
 - (g) Any other reason as applicable.
 7. The bid can only be submitted in the name of the bidder in whose name the bid documents are issued by IWAI.
 8. Any annotation or accompanying documentation in the bid shall be in Hindi or English language only and in metric system. Bid filled in any other language will be summarily rejected.
 9. The firms interested in the work must have a good track record and must not have been black-listed by any Government Organization/ PSUs / Statutory Body / Major Ports in course of last 5 years. Bids of such black listed firms will not be considered by the Authority. The intending tenderers must have positive net worth as on 31.03.2012. This fact should be certified by a Chartered Accountant. The tenderer must also submit banker’s certificate along with the offer regarding the financial credibility/solvency of the firm.
 10. Bidder shall sign their proposal with the exact name of the firm to whom the bid document has been issued. The bid shall be duly signed and sealed by an authorized person of the bidders’ organization as following:
 - (a) If the Tender is submitted by an individual, it shall be signed by the proprietor above his full name and full name of his firm with its current business address.

- (b) If the Tender is submitted by the proprietary firm, it shall be signed by the proprietor above his full name and full name of his firm with its name and current business address.
 - (c) If the Tender is submitted by a firm in partnership, it shall be signed by all the partners of the firm above, their full names and current business address, or by a partner holding the power of attorney for the firm for signing the Tender in which cases a certified copy of the power of attorney shall accompany the Tender. A certified copy of the partnership deed and current business address of all the partners of the firm shall also accompany the Tender.
 - (d) If the Tender is submitted by a limited company, or a limited Corporation, it shall be signed by a duly authorized person holding the power of attorney for signing the tender in which case a certified copy of the power of attorney shall accompany the Tender. Such limited company or corporation may be required to furnish satisfactory evidence of its existence before the contract is awarded. 'Satisfactory evidence' means the certificate of incorporation of the limited company or corporation under Indian Companies Act, 1956.
 - (e) Two or more firms interested in work may also submit joint bid. In such case, all the firms have to submit a memorandum of understanding alongwith the joint bid. In that case, the lead partner will sign all tender documents. The sponsoring firm/lead partner shall submit complete information pertaining to each firm in the group and state along with the bid as to which of the firm shall have the responsibility for tendering and for completion of the contract document and furnish evidence admissible in law in respect of the authority assigned to such firm on behalf of the group of firms for tendering and for completion of the contract document. The full information and satisfactory evidence pertaining to the participation of each member of the group of firm in the firm in the Tender shall be furnished alongwith the Tender.
11. Bidders shall clearly indicate their legal constitution and the person signing the bid shall state his capacity and also the source of his ability to bind the bidder. The power of attorney or authorization or any other document constituting adequate proof of the ability of the signatory to bind the bidder shall be annexed to the bid. The owner may reject outright any bid unsupported by inadequate proof of the signatory's authority.
 12. The bid document shall be completed in all respects and shall be submitted together with the requisite information and appendices. They shall be completed and free from ambiguity, change or inter-lineation.
 13. If the space in the bid form or in the Appendices thereto is insufficient, additional pages shall be separately added. These pages shall be page numbered & signed by the Bidder.
 14. Bidder shall set their quotation in firm figures and without qualification. Each figure stated should also be repeated in words and in the event of any discrepancy between the amounts stated in figures and words, the amount quoted in words shall be deemed the correct amount. Bid containing qualifying expressions such as "subject to minimum acceptance" of "subject to availability of material / equipment" etc. is liable to be rejected.
 15. IWAI shall have a unqualified option under the said bid bond to forfeit the EMD in the event of Bidder failing to keep the bid valid upto the date specified or refusing to accept work or carry it out in accordance with the bid if the IWAI decides to award the work to the Bidder.

16. The EMD shall be retained with the IWAI until finalization of tenders. If any statements documents/information submitted by tenderer is found false/incorrect, willful misrepresented or omission of facts or fake/forged documents, the EMD shall be forfeited.
17. IWAI shall, however, release the EMD in respect of unsuccessful bidders within 30 (thirty) days of placement of order to successful bidder. EMD of successful bidder will be converted into security refundable deposit. In case of any breach of contract, EMD will be forfeited.
18. The EMD shall be retained with the IWAI until finalization of tenders. Further, security deposit as per the clause of Security shall be payable by the successful bidder. If the tenderer fails to furnish the security deposit or performance guarantee in accordance with tender conditions, EMD shall be forfeited. In the event of the Bidder becoming the successful Contractor. The amount of EMD would be adjusted against the Security deposit.
19. IWAI shall, however, arrange to release the EMD in respect of unsuccessful bidders within 30 (thirty) days of placement of order to successful bidder. No interest shall be payable on EMD by IWAI.

DEFINITIONS

1. The contract means the documents forming the tender and acceptance thereof and the format agreement executed between the Competent Authority on behalf of the Chairman, Inland Waterways Authority of India and the contractor, together within the documents referred to therein including these conditions, the specifications, designs, drawings and instructions issued from time to time by the Engineer-in-charge and all these documents taken together shall be deemed to form one contract and shall be complementary to one another.
2. In the contract, the following expressions shall, unless the context otherwise requires, have the meanings, hereby respectively assigned to them;
 - (i) The expression work or works shall unless there be something either in the subject or context repugnant to such constructions be construed and taken to mean the works by or by virtue of the contract to be executed whether temporary or permanent, and whether original offered substituted or additional.
 - (ii) The 'Contractor' shall mean the individual, firm or company, whether incorporated or not, undertaking the works and shall include the legal personal representative of such individual or the persons composing such firm or company, or the successors of such firm or company and the permitted assignees of such individual, firm or company.
 - (iii) The 'Employer' means the Chairman, Inland Waterways Authority of India and his successors.
 - (iv) The 'Engineer/ Engineer-in-charge' means the Engineer officer who shall supervise and be in charge of the work and who shall sign the contract on behalf of the Employer.
 - (v) 'Engineer-in-charge representative' shall mean any officer of the Authority nominated by the Engineer to work on his behalf for supervision, checking, taking measurement, checking bills ensuring quality control, inspecting works, issue instructions and other related works for completion of the project.
 - (vi) 'IWAI/Authority/Department/Owner' shall mean the Inland Waterways Authority of India, which invites tenders on behalf of the Chairman, IWAI.
 - (vii) The 'Site' shall mean premises no. A-13, Sector – 1, Noida of owner on which the works are to be executed under this contract.
 - (viii) The term 'Day' shall mean a calendar day beginning and ending at midnight.
 - (ix) The term 'Week' shall mean seven consecutive calendar days.
 - (x) The term 'Month' shall mean the English calendar month.

- (xi) Excepted Risk are risks due to riots (other than those on account of contractors employees) war (whether declared or not) invasion, act of foreign enemies, hostilities, civil war, rebellion, revolution, insurrection, military or usurped power, any act of Govt. damages, acts of God, such as earthquake, lightning and unprecedented flood, and other causes over which the contractor has no control and accepted as such by the Accepting Authority or causes solely due to use or occupation by Govt. of the part the works in respect of which a certificate of completion has been issued or a cause solely due to Govt., faulty design of works.
- (xii) Market rate shall be as decided by the Engineer-in-charge on the basis of the cost of materials and labour at the site where the work is to be executed plus and percentage mentioned in tender to cover all overheads and profits.
- (xiii) Schedules referred to in these conditions shall mean the relevant schedules annexed to the tender papers or the standard schedule of rates of the Govt. mentioned with the amendments thereto issued up to the date of receipt of the tender.
- (xiv) District specifications mean specifications followed by the State Government in the area where the work is to be executed.
- (xv) Tendered value means the value of the entire work as stipulated in the letter of award.

Interpretation Clause

- The 'Chairman' means the Chairman of Inland Waterways Authority of India.
- Word Importing the singular number only includes the plural number and vice versa.



Integrity Pact

To,

M/s

Sub:- NIT No. IWAI/PR/Bldg./42/2011 (Vol.-III) for the work of Supply, installation, testing and commissioning of HVAC system are using Variable Refrigerant Flow (VRF) system at vertical expansion (2nd to 6th floors) of IWAI office cum R & D complex at A-13, Sector - 1, Noida.

Dear Sir,

It is hereby declare that IWAI is committed to follow the principle of transparency, equity and competitiveness in public procurement.

The subject Notice Inviting Tender (NIT) is an invitation to offer made on the condition that the Bidder will sign the integrity Agreement, which is an integral part of tender/bid documents, failing which the tenderer/bidder will stand disqualified from the tendering process and the bid of the bidder would be summarily rejected.

This declaration shall form part and parcel of the Integrity Agreement and signing of the same shall be deemed as acceptance and signing of the Integrity Agreement on behalf of the IWAI.

Yours faithfully

Dy. Director

To,

The Dy. Director,
Inland Waterways Authority of India,
A-13, Sector-1,
Noida – 201301 (U.P.)

Sub: Submission of Tender for the Work for Supply, installation, testing and commissioning of HVAC system are using Variable Refrigerant Flow (VRF) system at vertical expansion (2nd to 6th floors) of IWAI office cum R & D complex at A-13, Sector - 1, Noida.

Dear Sir,

I/We acknowledge that IWAI is committed to follow the principles thereof as enumerated in the Integrity Agreement enclosed with the tender/bid document.

I/We agree that the Notice Inviting Tender (NIT) is an invitation to offer made on the condition that I/We will sign the enclosed integrity Agreement, which is an integral part of tender documents, failing which I/We will stand disqualified from the tendering process.

I/We acknowledge that the making of the bid shall be regarded as an unconditional and absolute acceptance of this condition of the NIT.

I/We confirm acceptance and compliance with the Integrity Agreement in letter and spirit and further agree that execution of the said Integrity Agreement shall be separate and distinct from the main contract, which will come into existence when tender/bid is finally accepted by IWAI. I/We acknowledge and accept the duration of the Integrity Agreement, which shall be in the line with Article 1 of the enclosed Integrity Agreement.

I/We acknowledge that in the event of my/our failure to sign and accept the Integrity Agreement, while submitting the tender/bid, IWAI shall have unqualified, absolute and unfettered right to disqualify the tenderer/bidder and reject the tender/bid in accordance with terms and conditions of the tender/bid.

Yours faithfully

(Duly authorized signatory of the Bidder(s))

To be signed by the bidders' and same signatory competent/authorised to sign the relevant contract on behalf of IWAI.

INTEGRITY AGREEMENT

This Integrity Agreement is made at on this Day of..... 20.....

BETWEEN

Chairman, Inland Waterways Authority of India represented through Chief Engineer, Inland Waterways Authority of India, A - 13, Sec. – 1, Noida.

IWAI, (Hereinafter referred as the 'Principal/ Owner', which expression shall unless repugnant to the meaning or context hereof include its successors and permitted assigns)

AND

.....
(Name and Address of the Individual/Firm/Company)
through(Hereinafter referred to as the
(Details of duly authorized signatory)
"Bidder/Contractor" and which expression shall unless repugnant to the meaning or context hereof include its successors and permitted assigns)

Preamble

WHEREAS the Principal / Owner has floated the Tender [NIT No. IWAI /PR /Bldg. / 42 / 2011 (Vol.-III)] (hereinafter referred to as "Tender/Bid") and intends to award, under laid down organizational procedure, contract for "Supply, installation, testing and commissioning of HVAC system are using Variable Refrigerant Flow (VRF) system at vertical expansion (2nd to 6th floors) of IWAI office cum R & D complex at A-13, Sector - 1, Noida".

AND WHEREAS the Principal/Owner values full compliance with all relevant laws of the land, rules, regulations, economic use of resources and of fairness/transparency in its relation with its Bidder(s) and Contractor(s).

AND WHEREAS to meet the purpose aforesaid both the parties have agreed to enter into this Integrity Agreement (hereinafter referred to as "Integrity Pact" or "Pact"), the terms and conditions of which shall also be read as integral part and parcel of the Tender/Bid documents and Contract between the parties.

NOW, THEREFORE, in consideration of mutual covenants contained in this Pact, the parties hereby agree as follows and this Pact witnesses as under:

Article 1: Commitment of the Principal/Owner

- 1) The Principal/Owner commits itself to take all measures necessary to prevent corruption and to observe the following principles:
 - (a) No employee of the Principal/Owner, personally or through any of his/her family members, will in connection with the Tender, or the execution of the Contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.
 - (b) The Principal/Owner will, during the Tender process, treat all Bidder(s) with equity and reason. The Principal/Owner will, in particular, before and during the Tender process, provide to all Bidder(s) the same information and will not provide to any Bidder(s) confidential / additional information through which the Bidder(s) could obtain an advantage in relation to the Tender process or the Contract execution.
 - (c) The Principal/Owner shall endeavour to exclude from the Tender process any person, whose conduct in the past has been of biased nature.
- 2) If the Principal/Owner obtains information on the conduct of any of its employees which is a criminal offence under the Indian Penal code (IPC)/Prevention of Corruption Act, 1988 (PC Act) or is in violation of the principles herein mentioned or if there be a substantive suspicion in this regard, the Principal/Owner will inform the Chief Vigilance Officer and in addition can also initiate disciplinary actions as per its internal laid down policies and procedures.

Article 2: Commitment of the Bidder(s)/Contractor(s)

1. It is required that each Bidder/Contractor (including their respective officers, employees and agents) adhere to the highest ethical standards, and report to the IWAI all suspected acts of fraud or corruption or Coercion or Collusion of which it has knowledge or becomes aware, during the tendering process and throughout the negotiation or award of a contract.
2. The Bidder(s)/Contractor(s) commit himself to take all measures necessary to prevent corruption. He commits himself to observe the following principles during his participation in the Tender process and during the Contract execution:
 - a) The Bidder(s)/Contractor(s) will not, directly or through any other person or firm, offer, promise or give to any of the Principal/Owner's employees involved in the tender process or execution of the contract or to any third person any material or other benefit which he/she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the Tender process or during the execution of the contract.
 - b) The Bidder(s)/Contractor(s) will not enter with other Bidder(s) into any undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to cartelize in the bidding process.
 - c) The Bidder(s)/Contractor(s) will not commit any offence under the relevant IPC/PC Act. Further the Bidder(s)/Contractor(s) will not use improperly, (for the purpose of competition or personal gain), or pass on to others, any information or documents provided by the Principal/Owner as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.

- d) The Bidder(s)/Contractor(s) of foreign origin shall disclose the names and addresses of agents/representatives in India, if any. Similarly Bidder(s)/Contractor(s) of Indian Nationality shall disclose names and addresses of foreign agents/representatives, if any. Either the Indian agent on behalf of the foreign principal or the foreign principal directly could bid in a tender but not both. Further, in cases where an agent participate in a tender on behalf of one manufacturer, he shall not be allowed to quote on behalf of another manufacturer along with the first manufacturer in a subsequent/parallel tender for the same item.
 - e) The Bidder(s)/Contractor(s) will, when presenting his bid, disclose any and all payments he has made, is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the Contract.
3. The Bidder(s)/Contractor(s) will not instigate third persons to commit offences outlined above or be an accessory to such offences.
 4. The Bidder(s)/Contractor(s) will not, directly or through any other person or firm indulge in fraudulent practice means a willful misrepresentation or omission of facts or submission of fake/forged documents in order to induce public official to act in reliance thereof, with the purpose of obtaining unjust advantage by or causing damage to justified interest of others and/or to influence the procurement process to the detriment of the Government interests.
 5. The Bidder(s)/Contractor(s) will not, directly or through any other person or firm use Coercive Practices (means the act of obtaining something, compelling an action or influencing a decision through intimidation, threat or the use of force directly or indirectly, where potential or actual injury may befall upon a person, his/ her reputation or property to influence their participation in the tendering process).

Article 3: Consequences of Breach

Without prejudice to any rights that may be available to the Principal/Owner under law or the Contract or its established policies and laid down procedures, the Principal/Owner shall have the following rights in case of breach of this Integrity Pact by the Bidder(s)/Contractor(s) and the bidder/contractor accepts and undertakes to respect and uphold the Principal/Owner's absolute right:

1. If the Bidder(s)/Contractor(s), either before award or during execution of Contract has committed a transgression through a violation of Article 2 above or in any other form, such as to put his reliability or credibility in question, the Principal/Owner after giving 14 days' notice to the contractor shall have powers to disqualify the Bidder(s)/Contractor(s) from the tender process or terminate/determine the Contract, if already executed or exclude the Bidder/Contractor from future contract award processes. The imposition and duration of the exclusion will be determined by the severity of transgression and determined by the Principal/Owner. Such exclusion may be forever or for a limited period as decided by the Principal/Owner.
2. Forfeiture of EMD/Performance Guarantee/Security Deposit: If the Principal/Owner has disqualified the Bidder(s) from the tender process prior to the award of the contract or terminated/determined the contract or has accrued the right to terminate/determine the contract according to Article 3(1), the Principal/Owner apart from exercising any legal rights that may have accrued to the Principal/Owner, may in its considered opinion forfeit the entire amount of Earnest Money Deposit, Performance Guarantee and Security Deposit of the Bidder/Contractor.

3. **Criminal Liability:** If the Principal/Owner obtains knowledge of conduct of a bidder or Contractor, or of an employee or a representative or an associate of a bidder or Contractor which constitutes corruption within the meaning of IPC Act, or if the Principal/Owner has substantive suspicion in this regard, the Principal/Owner will inform the same to law enforcing agencies for further investigation.

Article 4: Previous Transgression

- 1) The Bidder declares that no previous transgressions occurred in the last 5 years with any other Company in any country confirming to the anticorruption approach or with Central Government or State Government or any other Central/State Public Sector Enterprises in India that could justify his exclusion from the Tender process.
- 2) If the Bidder makes incorrect statement on this subject, he can be disqualified from the Tender process or action can be taken for banning of business dealings/ holiday listing of the Bidder/Contractor as deemed fit by the Principal/ Owner.
- 3) If the Bidder/Contractor can prove that he has resorted / recouped the damage caused by him and has installed a suitable corruption prevention system, the Principal/Owner may, at its own discretion, revoke the exclusion prematurely.

Article 5: Equal Treatment of all Bidders/Contractors/Subcontractors

- 1) The Bidder(s)/Contractor(s) undertake(s) to demand from all subcontractors a commitment in conformity with this Integrity Pact. The Bidder/Contractor shall be responsible for any violation(s) of the principles laid down in this agreement/Pact by any of its Subcontractors/ sub-vendors.
- 2) The Principal/Owner will enter into Pacts on identical terms as this one with all Bidders and Contractors.
- 3) The Principal/Owner will disqualify Bidders, who do not submit, the duly signed Pact between the Principal/Owner and the bidder, along with the Tender or violate its provisions at any stage of the Tender process, from the Tender process.

Article 6- Duration of the Pact

This Pact begins when both the parties have legally signed it. It expires for the Contractor/Vendor 12 months after the completion of work under the contract or till the continuation of defect liability period, whichever is more and for all other bidders, till the Contract has been awarded.

If any claim is made/lodged during the time, the same shall be binding and continue to be valid despite the lapse of this Pacts as specified above, unless it is discharged/determined by the Competent Authority, IWAI.

Article 7- Other Provisions

- 1) This Pact is subject to Indian Law, place of performance and jurisdiction is the Headquarters of the Division of the Principal/Owner, who has floated the Tender.
- 2) Changes and supplements need to be made in writing. Side agreements have not been made.

- 3) If the Contractor is a partnership or a consortium, this Pact must be signed by all the partners or by one or more partner holding power of attorney signed by all partners and consortium members. In case of a Company, the Pact must be signed by a representative duly authorized by board resolution.
- 4) Should one or several provisions of this Pact turn out to be invalid; the remainder of this Pact remains valid. In this case, the parties will strive to come to an agreement to their original intentions.
- 5) It is agreed term and condition that any dispute or difference arising between the parties with regard to the terms of this Integrity Agreement / Pact, any action taken by the Owner/Principal in accordance with this Integrity Agreement/ Pact or interpretation thereof shall not be subject to arbitration.

Article 8- LEGAL AND PRIOR RIGHTS

All rights and remedies of the parties hereto shall be in addition to all the other legal rights and remedies belonging to such parties under the Contract and/or law and the same shall be deemed to be cumulative and not alternative to such legal rights and remedies aforesaid. For the sake of brevity, both the Parties agree that this Integrity Pact will have precedence over the Tender/Contact documents with regard any of the provisions covered under this Integrity Pact.

IN WITNESS WHEREOF the parties have signed and executed this Integrity Pact at the place and date first above mentioned in the presence of following witnesses:

.....
 (For and on behalf of Principal/Owner)

.....
 (For and on behalf of Bidder/Contractor)

WITNESSES:

1.
 (Signature, name and address)

2.
 (Signature, name and address)

Place:

Date:

GENERAL CONDITIONS

1. All supplies proposed to be obtained on contract are as notified in Notice Inviting Tender published in newspapers.

This form will state the supplies to be made as well as the date for submitting and opening tenders and the time allowed for carrying out the work, also the amount of the earnest money to be deposited with the tender and the amount of the security deposit to be deposited by the successful tender and the percentages, to be deducted from bills, copies of the specifications and any other documents required in connection with the work, signed for the purpose of identification by the Engineer-in-charge. These documents shall also be open for inspection by the contractor at the office of the Inland Waterways Authority of India during office hours.

2. In the event of the tender being submitted by a firm, it must be signed separately by each member thereof, in the event of the absence of any partner, it must be signed on his behalf by a person holding a valid power of attorney authorizing him to do so, such power of attorney shall be produced with the tender and it must disclose that the firm is duly registered under the Indian Partnership Act.
3. Receipts for payment made to a firm must also be signed by the several partners except where the contractor as described in their tender is a firm, in which case the receipt must be signed in the name of firm by one of the partners, or by some other person having authority to give effectual receipts for the firm.
4. Any person who submits a tender shall fill up the supplied form stating at what rate he is willing to undertake each item of the work. Tenderers who propose alteration in the work specified in the said form of invitation to tender or in the time allowed for carrying out the work or which contain any other conditions of any sort will be liable for rejection. No single tender shall include more than one work, but contractors wish to tender for two or more works shall submit a separate tender for each. Tenders shall have the name and number of the work to which they refer written outside the envelope.
5. The Engineer-in-charge or his duly authorized representative will open tenders in the presence of any intending bidders who may be present at the time, and will enter the amounts of the several tenders in a Comparative Statement in a suitable form. In the event of a tender being accepted a receipt for the earnest money forwarded therewith shall thereupon be given to the contractor who shall thereupon for the purpose of identification sign, copies of the specification and other documents mentioned in rule 1. In the event of a tender being rejected the earnest money forwarded with such unaccepted tender shall thereupon be returned to the respective bidder.
6. The officer inviting tenders shall have the right of rejecting any or all of the tenders without assigning any reason and will not be bound to accept the lowest tender.
7. The receipt of the Finance Department for any money paid by the contractor will be considered as payment to the Engineer-in-charge and the contractor shall be responsible for seeing that he produces a receipt signed by the Engineer-in-charge or the authorized signatory of Finance Department of Inland Waterways Authority of India (IWAI), Noida.

8. The person/persons, whose tender(s) may be accepted (herein after called the contractor) shall permit IWAI/Govt. at the time of making any payment to him for work done under the contract to deduct such sum as long with the sum already deposited as earnest money will amount to 5% of the total cost of the work. Such deduction to be held by Govt. by way of security deposit provided always that the Govt. for this purpose should be entitled to recover the amount from each running bill unit the balance of the amount of security deposit is realized. All compensation or other sums of money payable by the contractor under the terms of this contract may be deducted from or paid by the sale of a sufficient part of his security deposit. In case security deposit is reduced by reasons of any deductions or sale as aforesaid the contractor shall within 10 days make good in cash or demand draft in favour of the Inland Waterways Authority of India. The security deposit shall be collected from the running bills of that contractor at the rates mentioned above and the earnest money if deposited at the time of tender will be treated as part of security deposit. No interest shall be payable on security deposit or Earnest Money Deposit.
9. The Security Deposit of Contractor shall not be refunded before the expiry of guarantee period stipulated in the contract.

CLAUSES:

1. The contractor is to complete his work under this contract on or-before the date mentioned in the tender failing which he shall be subject to pay or allow deduction of one percent on the total amount of the contract for every day of delay subject to a total deduction of 10% of the tender value/agreement amount or the value of final bill whichever is more as liquidated damages to the IWAI.
2. In every case in which the payment or allowance mentioned in clause 1 shall have incurred for ten consecutive days, the Engineer-in-charge shall have the power to annul the contract and or have the supply completed at the contractors risk and expenses without any further notice to him and the contractor shall have no claim to compensation for any loss that may incur in any case.
3. If the contractor shall be hindered in the supply of the materials so as to necessitate an extension of the time allowed in this tender, he shall apply in writing to the Engineer-in-charge who shall grant it in writing if there are reasonable ground for it, and without such Authority in writing by the Engineer-in-charge, the contractor shall not claim exempted from the fine livable under Clause 2. For the completion of the rest of the works the contractor shall be entitled such extension of time as may be determined by the Engineer-in-charge.
4. The contractor shall inform the Engineer-in-charge of his intention of making delivery of materials and on the materials being approved the Engineer-in-charge or his authorized representative shall grant a receipt to him no material will be considered as delivered until so approved.
5. On the completion of the delivery of material the contractor shall be furnished with a certificate to that effect by the Engineer-in-charge but the delivery will not be considered complete until the contractor shall have removed all rejected materials and shall have the approved materials stocked or placed in such positions as be pointed out to him.

6. If at any time after the commencement of the supplies the Chairman, IWAI/Government shall for any reason whatsoever not require the whole or part thereof as specified in the tender to be supplied, the Engineer-in-charge shall in addition to his power to annul the contract in case of default on the part of the contractor, have power to terminate all liability of the IWAI/Govt. there under at any time after giving due notice in writing to the contractor of his desire to do so. In the event of such a notice being given:
 - (a) The Engineer-in-charge shall be entitled to direct the contractor to complete the supply of the material which are ready for delivery up to the expiry of the notice and thereafter to cease their supply, all the articles or supplies received and accepted up to that date shall be paid for at the tender rate, and.
 - (b) The contractor shall have no claim to any payment or compensation what-so-ever on account of any profit or advantage which he might have derived in consequence of his full execution of the contract but which he did not obtain owing to its premature termination or for any loss which he might have sustained on this account.
7. No payment should be made for a work estimated to cost rupees five thousand or less till the whole of the work shall have been completed and certificate of completion given. But in the case of work estimated to cost more than rupees five thousand and contractor shall on submitting the bill be entitled to receive a monthly payment proportionate to the part thereof then executed to the satisfaction of the Engineer-in-charge, whose certificate of the sum of payable shall be final and conclusive against the contractor.
8. Payment due to the contractor may, if so desired by him, be made to his bank instead direct to him, provided that the contractor furnishes to the Engineer-in-charge (1) an authorization in the form of a legally valid documents such as a power of attorney containing authority on the bank to receive payment and (2) his own acceptance of the correctness of the account made out as being due to him by Government or his signature on the bill or other claim preferred against Govt. before settlement by the Engineer-in-charge of the account of claim by payment to the bank while the receipt by such bank shall constitute a full and sufficient discharge for the payment, the contractor should, wherever possible present his bills duly receipted and discharge through his bankers.
9. Nothing herein contained shall separate to create in favour of the bank any rights or equities vis-à-vis the IWAI.
10. The materials shall be of the best description and in strict accordance with the specification and the contractor shall receive payment for such materials only as are approved and passed by the Engineer-in-charge.
11. In the event of the material being considered by the Engineer-in-charge to be inferior to that described in the specifications, the contractor shall on demand in writing forthwith remove the same at his own charge and cost and in the event of his neglecting to do so within such period as may be named by the Engineer-in-charge that office may have such rejected materials removed at the contractor's risk and the expenses incurred being liable to be deducted from any sums due or which may become due to the contractor:
 - (a) Contractor/supplier hereby declares that the goods, stores, articles sold or to be sold to the IWAI/ Govt. under this contract shall be of the best quality and workmanship and shall be strictly in accordance with the specifications and particulars contained in the tender document and the contractor/seller hereby

guarantees that the said goods/stores articles shall continue to conform to the description and quality aforesaid for a period of 12 months from the date of delivery of the said goods/stores/article to the Engineer-in-charge and that notwithstanding the fact that the Engineer-in-charge may have inspected and on approved the said good articles be discovered not be conforming to the description and quality/aforesaid or to have deteriorated (and the decision of the Engineer-in-charge will be entitled to reject the said good/stores/articles or such portion thereof as may be discovered not to confirm to the said description and quality). On such rejection the goods/articles stores will be at the contractors risk and the provisions contained in the tender document shall mutates mutinies apply to the removal of the goods/stores/articles rejected under this clause. The contractor/seller shall if called upon to replace the said goods/stores/articles or such portion thereof as has been rejected by the Engineer-in-charge or otherwise the contractor/seller shall pay to the IWAI such damages as may arise by reason of the breach of the condition herein contained. Nothing herein contained shall prejudice any other right of the IWAI/Govt. in that behalf under this contract or otherwise.

12. if the contractor or his work people or servants shall break, deface injure or destroy buildings, road, fence, enclosure, water pipes, cabbies, drains, electric or telephones posts or wires, trees, grass or grass land or any other property belonging to IWAI or any other contractor working in the same premises where the materials are being supplied, he shall make good the same at his own expenses and in the event or his refusing of failing to do so the damage shall be made good as required at his expenses by the Engineer-in-charge, who shall deduct the cost from any sums due, or which may become due, to the contractor.
13. The contractor shall supply at his own expenses all tools, plant and equipment's required for the due fulfillment of this contract and the material shall remain at his risk till the date of final delivery, unless it shall have been in the meantime remove for use by the Engineer-in-charge.
14. No material shall be brought to site or delivery given on Sundays or holidays without the written permission of the Engineer-in-charge. Normally all material shall be delivered during office house and with prior information to the Engineer-in-charge.
15. This contract shall not be sublet without the written permission of the Engineer-in-charge. In the event of the contractor subletting his contract without such permission he shall be considered to have thereby committed a breach of contract, and shall forfeit his security deposit and shall have no claim for any compensation for any loss.
 - (a) The Engineer-in-charge shall have power to make any alteration, omissions, additions or substitutions in the original specifications, drawings, designs, and instruction that may appear to him be necessary or advisable during the course of supply of the materials and the contractor shall be bound to supply the materials in accordance with any such instruction which may be given to him in writing signed by the Engineer-in-charge and such alterations, omissions, additions or substitution shall not invalidate the contractor, and altered, additional or substituted materials which the contractor may be directed to supply in the manner above specified as part of the work shall be supplied by the contractor on the same conditions in all respect for which he agreed to do the main work, and at the same rates, as specified in the tender for the main work. The time for the completion of the supply shall be extended in the proportion that the altered, additional or substituted quantity of materials bears to het original quantities and the certificate of Engineer-in-charge shall be conclusive as to

such proportion. And if the altered, additional or substituted materials include any class of materials, for which the rate is specified on this contract than such class of materials shall be supplied at the rates entered in the schedule of rates of the main contract direct on which the estimated cost shown in the tender is passed and in such class of materials are not entered in the schedule of rates of the main contract direct on which the estimated cost shown in the tender is passed and in such class of materials are not entered in the said schedule of rates than the contractor shall which seven days of the date or his receipt of the order to supply the materials inform the Engineer-in-charge of the rate which he intends to charge for such class of materials and if the Engineer-in-charge does not agree to his rate he shall give notice in writing and be at liberty to cancel this supply, such class of materials and arrange the supply thereof in such manner as he may consider advisable provided always that if the contractor shall commence supply or incur any expenditure in regard thereof the rates shall have been determined as lastly herein before mentioned time and in such case he shall only be entitled to be paid in respect of the supply made or expenditure incurred by any him prior to the date of the determination of the rate as aforesaid according to such rate or rates shall be fixed by the Engineer-in-charge. In the event of any disputes the decision of the Chairman, IWAI shall be final and binding to all.

16. In respect of all labour directly or indirectly employed in the work for performance of the contractor's parts of this agreement the contractor shall at his own expense arrange for the safety provision as per CPWD safety code framed from time to time and shall at his own expense provide for all facilities in connection therewith. In case the contractor fails for making arrangement and provide necessary facilities as aforesaid he shall be liable to pay a penalty of Rs. 50/- for each default and in addition the Engineer-in-charge shall be at liberty to make arrangement and provide facilities as aforesaid and recover the cost incurred in that behalf from the contractor.
17. Except otherwise provided in the contract all questions and disputes relating to the meaning of the specification designs drawing and instructions herein mentioned 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, design drawings, specifications, estimates, instructions orders or these conditions or otherwise concerning the works or the execution or failure to execute the same whether arising during the progress of the work or after the completion, abandonment thereof shall be referred to the sole arbitrator or the person appointed by the Chief Engineer, IWAI in charge of work. At the time of such appointment, it will be no objection to any such appointment that the arbitrator so appointed is a IWAI/Government servant that he had deal with the matter to which the contract relates and that in the course of his duties as Govt. servant he had expressed views on all or any of the matters in disputes or difference. The arbitrator to whom the matter is originally referred being transferred or vacating his office or being unable to act for any reasons, such C.E. or administrative head as aforesaid at the time of such transfer vacation of officer or inability to act shall appoint another person to act as arbitration in accordance with the terms of the contract that one person other than a person appointed by such Chief Engineer or administrative head of the IWAI as aforesaid should act as arbitrator and if for any reason, that is not possible, the matter is not to be referred to arbitration at all.
18. Subject to as aforesaid the provisions of the Arbitration Act, 1940 or any statutory modification or re-enactment thereof and the rules made there under and for time being in force shall apply to the arbitration proceeding under this clause.

19. It is term of the contract that the party invoking arbitration shall specify the disputes or disputes to be referred to arbitration under this clause together with the amount or amounts claimed in respect of such dispute.
- The arbitrator(s) may from time to time with consent of the parties enlarge the time, for making and publishing the award.
- 19(a) The arbitrator/s shall make such inquiries and shall call upon such evidences as he may deem fit.
- 19(b) The arbitrator/s may call upon the parties for their personal appearance before him on the date fixed by him at the specified time and place.
- 19(c) That in case of non-appearance of either of the parties the arbitrator/s shall proceed ex-parte.
- 19(d) The decision of the arbitrator/s shall be binding on the parties, their legal representatives, successor and heirs.
- 19(e) The cost of the reference shall be on the sole discretion of the arbitrator/s.
20. On the breach of any terms or conditions of this contract by the contractor, the said owner/ IWAI shall be entitled to forfeit the security deposit or the balance thereof that may at that time be remaining and to release and retain the same as damages and compensation for the said breach but without prejudice to right of the said owner/IWAI to recover any further sums as damage from any sums due or which may become due to the contractor by Government or otherwise howsoever.
21. Without prejudice to any of the right or remedies under this contract. If the contractor dies the Engineer-in-charge on behalf of Chairman, IWAI shall have the option of terminating the contract without compensation of the contractor.
- 22.(1) Whenever any claim against the contractor for the payment of a sum or money arises out or under the contract, IWAI shall be entitled to recover such sum by appropriating in part or whole security deposit of the contractor and to sell any of his equipment etc. In event of the security being insufficient or if no security has been taken form the contractor then the balance or the total sum recoverable as the case may be, shall be deducted from any sum hence due or which at any time thereafter may become due from the contractor under this or any other contract with the Government. Should this sum be not sufficient to cover the full amount recoverable, the contractor shall pay to IWAI/Government on demand the balance remaining due.
- 22.(2) IWAI/Government shall have the right to cause an audit the technical examination of the works and the final bill of the contractor including all supporting vouchers abstract etc. to be made after payment of final bill and if as a result of such audit and technical examination any sum is found to have been overpaid in respect of any work done by the contractor under the contract or any work claimed by him to have been done by him under contract and found not to have been executed the contractor shall be liable to refund the amount of the overpayment and it shall be lawful for Government to recover the same from him in the manner described in sum clause (1) of this clause or in any other manner legally permissible and if as a result of audit and technical examination, it is found that contractor was paid less than what was due to him under the contract in respect of any work executed by him under it, the amount of such under payment shall be duly paid by IWAI to the contractor.
- 22.(3) Provide that IWAI/Government shall not be entitled to recover any sum overpaid, not the contractor shall be entitled to payment of any sum paid short where such payment has been agreed upon between the Engineer-in-charge on the one hand and the contractor on

the other under any term of the contract permitting payment for work after assessment by the Competent Authority.

23. The work is under progress and there are other contractors working under separate contract agreement with IWAI. Contractor/Supplier shall ensure that their material, workmanship, workmen do not obstruct/damage the work of other contractors and maintain a peaceful atmosphere. The entire work shall be done at contractor's risk. Any damage to the office property/outside property or injury to any the outsiders, office staff, staff and labour of the other contractors working at the same site under separate agreement with IWAI or to any of contractor own staff/labour shall be completely at contractor risks and costs. Contractor shall also undertake the necessary insurance cover for all their supervisor, staff and worker. The work is to be done in co-ordination with other contractors working at site. Contractor should undertake work in workman like manner and it should not create hindrance working at site.
24. **Force Majeure:**
 - 24.1 If at any time during the continuance of this contract, it becomes impossible by reason of war, warlike operation, strikes, riots, civil commotion, epidemical sickness, pestilence, earthquake, fire, storm or floods, you shall during the continuance of such calamities be not bound to execute the contract provided always that the work shall be resumed immediately on the cessation or otherwise termination of the calamity and your obligations under various clauses of this contract shall continue to be in force and time necessary for the fulfillment of your obligation shall be extended correspondingly to the period for which the calamity lasted.
 - 24.2 Non availability of power due to any reason shall not constitute force majeure.
 - 24.3 Contractor will inform the Engineer in charge by fax, followed by confirmation by registered post, with appropriate documentation in support of the beginning and end of force majeure conditions as per clause stated above. The delivery period will suitably be extended by Engineer-in-charge if the causes for the delay are beyond the control of contractor and are as per the clause 24 above.
25. The bidder shall acquaint himself with the site of work, its approach roads, working space available for stacking of material, equipment, labour hutments, etc. before quoting. Since the building is occupied by IWAI, access to vehicles, officials and visitors to office building will be permitted from one side including access to basement and necessary barricading to provide safety of building and visitors shall be done by the contractor at his cost.
26. The contractor shall ensure that their material, workman do not obstruct/damage the window and curtain walls, glass panes, façade of building, office furniture, materials, racks and other goods, fixtures, etc and maintain a peaceful atmosphere and any damage to the building, glass panes, curtain wall or any fitting and fixtures of the existing building shall be made good by the contractor at his cost. The entire work shall be done at contractor's risk. Any damage to the property or injury to any of the staff, visitors and labour of the other contractors shall be at the contractor's risk. The contractor shall take necessary insurance cover for all their workmen working at the site.

SPECIAL CONDITION

1.0 Rates:

- 1.1 The rates quoted by the tenderer, shall be firm and inclusive of all taxes (including works contract taxes), duties and levies, octroi and all charges for packing forwarding, insurance, freight and delivery, installation, testing, commissioning etc. at site i/c temporary constructional storage, risks, overhead charges general liabilities/obligations and clearance form local authorities. However, the fee for inspections shall be borne by the department.
- 1.2 The contractor has to carry out routine & preventive maintenance for 12 months from the date of handing over. Nothing extra shall be paid.

2.0 Payment

- 2.1 The payment will be made only for the quantity actually executed and certified.
- 2.2 Payment will be made on completion of each item of work. However, payment of part quantity would be considered. Contractor shall submit their running bill for the payment after the measurement is recorded by the representative of the Engineer-in-charge in the measurement books. Part rate payment will not be permitted.
- 2.3 Necessary deduction for Security Deposit, TDS etc. shall be made from the bills.

3.0 Period of Completion

The completion period of 3 Months indicated in the tender documents is for the entire work of planning, designing, supplying, installation, testing, commissioning and handing over of the entire system to the satisfaction of the Engineer-in-charge.

4.0 Performance Guarantee:

- 4.1 The tenderer shall guarantee among other things, the following
 - (a) Quality, strength and performance of the materials used.
 - (b) Safe mechanical and electrical stress on all parts under all specified conditions of operation.
 - (c) Satisfactory operation during the maintenance period.
- 4.2 The successful tenderer shall submit an irrevocable performance guarantee of 5% of the tendered amount in addition to other deposits mentioned elsewhere in the contract for his proper performance of the contract agreement within 15 days of issue of letter of intent. This guarantee shall be in the form of government securities of fixed deposit receipts or guarantee bonds of any scheduled bank or the State Bank of India in the specified format. The performance guarantee shall be initially valid up to the stipulated date of completion plus 12 months beyond. This bank guarantee shall be kept valid till the recording of completion certificate for the work by the Competent Authority.

5.0 Guarantee

- 5.1 All equipments shall be guaranteed for a period of 12 months form the date of taking over the installation by the department against unsatisfactory performance and /or break down due to defective design, workmanship of material. The equipment's of components, or any part thereof, so found defective during guarantee period shall be forth with repaired or replaced free of cost, to the satisfaction of the Engineer-in-charge. In case it is felt by the department that undue delay is being caused by the contractor in doing this, the same will be got done by the department at the risk and cost of the contractor. The decision of the Engineer-in-charge in this regard shall be final.

6.0 Power Supply

Electric service connection of 415 V, 3 Phase, 4 Wire, 50 Hz, AC supply shall be provided by the Deptt. for installation purpose free of charge.

7.0 Water Supply

Water supply shall be made available by the department at one point.

8.0 After Award of work

(i) The successful tenderer would be required to submit the following drawings/documents within 15 days of award of work for approval before commencement of installation.

(a) All general arrangement drawings.

(b) Details of foundations for the equipment, load, location etc. of various assembled equipment as may be needed generally by other agencies for purpose of their work. lift well etc.

(c) Complete layout dimensions for every unit/group of units with dimensions required for erection purposes.

(d) Any other drawing/information not specifically mentioned above but deemed to be necessary for the job by the contractor.

9.0 The successful tenderer should furnish well in advance three copies each of detailed instructions and manuals of manufactures for all items of equipments regarding installation, adjustments operation and maintenance i/c preventive maintenance & trouble shooting together with all the relevant data sheets, spare parts catalogue and workshop procedure for repairs, assembly and adjustment etc. all in triplicate.

10.0 Extent of work

10.1 The work shall comprise of entire labour including supervision and all materials necessary to make a complete installation and such tests and adjustments and commissioning as may be required by the department. The terms complete installation shall not only mean major items of the plant and equipment's covered by specifications but all incidental sundry components necessary for complete execution and satisfactory performance of installation with all layout charges whether or not those have been mentioned in details in the tender document in connection with this contract.

10.2 Minor building works necessary for installing of equipment, foundation, making of opening in walls or in floors and restoring to their original condition, finish and necessary grouting etc. as required.

10.3 Maintenance (Routine & Preventive) for one year from date of completion and handing over.

10.4 The work is a turnkey project. Any item required for completion of the project but left inadvertently shall be executed with in the quoted rates.

11.0 Inspection and testing:

11.1 Copies of all documents of routine and type test certificates of the equipment, carried out at the manufacturers premises shall be furnished to the Engineer-in-charge and consignee.

11.2 After completion of the work in all respect the contractor shall offer the installation for testing and operation.

12.0 Validity

Tenders shall be valid for acceptance for a period of 90 days from the date of opening of price bid.

13.0 Compliance with regulations and Indian standards

13.1 All works shall be carried out in accordance with relevant regulation, both statutory and those specified by the Indian Standards related to the works covered by this specification. In particular, the equipment and installation will comply with the following:

- (i) Factories Act.
- (ii) Indian Electricity Rules.
- (iii) IS & BS Standards as applicable.
- (iv) Workmen's compensation Act.
- (v) Statutory norms prescribed by local bodies like NOIDA etc.

13.2 Nothing in this specification shall be construed to relieve the successful tenderer of his responsibility for the design, manufacture and installation of the equipment with all accessories in accordance with currently applicable statutory regulations and safety codes.

13.3 Successful tenderer shall arrange for compliance with statutory provisions of safety regulations and departmental requirements of safety codes in respect of labour employed on the work by the tenderer. Failure to provide such safety requirement would make the tenderer liable for penalty of Rs. 50/- for each default. In addition, the department will be at liberty to make arrangement for the safety requirements at the cost of tenderer and recover the cost thereof from him.

14.0 Indemnity

The successful tenderer shall at all times indemnify the department, consequent on this works contract. The successful tenderer shall be liable, in accordance with the Indian Law and Regulations for any accident occurring due to any cause and the department shall not be responsible for any accident or damage incurred or claims arising therefrom during the period of erection, construction and putting into operation the equipments and ancillary equipment under the supervision of the successful tenderer in so far as the latter is responsible. The successful tenderer shall also provide all insurance including third party insurance as may be necessary to cover the risk. No extra payment would be made to the successful tenderer due to the above.

15.0 Erection Tools

No tools and tackles either for unloading or for shifting the equipment's for erections purposes would be made available by the department. The successful tenderer shall make his own arrangement for all these facilities.

16.0 Cooperation with other agencies

The successful tenderer shall co-ordinate with other contractors and agencies engaged in the construction of building, if any, exchange freely all technical information so as to make the execution of this works contract smooth. No remuneration should be claimed from the department for such technical cooperation. If any unreasonable hindrance is caused to other agencies and any completed portion of the work has to be dismantled and re-done for want of cooperation and coordination by the successful tenderer during the course of work, such expenditure incurred will be recovered from the successful tenderer if the restoration work to the original condition or specification of the dismantled portion of the work was not undertaken by the successful tenderer himself.

17.0 Mobilization Advance

No mobilization advance shall be paid for this work.

18.0 Insurance and Storage

All consignments are to be duly insured the cost of the supplier. The insurance covers shall be valid till the equipment is handed over duly installed, tested and commissioned.

19.0 Verification of correctness of Equipment at Destination

The contractor shall have to produce all the relevant records to certify that the genuine equipment from the manufactures has been supplied and erected.

20.0 Training

The scope of works includes on job technical training of two persons at site. Nothing extra shall be payable on this account.

21.0 Maintenance

21.1 Sufficient trained and experienced staff shall be made available to meet any exigency of work during the guarantee period of one year from the handing over of the installation.

21.2 The maintenance, routine as well as preventive for one year from the date of taking over the installation as per manufacturer's recommendation shall be carried out and the record of the same shall have to be maintained.

22.0 Interpreting Specifications

In interpreting the specifications, the following order of decreasing importance shall be followed in case of contradictions:

- (a) Schedule of quantities
- (b) Technical specifications
- (c) Drawing (if any)
- (d) General Specifications
- (e) Relevant IS or other international code in case IS code is not available.

23.0 Specifications

The work shall be carried out as per CPWD General Specifications for HVAC works 2004 as amended upto date along with the following changes, CPWD General Specifications for Electrical Works Part – I, II & IV as amended upto date, relevant IE rules, and as per directions of Engineer-in-charge. For electrical panels, CPWD General Specifications for Electrical Works Part – IV shall be applicable.

24.0 Programme Chart

24.1 The Contractor shall prepare an integrated programme chart in MS Project software for the execution of work, showing clearly all activities from the start of work to completion, with details of manpower, equipment and machinery required for the fulfillment of the programme within the stipulated period or earlier and submit the same for approval to the Engineer-in-Charge within ten days of award of the contract. **A recovery of Rs. 1000/ shall be made on per day basis in case of delay** in submission the above programme subject to a max. of **Rs. 20,000/-**.

24.2 The programme chart should include the following:

- (a) Descriptive note explaining sequence of the various activities.
- (b) Network (PERT / CPM / BAR CHART).
- (c) Programme for procurement of materials by the contractor.
- (d) Programme of procurement of machinery / equipments having adequate capacity, commensurate with the quantum of work to be done within the stipulated period, by the contractor.

- 24.3 If at any time, it appears to the Engineer-in-Charge that the actual progress of work does not conform to the approved programme referred above, the contractor shall produce a revised programme showing the modifications to the approved programme to ensure completion of the work. The modified schedule of programme shall be approved by the Engineer in Charge.
- 24.4 The submission for approval by the Engineer-in-Charge of such programme or the furnishing of such particulars shall not relieve the contractor of any of the duties or responsibilities under the contract. This is without prejudice to the right of Engineer-in-Charge to take action against the contractor as per terms and conditions of the contract.
- 24.5 Contractor shall give the Engineer-in-charge **on 5th day** of each month a progress report in MS Project with base line programme referred above for the work done during previous month.

GENERAL SPECIFICATION

The specifications given hereunder relate to the supply, installation, testing and commissioning of HVAC system using Variable Refrigerant Flow (VRF) system and shall be read in conjunction with the appropriate International & Indian Standard Specifications.

2.0 Site

A comfort air conditioning system using variable refrigerant flow (VRF) system has been designed for Inland Waterways Authority of India's Office and R & D Building in NOIDA to provide summer/monsoon cooling and winter heating.

The design also envisages mechanical ventilation for toilets and other areas.

3.0 Scope of Work

The scope of work to be carried out under this contract is illustrated in Drawings, Specifications and Schedule of Quantities. The Contractor shall carry out and complete the said work under the contract in every respect in conformity with the contract documents and with the directions of and to the satisfaction of the Engineer-in-charge. The Contractor shall furnish all labour, materials and equipment (except those to be supplied by the Owner) as listed under Schedule of Quantities and specified otherwise, transportation and incidental necessary for supply, installation, testing and commissioning of complete HVAC system as described in the specifications and as shown on the drawings. This also includes all materials, equipment, appliances and incidental work not specifically mentioned herein or noted on the drawings or documents as being furnished or installed, but which are necessary and customary to make a complete installation. Following shall be the scope of work in brief to be carried out under this contract:

- a. Supply, Installation, Testing and Commissioning of air cooled variable refrigerant flow system comprising of outdoor units and indoor units.
- b. Supply, Installation and Testing of copper refrigerant piping complete with fittings, full refrigerant charge and class 'O' closed cell elastomeric insulation.
- c. Supply & Installation of condensate drain piping complete with insulation.
- d. Supply, Fabrication and Installation of air distribution system comprising of GSS supply air duct work, extruded aluminum powder coated grilles/ diffusers, insulation etc.
- e. Extract system for toilets and pantries using inline fans.
- f. Supply, Installation, Testing & Commissioning of fresh air fan section.
- g. Supply, Installation, Testing & Commissioning of fan sections associated with lift well pressurizations.
- h. Supply, Installation, Testing & Commissioning of associated electrical work comprising of power cabling, control wiring, earthing etc.
- i. Balancing, Testing and Commissioning of the entire installation.

4.0 Exclusions:

The following works associated with the air conditioning installation do not fall in the scope of HVAC package and shall be carried out by respective agencies under direct supervision of the HVAC contractor:

Associated Works: Civil

- i) Foundation for installation of VRF outdoor units & Pressurization Fans.
- ii) Providing cutouts in slabs/walls for passage of refrigerant/condensate drain pipes.
- iii) Finishing & making good of the above openings/cutouts.
- iv) Over deck thermal insulation to be provided using at least 40mm thick extruded polystyrene insulation material, density not less than 40Kg/CuM, for roof exposed to sun.

Associated Works : Electrical

- i) 415+ 10% V, 3 Phase AC power supply along with earthing to be terminated at each indoor unit room, VRF outdoor units and fresh air fan panel.
- ii) 220+ 6% V, 1 Phase AC power supply to be provided at each indoor unit (where required) and inline fans for toilets and other spaces.

Associated Works : Plumbing

- i) Providing floor trap for termination of condensate drain of indoor units.

5.0 Equipment :

Testing and Commissioning shall include furnishing all labour, materials, instruments etc. and incidentals necessary for complete testing of each component as per the specifications and manufacturer’s recommendations. Maintenance services for the complete HVAC installation shall be provided during the defects liability period.

6.0 Air Conditioning System

Basis of Design

The various parameters influencing the air conditioning system design have been furnished below.

- a. Orientation
The building orientation is as envisaged in the architectural plans.
- b. Outside design conditions
The outside design conditions for NOIDA have been given here under:

Season	Dry Bulb Temperature	Wet Bulb Temperature
Summer	110 F (43.3C) db	75 F (23.9 C) wb
Monsoon	95 F (35.0 C) db	83 F (28.3 C) wb
Winter	45 F (7.2 C) db	41 F (5.0 C) wb

- c. Inside design conditions

Summer & Monsoon:

Temperature	73 + 2 F (23 + 1 C)
Relative Humidity	Not to exceed 70% during Monsoon.

Winter:

Temperature	68 + 2 F (20 + 1 C)
Relative Humidity	Not to fall below 35%.

- d. Fresh air requirement : Generally in line with ASHRAE 62.1-2010 recommendations.

SECOND FLOOR

Floor/ pace	Floor Area (Sft)	Height (ft)	Occupancy (Sft/ Person)	Lighting Load (Watts/Sft)	Equipment Load (KW)	Hours of Operation
Office RHS	3280	11	50	1.5	9	12-15
Office LHS	3260	11	50	1.5	9	12-15
Total Second Floor	6640					

THIRD FLOOR

Office RHS	3280	11	50	1.5	9	12-15
Office LHS	3260	11	50	1.5	9	12-15
Total Second Floor	6640					

FOURTH FLOOR

Office RHS	3280	11	50	1.5	9	12-15
Office LHS	3260	11	50	1.5	9	12-15
Total Fourth Floor	6640					

FIFTH FLOOR

Office RHS	3280	11	50	1.5	9	12-15
Office LHS	3260	11	50	1.5	9	12-15
Total Fifth Floor	6640					

SIXTH FLOOR

Office RHS	3280	11	50	1.5	9	12-15
Office LHS	3260	11	50	1.5	9	12-15
Total Sixth Floor	6640					
GRAND TOTAL (2nd to 6th Floor)	33200					

Notes:

01. The design data considered above is subject to further confirmation from Clients.
02. Equipment load for various office spaces have been arrived at considering 150 watts per work station with a diversity factor of 0.9.

7.0 Heat Loads

Based on the Architectural layouts and above design data, the Heat Loads for the various spaces to be air-conditioned have been worked out and the heat load results and maximum demand have been furnished below:

OFFICE SPACES EXCLUDING COMMON AREAS

Floor/ Space	Floor Area (Sft)	Refrigeration Load (TR)		Dehumidified Air Qty (Cfm)	Low side Equipment Selection	Fresh Air (Cfm)
		Summer	Monsoon			
SECOND FLOOR						
Office RHS	3280	17	16.2	8600	1 x 9000 Cfm, 20 TR floor mounted unit	525
Office LHS	3260	18	17.2	9200	1 x 9500 Cfm, 21 TR floor mounted unit	550
Total Fourth Floor	6640	35	33.4			1075
THIRD FLOOR						
Office RHS	3280	17	16.2	8600	1 x 9000 Cfm, 20 TR floor mounted unit	525
Office LHS	3260	18	17.2	9200	1 x 9500 Cfm, 21 TR floor mounted unit	550
Total Fourth Floor	6640	35	33.4			1075
FOURTH FLOOR						
Office RHS	3280	17	16.2	8600	1 x 9000 Cfm, 20 TR floor mounted unit	525
Office LHS	3260	18	17.2	9200	1 x 9500 Cfm, 21 TR floor mounted unit	550
Total Fourth Floor	6640	35	33.4			1075
FIFTH FLOOR						
Office RHS	3280	17	16.2	8600	1 x 9000 Cfm, 20 TR floor mounted unit	525
Office LHS	3260	18	17.2	9200	1 x 9500 Cfm, 21 TR floor mounted unit	550
Total Fifth Floor	6640	35	33.4			1075
SIXTH FLOOR						
Office RHS	3280	17	16.2	8600	1 x 9000 Cfm, 20 TR floor mounted unit	525
Office LHS	3260	18	17.2	9200	1 x 9500 Cfm, 21 TR floor mounted unit	550
Total Sixth Floor	6640	35	33.4			1075
Grand Total	33200	319	301.1			

Assumptions:

The above heat loads have been worked out based on the following assumptions:

- a) All structural glazing and windows considered as single glass.
- b) Windows in office areas shall be provided with venetian blinds.
- c) Over deck thermal insulation shall be provided for exposed roof using at least 40mm thick extruded polystyrene insulation material (by other agencies).
- d) Basement has been considered as non-air conditioned but mechanically ventilated.

8.0 Maximum Demand & High Side Equipment Selection

Maximum Demand & high side equipment selection have been furnished below:

OFFICE SPACES EXCLUDING COMMON AREAS:

SECOND FLOOR - Outdoor Units on the capacity of indoor units:

S. No.	Description	Peak Heat load in Tons of Refrigeration
1.	Low side equipment installed capacity	41 TR based on 18500 CFM
2.	Diversity factor	NIL
3.	Maximum Demand (Nominal capacity)	41 TR
4.	Proposed capacity of outdoor units	50 HP (41 TR)

THIRD FLOOR - Outdoor Units on the capacity of indoor units:

S. No.	Description	Peak Heat load in Tons of Refrigeration
1.	Low side equipment installed capacity	41 TR based on 18500 CFM
2.	Diversity factor	NIL
3.	Maximum Demand (Nominal capacity)	41 TR
4.	Proposed capacity of outdoor units	50 HP (41 TR)

FOURTH FLOOR- Outdoor Units on the capacity of indoor units:

S. No.	Description	Peak Heat load in Tons of Refrigeration
1.	Low side equipment installed capacity	41 TR based on 18500 CFM
2.	Diversity factor	NIL
3.	Maximum Demand (Nominal capacity)	41 TR
4.	Proposed capacity of outdoor units	50 HP (41 TR)

FIFTH FLOOR- Outdoor Units on the capacity of indoor units:

S. No.	Description	Peak Heat load in Tons of Refrigeration
1.	Low side equipment installed capacity	41 TR based on 18500 CFM
2.	Diversity factor	NIL
3.	Maximum Demand (Nominal capacity)	41 TR
4.	Proposed capacity of outdoor units	50 HP (41 TR)

SIXTH FLOOR- Outdoor Units on the capacity of indoor units:

S. No.	Description	Peak Heat load in Tons of Refrigeration
1.	Low side equipment installed capacity	41 TR based on 18500 CFM
2.	Diversity factor	NIL
3.	Maximum Demand (Nominal capacity)	41 TR
4.	Proposed capacity of outdoor units	50 HP (41 TR)

9.0 System designing

a. HVAC System based on Variable Refrigerant Flow System (VRF)

An air-conditioning system using Variable Refrigerant Volume system shall facilitate year round air conditioning.

The floor mounted indoor units shall be installed within AHU rooms & outdoor units shall be installed on Terrace, with minimum refrigerant piping between indoor & outdoor units.

Dehumidified cool air shall be supplied to various areas through acoustically lined and thermally insulated supply air ducts. Supply air ducts shall be installed within the suspended ceiling spaces and the same shall distribute dehumidified air through extruded aluminum grilles and diffusers. Return air shall be brought back into the air handling unit rooms through the same suspended ceiling spaces surrounding the supply air ducts as required. At the air handling unit rooms new generation fire dampers shall be provided in both supply air ducts as well as in return air spaces. AHU rooms shall also be acoustically/thermally insulated to minimize noise transmission to adjoining areas and at the same time offset unwanted return air heat gain. For let out areas the above mentioned work shall be done by occupant i.e. Air Distribution.

Condensate drain piping shall be carefully carried out to ensure leak proof disposal of condensate water. Dedicated Fresh Air units with three stage filtration shall be installed to cater to the fresh air requirements at each level.

b. Mechanical Ventilation System

Exhaust air system for toilets shall be affected using inline fans with dedicated exhaust air ductwork & exhaust air grilles.

All Toilets shall be mechanically ventilated using inline fans @ 20 ACPH.

10.0 Noise Level

Noise level in conditioned spaces due to all refrigeration and air conditioning equipment shall not exceed 48 dB at 125 Hz when measured at any point in occupied spaces less than 150 cm above floor level and not closer than 150 cm from any supply air register or 60 cm from any return air grille.

11.0 Engineering Responsibility of the System

- a. The responsibility of system design, manufacturing, erection, working and safety will solely be responsibility of the Contractor for the parameters as mentioned in the tender documents prepared by the Consultants.
- b. The system after commissioning shall be handed over to the Owners and thereafter they will monitor the performance for standard designed parameters for 30 days continuously. In case during this period the performance is not found satisfactory and rectification/replacement, design improvement or any other change as felt necessary, will be made by the Contractor at no extra cost. Though these improvements can only be done after getting the approval from the Owners/ Architects.

12.0 Schedule and Manner of Operations

Time being the essence of this contract, the Contractor will be expected to furnish all labor and materials in sufficient quantities and at appropriate times, expedite and schedule the work as required and so manage the operation that the work will be completed within the time stated in the contract. In addition to providing a detailed time and progress schedule, the Contractor shall submit an outlined and graphic schedule of proposed procedures to the Consultants/Architects/Owners.

13.0 Performance Guarantee

The Contractor shall guarantee uninterrupted service and stipulated quality of performance of the installed HVAC system. The guarantee shall be furnished in the proforma indicated in the Appendix-I. It is to be clearly understood that the specifications indicated represent minimum performance requirements for the tender's guidance.

14.0 Performance Bank Guarantee

As per clause 4.0 of special condition.

15.0 Taxes & Duties

- (i) All duties and taxes like custom duty, CVD, excise duty, local sales tax, octroi, sales tax on works contract, VAT, Service tax etc. shall be included in the quoted price.
- (ii) Transit insurance shall be borne by the Contractor. All the prices indicated shall be F O R site.

16.0 Liability to Govt. Regulations

- (a) The Contractor shall be responsible and shall abide by all the government rules and regulations pertaining to erection, testing and commissioning of the complete HVAC system at site.
- (b) Any compensation towards damage/loss of property/material/equipment or to any person working at site shall be borne by the Contractor as per standard terms of contract.
- (c) No escalation/ change of prices would be admissible under any circumstances.

17.0 Erection and Supervision

- (a) The Contractor shall depute engineers from time to time of commencement of assembly and installation work to inspect all relevant civil construction/ fabrication and other necessary facilities to make improved action if felt necessary. However, a site engineer preferably a graduate in mechanical or electrical discipline shall be deputed at site permanently till completion of the work.

18.0 Bye Laws & Regulations

The installation shall be in conformity with the bye-laws, regulations and standards of the concerned local authorities so far as these become applicable to the installation. However, if these specifications call for a higher standard of materials and /or workmanship than those required by the regulations and standards then these specifications shall take precedence over the said regulations and standards. If the specifications call for requirements which violate the bye-laws and regulations, the bye-laws and regulations shall govern the requirements of this installation.

19.0 Fees and Permits

The Contractor shall obtain all permits /licenses and pay for any and all fees required for the installation, inspection and commissioning of the work.

20.0 Electrical Power Requirement

The tenderer shall submit with their quotation the break-up of electrical power requirement for all the HVAC equipment.

21.0 Design Drawings

The drawings prepared by the Consultants are indicative only of the general arrangement of the entire installation. The Contractor shall follow these drawings and specifications in preparation of his shop drawings and subsequent installation. He shall check the drawings of other trades to verify space for his installation. The Contractor shall examine all

relevant architectural, structural, plumbing, electrical and other services layout drawings before preparing the shop drawings for this installation, and report to the Consultants any discrepancy and obtain clarifications. Any changes found necessary for co-ordination and installation of this work with other services and trades shall be made with prior approval of the Architects/Consultants and Project Managers without any additional cost to the Owner.

22.0 Technical Data

The tenderer shall submit a comprehensive schedule of technical data and complete manufacturer's specifications for all items of equipment and material including the manufacturer's name. The technical data shall be furnished in the proforma indicated in Appendix VI.

23.0 Shop Drawings

- (a) Within seven days after the award of the Contract, the contractor shall furnish for the approval of the Architect/Consultants, three sets of detailed shop drawings of all equipment and materials including plant room, ducting, piping, ventilation system, electrical work associated with the HVAC system required to complete the project as per specifications and as required by the Architect/Consultant. These drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all equipment, also the details of all related items of work by other Contractors. Each item of equipment proposed shall be a standard catalogue product of an established manufacturer as per specifications.

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

- (b) The shop drawings shall be submitted for approval sufficiently in advance of planned delivery and installation of any material to allow Architects/Consultants ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved CPM charts.
- (c) Samples, drawings, specifications, catalogues, pamphlets and other documents submitted for approval shall be in quadruplicate, each item in each set shall be properly labeled, indicating the specific service for which material or equipment is to be used, giving reference to the governing section and clause number of Specifications clearly identifying in ink the items and the operating characteristics. Data of a general nature shall not be accepted.
- (d) Approval rendered on shop drawings shall not be considered as a guarantee of measurements of building conditions. Where drawings are approved, said approval does not mean that drawings have been checked in detail nor does it in any way relieve the Contractor from his responsibility or necessity of furnishing material or performing work as required by the contract.

- (e) Where the Contractor proposes to use an item of equipment other than that specified or detailed on the drawings which requires any redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical, electrical or architectural layout, all such redesign and all new drawings and detailing required thereof, shall be prepared by the Contractor at his own cost and approved by the Architect/Consultant.
- (f) Where the work of the Contractor has to be installed in close proximity to, or will interfere with work of other trades, he shall assist in working out space conditions to make satisfactory adjustments. If so directed by the Architect/Consultant, the Contractor shall prepare composite working drawings and sections at a suitable scale not less than 1:50, clearly showing how his work is to be installed in relation to the work of other trades. If the Contractor installs his work before coordinating with other trades, or so as to cause any interference with work of other trades, he shall make all the necessary changes without extra cost to the Owner.
- (g) Within two weeks of approval of all the relevant shop drawings, the Contractor shall submit to the Architect/Consultant four copies of comprehensive itemized price list of recommended imported and local spare parts and tools covering all equipment and materials in this contract. The Owner shall make arrangements to procure these spare parts and tools.

24.0 Construction Program & Schedule of Operations

A tentative construction program indicating the scheduling of various activities forms an annexure to this document. The Contractor should examine this program with respect to construction logic, scheduling and duration of various activities etc. in relation to the resources available at his disposal, and suitably modify the program without extending the total duration of the job as also the completion targets for major milestones of the job and submit a modified construction program along with a firm commitment to adhere to the dates of completion of various activities. This construction program shall after scrutiny and approval of the Architects/ Consultants form part of the agreement and shall be treated as a baseline schedule to monitor, determine delays in individual activities, work milestones or the overall duration of the work.

In the event of the Contractor, not submitting any modified construction program, the tentative construction program shall remain binding on the Contractor.

The Contractor shall mobilize equipment, tools, plant, scaffolding, shuttering, material labor etc., in sufficient quantities so as to complete the work to meet the above agreed construction program. In the event of delays in the construction activities, the Contractor shall mobilize additional resources to complete the job in the specified time period and at no extra cost to the Owner.

25.0 Electrical Installation and Cabling

The electrical works related to the HVAC system shall be carried out in full knowledge and with complete co-ordination of the Contractor. It is to be clearly understood that the final responsibility for sufficiency, adequacy, and conformity to the performance of the HVAC system shall be with the Contractor.

26.0 Testing and Commissioning

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

again after the removal of the defects and shall be commissioned only after approval by competent inspecting authority or the Consultants and the Owner. All tests shall be carried out in the presence of the Consultants and Owner's representative.

27.0 Completion Certificate

On successful completion of the installation, a Certificate in the approved format shall be furnished by the Contractor. The Contractor shall be responsible for getting the entire installation duly approved by the Electrical Inspector or concerned authority, if any, and shall bear all the expenses in connection with the same.

28.0 Completion Documents

- a. 5 copies of operation manuals/catalogues of all standard equipment to be furnished by the contractor immediately after commissioning of plant.
- b. 5 copies of write up on preventive maintenance, trouble shooting and operating instructions of the system along with the as-built drawings to be supplied by the Contractor at time of commissioning.
- c. 5 sets of catalogues of all equipment such as outdoor units, indoor units, split packages, centrifugal fan sections, electrical components etc.

29.0 Completion Drawings

The Contractor shall submit five sets cloth mounted drawings showing all details of the installation including the equipment layout, size & routing of duct work, refrigerant piping, run of cable and any other information required by the Consultants.

30.0 Technical Submittals

The successful tenderer after award of work shall furnish submittals for various items incorporating complete technical details for the approval of the Consultants. The submittals for items mentioned in the tender document but not restricted to the following:

- a. VRF System
- b. Fresh air system
- c. Ventilation fans including Inline fans etc.
- d. Copper pipes
- e. Grilles & diffusers.
- f. Insulation material.

31.0 Maintenance during Liability Period

Defects liability period shall commence from the date of virtual completion upon fulfillment of the procedure laid down in the relevant clause mentioned above. Contractor shall include incidental expenses towards necessary maintenance during defects liability period by deputing a skilled technician once in every week. The scope of such maintenance work to include:

- a. Wet Cleaning of indoor unit filters and fresh air intake filters.
- b. Checking of fan belts, pulleys etc.
- c. Dry Cleaning of electrical components using air blower.

TECHNICAL SPECIFICATIONS

1.0 Equipment

1.1 DX-Split Type Air-cooled Variable Refrigerant Flow Packages

1.1.1 Scope

The scope of this section comprises of supply, installation, testing and commissioning of self-contained air cooled split type variable refrigerant flow packages each comprising of an outdoor and multiple indoor ductable/nonductable units conforming to these specifications and in accordance with the requirement of drawings and schedule of quantities.

1.1.2 Outdoor Unit

Outdoor unit shall be factory assembled, good for outdoor installation, constructed out of heavy gauge MS panels with weather proof painting. The units shall be factory wired with necessary controls duly tested prior to dispatch conforming to the following specifications.

- (a) All outdoor units shall consist of minimum two scroll compressors, preferably one with inverter drive, capable to operate even when one compressor is unserviceable.
- (b) Outdoor units above 16 HP shall consist of minimum two separate inverter driven compressors.
- (c) The units shall be provided with duty cycling arrangement for multiple inverter compressors.
- (d) The outdoor unit shall be modular in design to facilitate installation one after another close to each other. Preference would be given to compact units having smaller footprint.
- (e) Outdoor units should be rugged of anti-corrosion design.
- (f) The outdoor unit shall comprise of sub cooling feature to effectively use the entire coil surface through proper circuit/bridge in order to prevent flushing of refrigerant owing to large length of piping.
- (g) The condensing unit shall be provided with state-of-the-art microprocessor based control panel.

The outdoor unit shall be provided with Aero spiral design fan exhibiting low noise level characteristics complete with aero fitting grille to facilitate spiral discharge of airflow to effect reduction in pressure losses. The fan should be capable to respond to external static pressure of 5mm. The condensing unit shall be designed to facilitate fail safe operation when connected to multiple indoor units. Following safety devices shall be integral part of the outdoor unit:

- High pressure switch
- Fan drive overload protection switch
- Fusible plug

Overload relay including overload protection for inverter driven compressor.

1.1.2.1 Scroll Compressor

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

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

The compressor shall be capable of functioning with inverter control as well. The inverter driven compressor shall preferably be with reluctance DC inverter for higher efficiency and reliability.

1.1.2.2 Condenser

Condenser shall be air-cooled type, suitable for outdoor installation and shall be suitable for operating at 46 deg C db and 24 deg C wb temperatures. Condenser shall be in copper tube & aluminium fin construction. Condenser coil shall be of minimum 4 rows deep and the fin spacing shall not exceed 2mm. The maximum face velocity across the coil shall not exceed 215 MPM. The condenser frame shall be constructed from heavy duty galvanized steel.

The condenser fan/s shall be of propeller type with 900 RPM variable voltage electric motor complete with IP-55 protection. Motor shall be speed controlled to ensure a stable operation for varying ambient, by a factory fitted direct acting head pressure activated variable speed drive. The condenser shall be complete with provisions for refrigerant piping connections, shut off valves and any other standard accessories necessary with the equipment supplied.

1.1.3 Anti-Corrosion Protective Treatment Associated with Condensing Units, Piping, Joints and U bends & Refrigerant Piping between Outdoor and Indoor Units.

All interconnecting piping, joints and U bends within the condensing unit shall be painted with two coats of clear transparent polymer coating for protection against corrosion from ambient air pollution. Two coats of protective coating shall be applied. Each coat shall have dry film thickness of 35 micron or more.

The coating shall be strong, flexible and durable. It shall have good adhesive and abrasion resistance. It shall be resistant to moisture, UV, acid, alkali and other chemicals and capable of functioning between -250 C and 1500 C.

The polymer shall be obtained by the mixing of base / monomer with a hardener/polymerizer. It may brush applied or with the use of a suitable gun.

1.2 DOUBLE SKIN AIR HANDLING UNITS (DIRECT EXPANSION TYPE)

Scope

The scope of this section comprises of supply, erection, testing and commissioning of double skin construction air handling units, conforming to these specifications and in accordance with requirements of drawings and schedule of quantities.

Type

The air handling units shall be double skin construction, draw-thru type comprising of various sections such as filter section, DX coil section and fan section factory assembled as elaborated in drawings and schedule of quantities. The AHUs shall be compatible with VRF Outdoor Units.

Capacity

The air handling capacities, maximum motor rating, static pressure shall be as shown on drawings and schedule of quantities.

Housing/Casing

The housing/casing of the air-handling unit shall be of double skin construction. The housing shall be so constructed that it can be delivered at site in total/semi knock down conditions depending upon the location.

The framework shall be extruded aluminium hollow sections filled with preformed insulation section. Frames shall be assembled using mechanical joints to make a sturdy and strong framework for various sections.

Double skin panels (each not exceeding 750mm wide) shall be made out of 24 gauge pre painted galvanized steel sheet on outside and 24 gauge plain galvanized sheet inside with 50 mm thick injected PU foam insulation in between. These panels shall be bolted from inside on to the work frame with soft rubber gaskets in between to make the joints air tight. Frame work for each section shall be provided with thermal break profiles and bolted together with soft rubber gasket in between to make the joints air tight.

Suitable doors with pressure die cast aluminium hinges and latches shall be provided for access to various panels for maintenance. The entire housing shall be mounted on steel channel frame work.

Marine light, view window and proximity switch to be provided in the casing of each Air Handling Unit.

Drain pan shall be constructed out of 18 gauge stainless steel with necessary slope to facilitate rapid removal of condensate water. Drain pan shall be insulated with closed cell elastomeric insulation material as required. Necessary supports will be provided to slide the coil in the drain pan. Outlet shall be provided from the drain pan in a manner that access panel can be opened without disconnecting the drain pipe connection.

Motor and Drive

Fan motors shall be high efficiency EFF-1 suitable for operation on 415 + 10% volts, 50 cycles, 3 phase, squirrel cage, totally enclosed fan cooled with IP-55 protection. Motors shall be especially designed for quiet operation and motor speed shall not exceed 1440 RPM. Drive to fan shall be provided through belt-drive arrangement. Belts shall be of the oil-resistant type. Minimum efficiency of motors shall be 85%.

The fan shall be forward curved floor standing double inlet double width type. The wheel and housing shall be fabricated in galvanized steel construction as per manufacturer standard. The fan impeller shall be mounted on a solid shaft supported to housing with angle iron frame and pillow block heavy duty ball bearings. The impeller and fan shaft shall be statically and dynamically balanced. The fan outlet velocity shall not be more than 1800 FPM (9.2 MPS). Fan housing with motor shall be mounted on a common steel base mounted inside the air handling housing on antivibration spring mounts or rubber turret mounts. The fan outlet shall be connected to casing with the help of fire retardant canvass. Fan shall be selected for high efficiency.

Cooling /Heating Coils

Direct Expansion coils shall have 12.5 mm to 16 mm dia tubes of wall thickness not less than 27 G (0.41mm thick) with aluminium fins firmly bonded to copper tubes assembled in zinc coated steel frame. Face and surface areas shall be such as to ensure rated capacity from each unit and such that air velocity across each coil shall not exceed 500 FPM. The coil shall be pitched in the unit casing for proper drainage. Each coil shall be factory tested at 21Kg/Sqcm air pressure under water. Tubes shall be hydraulically/ mechanically expanded for minimum thermal contact resistance with fins. Fin spacing shall be 11 to 13 fins per inch (4 to 5 fins per cm.)

Filters

Each unit shall be provided with a factory assembled filter section containing pre –filters having cleanable type synthetic air filters having anodized aluminium frame. Wherever MERV 13 filters are required to be installed, unit shall be provided with factory fabricated

plenum chamber in double skin construction as described above for casing specifications. The media shall be supported with HDP mesh on one side and aluminium mesh on other side. Filter face velocity shall not exceed 500 FPM. Filters shall fit so as to prevent bypass. Holding frames of aluminium shall be provided for installing a number of filter cells in banks. These cells shall be held within the frames by sliding the cells between guiding channels.

Accessories

The following accessories may be required at air handling units, the detailed specifications are given in individual sections, and quantities separately described in the schedule of quantities.

- a. Thermostatic expansion valves for each 3 row coil set.
- b. Cooling/heating thermostats as per section "Automatic Controls and Instruments" shall be located in return air stream.
- c. Condensate drain piping upto sump or floor drain in air handling unit rooms as described in section "Piping".
- d. Vibration isolation pads for mounting of Air Handling Units on PCC blocks (225 x 225 x 225 PCC blocks shall be provided by other agencies)

Performance Data

Air handling units shall be selected for the lowest operating noise level. Technical submittal of air handling units shall be prepared for Consultants approval prior to procurement as mentioned under clause 7 under Special Conditions. Fan performance rating and power consumption characteristics shall be submitted and verified at the time of testing and commissioning of the entire installation.

Testing

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

1.3 Refrigerant Piping (VRF)

The copper refrigerant piping shall be carried out neatly to connect outdoor and group of indoor units and shall run along with wires/cables. The refrigerant piping shall be carried out using hard drawn copper pipes & readymade copper fittings for pipe diameter exceeding 19mm. Piping less than 19mm shall be carried out using soft seamless copper pipes. Joints shall be affected by soldering/brazing process using silver rods. Suitable sleeves shall be provided at all wall crossings as required. The refrigerant circuit shall include liquid line and gas shut-off valves besides solenoid valve at the end of condenser. The refrigerant piping shall be carefully sized with necessary headers and should consist of accessories including Y-joints.

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

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

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

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

The recommended wall thickness of copper pipes being used for VRF application using high pressure refrigerant, R 410 a, is as under:

Copper Pipe Outer dia (mm)	Copper tube wall thickness (mm)
	Minimum requirement
Dia 6.4	0.8
Dia 9.5	0.8
Dia 12.7	0.8
Dia 15.9	1
Dia 19.1	0.8
Dia 22.2	0.8
Dia 25.4	0.88
Dia 28.6	0.99
Dia 31.8	1.10
Dia 34.9	1.21
Dia 38.1	1.32
Dia 41.3	1.43

1.4 Centralized Remote Controller, Touch Screen Type

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

The Graphic Controller must act as an advanced air conditioning management system to facilitate complete control of VRF air conditioning equipment, It should be user friendly through its touch screen, icon display and color LCD display.

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

Starting/stopping of Airconditioners as a zone or group or individual unit.

Temperature setting for each indoor unit or zone.

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

Monitoring of operation status such as operation mode & temperature setting of individual indoor unit, maintenance information and troubleshooting information.

Display of air conditioner operation history.

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

The controller shall comprise of wide screen user friendly color LCD display and can be wired by a non-polar 2 wire transmission cable upto a distance of 1 km away from indoor unit.

1.5 Unified On/Off Controller

Unified ON/OFF controller shall be supplied as optional accessory.

The controller shall be able to control minimum 15 groups, each group containing maximum 16 indoor units or 128 indoor units with the following functions:

On/Off as a zone or individual unit.

Indication of operation condition of each group.

Select one of 4 operation modes.

1.6 Schedule Timer

A schedule timer shall be supplied as an optional accessory.

The timer shall be able to set operation schedule for all indoor units.

The timer shall be able to set 8 pattern of schedule combined with centralized controller.

1.7 Propeller Fans

Propeller type, Ring/Diaphragm mounted fans shall be equipped with a TEFC phase motor with the impeller mounted directly on the shaft. The blades shall be die formed steel. The fan shall be fitted with gravity type louvers. The speed of fan shall not exceed 900 RPM. The fan speed can go upto 1400 RPM only in case of fans having diameter of 305 mm. Installation

- a. The Contractor shall supply all foundation bolts, base frame wherever required, vibration eliminators etc. and shall ensure that all the above accessories are placed securely in proper position while the foundation is cast.
- b. Vibration eliminators shall be provided with an efficiency of not less than 80% wherever necessary.
- c. Fan inlet and outlet connections shall be with flexible canvas connections wherever necessary.

Testing

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

- a. Air flow rate in CFM.
- b. Static pressure at the fan supply end.

Painting

On completion of the erection and testing, the outside of the fans shall be painted with two coats of Synthetic Enamel paint of approved color over and under coat of primer.

1.8 Inline Fans

Inline fan shall incorporate approved make SISW direct driven Centrifugal Fan with TEFC motor with IP-44 protection. The fan assembly shall be encased in a sheet metal housing of 22 gauge GSS and with necessary inspection cover with proper gasket assembly. The fan material shall be galvanized sheet steel. Flanges shall be provided on both sides of the Inline fan to facilitate easy connection. Flexible anti-vibration joints shall be provided to arrest vibration being communicated to other equipment connected to the Inline fan. Motor shall be single phase/three phase as per required duty conditions.

All single phase fans shall be provided with speed regulator while all three phase fans shall be provided with opposed blade damper in GSS construction at fan outlet for air balancing.

All inline fans shall be internally lined with 15mm thick open cell nitrile rubber insulation to achieve noise level of 40 db.

1.9 Centrifugal Fans

Centrifugal fans shall be of high efficiency forward/backward curved approved make DIDW/SISW of specified Class and arrangement complete with access door, squirrel-cage induction motor, V belt drive, belt guard and vibration isolators. Type, direction of discharge / rotation, and motor position shall be as per the Approved for Construction shop drawings. The fan shall be complete with the following:

Housing

Housing shall be constructed out of heavy gauge galvanized sheet steel welded/bolted construction. Housing for mounting of blower should be strong enough to hold the bearings preferably with twin rib spider arrangement. It shall be rigidly reinforced and supported by structural angles. Split casing shall be provided on larger sizes of fans, however neoprene packing should be provided throughout split joints to make it air tight.

18 gauge galvanized wire mesh inlet guards of 5 cm sieves shall be provided on both inlets. Housing shall be provided with standard cleanout and door with quick locking tension handles and neoprene gasket. Rotation arrow shall be clearly marked on the housing.

Fan Wheel

Fan Wheel shall be backward-curved non-overloading type OR forward curved type. Fan wheel and housing shall be statically and dynamically balanced, conforming to standard G 2.5 . Fan outlet velocity shall not exceed 2000 FPM (610 MPM) and maximum fan speed shall be 1000 RPM.

Shaft

Shaft shall be constructed of high quality steel, turned, ground and polished.

Bearings

Bearings shall be of ball bearing, taper lock type for self-alignment, mounted directly on the fan housing. Bearings shall be designed especially for quiet operation and shall be of the self-aligning, oil grease pack pillow block type.

Motors

Fan motor shall be high efficiency EFF-1 suitable for operation on 415 + 10% volts, 50 cycle, 3 phase AC power supply. The motor shall be TEFC, squirrel cage induction type having two speed and IP-55 protection, provided with class 'B' insulation, centrifugal fans, whenever used for smoke venting duty, motor shall be with class 'H' insulation. Motor name plate horse power shall exceed brake horse power by a minimum of 20%. Motor shall be designed especially for quiet operation and motor speed shall not exceed 1450 rpm. The fan and motor combination selected for the particular required performance shall be energy efficient ensuring lowest noise level. The motor shall be of approved make.

Drive

Drive to fan shall be provided through belt with adjustable motor sheave and standard belt guard. Belt shall be of the oil resistant type.

Vibration Isolation

MS base shall be provided for both fan as well as motor, built as an integral part, and shall be mounted on a concrete foundation through vibration isolators of approved make or cushy foot mountings. The concrete foundation shall be at least 15 cm above the finished floor level or as shown in approved for construction shop drawings.

1.10 Extract Fan Section

Fan section casing shall be of at least 16 gauge galvanized sheet complete with provisions of separate GI sheet enclosure to locate the motor in hot air stream free area (applicable for kitchens). The fan section shall be re-inforced with access panel as required. Factory Fabricated Plenums shall be provided as shown in design drawings.

The fan shall be forward curved, floor standing, double inlet double width type. The wheel and housing shall be fabricated from heavy gauge galvanized steel. The fan impeller shall be mounted on a solid shaft supported to housing with angle iron frame/spider and self-lubricated sealed eccentric type ball bearings.

The impeller and fan shaft shall be statically and dynamically balanced. The fan outlet velocity shall not be more than 2000 FPM (610 MPM). Fan housing with motor shall be mounted on a common steel base inside the air handling housing on anti-vibration springs mounts or rubber mounts. The fan outlet shall be connected to casing with the help of fire retardant canvass.

Fans shall be driven by an electric motor as specified in the schedule of quantities. Motor ratings are only tentative and where a fan requires a higher capacity motor, the contractor shall clearly point out the requirement and make his offer accordingly. Motor ratings shall be at least 20% over limit load plus transmission losses.

Fan motors shall be suitable for operation on 415+10% volts, 50 cycles, 3 phase, AC power supply and shall be EFF1, TEFC squirrel cage induction type totally enclosed, fan cooled with IP-55 protection. Motors shall be especially designed for quiet operation and motor speed shall not exceed 1440 RPM. Drive to fan shall be provided through belt-drive arrangement. Belts shall be of the oil-resistant type.

1.11 Fan Filter Units (Fresh Air Fans)

Fan section casing shall be of at least 16 gauge galvanized sheet complete with viscous metallic filters and Factory Fabricated Plenums as shown in design drawings. The fan section shall be re-inforced with access panel as required. Factory Fabricated Plenums shall be provided as shown in design drawings. Where called for in 'Schedule of Quantities', unit shall be provided in double skin configuration similar to 'Air Handling Units'.

The fan shall be forward curved floor standing double inlet double width type. The wheel and housing shall be fabricated from heavy gauge galvanized steel. The fan impeller shall be mounted on a solid shaft supported to housing with angle iron frame/spider and self-lubricated sealed eccentric type ball bearings.

The impeller and fan shaft shall be statically and dynamically balanced. The fan outlet velocity shall not be more than 2000 FPM (610 MPM). Fan housing with motor shall be mounted on a common steel base inside the air handling housing on anti-vibration springs mounts or rubber mounts. The fan outlet shall be connected to casing with the help of fire retardant canvass.

Fans shall be driven by an electric motor as specified in the schedule of quantities. Motor ratings are only tentative and where a fan requires a higher capacity motor, the contractor shall clearly point out the requirement and make his offer accordingly. Motor ratings shall be at least 20% over limit load plus transmission losses.

Fan motors shall be suitable for operation on 415+10% volts, 50 cycles, 3 phase, AC power supply and shall be EFF1, TEFC squirrel cage induction type totally enclosed, fan cooled with IP-55 protection. Motors shall be especially designed for quiet operation and

motor speed shall not exceed 1440 RPM. Drive to fan shall be provided through belt-drive arrangement.

Belts shall be of the oil-resistant type.

Fan Filter units should be provided with necessary viscous metallic filters as mentioned under subhead filters.

1.12 Filters

1.12.1 Viscous Metallic Filters

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

1.12.2. Synthetic Fibre Filters (EU-3)

Synthetic fibre filter shall be constructed out of 50mm deep non-woven synthetic fibre replaceable media secured with anodized ductile aluminium mesh on one side & 40 sieve HDPE mesh on the other side. All the layers to be dully stitched together & to be housed in 18G Aluminium anodized frame. The filter element shall have 11 folds/Rft. The filter shall have an efficiency of 90% down to 10 microns when tested as per BS: 2831 standard. It shall be suitable for operation under 100% Relative Humidity & 120 degree C temperature conditions. The velocity over the face of filter shall not exceed 105 MPM and the pressure drop across the filter shall not exceed 3 mm WG for 50mm thick filter. The filter frame shall be suitable for mounting in air handling unit as required at site.

1.12.3 Minimum Efficiency Reporting Value Parameters (MERV-13)

ASHRAE Standard 52.2 Minimum Efficiency Reporting Value (MERV)	Composite Average Particle size Efficiency, Percentage in Size Range		
	Range1 0.30 – 1.0	Range 2 1.0 –3.0	Range3 3.0- 10.0
1.	N/A	N/A	E3 < 20
2.	N/A	N/A	E3 < 20
3.	N/A	N/A	E3 < 20
4.	N/A	N/A	E3 < 20
5.	N/A	N/A	20 < E3 < 35
6.	N/A	N/A	35 < E3 < 50
7.	N/A	N/A	70 < E3
8.	N/A	E2 < 50	85 < E3
9.	N/A	50 < E2 < 65	85 < E3
10.	N/A	65 < E2 < 80	85 < E3
11.	N/A	80 < E2	85 < E3
12.	E1 < 75	90 < E2	90 < E3
13.	75 < E1 < 85	90 < E2	90 < E3
14.	85 < E1 < 95	90 < E2	90 < E3
15.	95 < E1	95 < E2	90 < E3

1.12.4 Microvee Filters : (EU-7)

Fine filters shall be designed to remove particles down to 3 microns as per BS: 6540 standard.

Filter shall comprise of aluminium sheet duly anodized. Filter element shall be made out of non-woven synthetic supported by anodized ductile aluminium mesh on one side & HDPE mesh not less than 40 sieve size on the other side with 11 folds/Rft of filtration area. All the layers to be dully stitched together. All sides to be sealed with ductile epoxy resin and filters shall be cleanable type using water/detergent. Rubber gaskets to be provided on the flange. Filter element shall be specially treated with antifungal and bacterial reagent to prevent growth of micro-organisms shall be screwed into the frame by means of an aluminium clamp patti and brass screws. They shall comprise of housing made from MS angles/flats epoxy coated of size suitable to receive the required number of filters to handle specified Cfm for each AHU. All filters shall be installed in same plane. No zigzagging shall be allowed by means of threaded bolts.

1.13 Air Curtains

Air curtains shall be vertical down throw type and shall comprise of twin centrifugal blowers, statically and dynamically balanced, designed for noiseless and continuous operation, motor etc. The enclosure shall be factory fabricated out of 18 gauge aluminium/CRCA sheet duly powder coated. The outlet shall be carefully designed to create laminar draft providing an invisible air curtain at critical junction isolating clean and semiclean areas or as required.

1.14 DX-Split Packages

Scope

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

1.14.1 Outdoor Unit

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

1.14.1.1 Unit Base & Casing

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

1.14.2 Compressor

1.14.2.1 Scroll Compressor

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

1.14.2.2 Rotary Compressor

The rotary compressor shall be an industrial quality rugged, cast iron, hermetic/ semi hermetic compressor with capacity control side valve , oil sump heater & differential

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

1.14.2.3 Condenser

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

1.14.2.4 Condenser Fan

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

1.14.3 Indoor Unit

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

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

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

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

The hi-wall indoor units shall be suitable for installation on the wall preferably at lintel level. The specifications shall otherwise be similar to above. Ceiling mounted ductable indoor units shall comprise of high static centrifugal fan, direct driven or belt driven through TEFC squirrel cage induction motor suitable for moderate amount of duct work. The housing shall be of light weight construction fabricated out of powder coated galvanized sheet steel single skin panels, internally insulated with 9mm thick closed cell elastomeric insulation material.

1.14.3.1 Cooling coil

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

1.14.3.2 Fan Section

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

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

1.14.3.3 Filters

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

1.14.3.4 Insulation

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

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

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

1.14.4 Refrigerant Piping (For Split Units)

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

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

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

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

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

2. Air Distribution

2.1 Scope

The scope of this section comprises of supply, fabrication, installation and testing of all sheet metal ducts and supply, installation, testing and balancing of grilles, registers and diffusers, in accordance with these specifications and the general arrangements shown on various drawings.

2.2 Duct Material

The ducts shall be fabricated from galvanized steel sheets class VIII conforming to ISS:277, 1962 (revised) or aluminium sheets conforming to ISS:737-1955, wherever aluminium ducts are specified.

All ducts shall be fabricated from galvanized steel sheets and all ductwork shall conform to SMACNA Standard.

Galvanized sheet shall possess light coating of Zinc, generally 120gm/sum of surface area. GI sheets shall be of Lock Forming Quality prime material along with mill test certificates. In addition, if deemed necessary, samples of raw material, selected at random by Owner's site representative shall be subject to approval and tested for thickness and zinc coating at Contractor's expense.

2.3 Duct Fabrication

All ducts shall be fabricated and installed in a workman like manner, generally conforming to SMACNA Standards. Round exposed ducts shall be die formed for achieving perfect circle configuration. The plain end of the round duct shall be slipped into the mating round duct with machine pressed flared end and thereafter pop riveted to complete the joint. The sample of round duct shall be displayed at the site prior to procurement for the approval of Consultants and Architects.

- a. Ducts shall be straight and smooth on the inside with neatly finished joints. All joints shall be made air tight.
- b. All exposed ducts within conditioned spaces shall have only slip joints and no flanged joints. The internal ends of slip joints shall be made in the direction of air flow.
- c. Change in dimensions and shape of ducts shall be gradual. Curved elbows, unless otherwise approved, shall have a center line radius equal to one and half times the width of the duct. Air turns shall be installed in all abrupt elbows and shall consist of curved metal blades or vanes, arranged to permit the air to make the turns without appreciable turbulence. GI splitter dampers complete with brass metal lever shall be installed at each bifurcation/trifurcation point of duct for proper flow of air quantity in each duct.
- d. All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees or angles of ample size to keep the ducts true to shape and to prevent buckling, vibration or breathing.
- e. All sheet metal connections, partitions and plenums required to confine the flow of air to and through the filters and fans, shall be constructed out of 18 gauge galvanized steel sheet, thoroughly stiffened with 25mm x 25mm x 3mm angle iron braces and fitted with all necessary doors as required by the Consultants to give access to all parts of the apparatus. Doors shall not be less than 450mm x 450mm in size. All hardware fittings such as thunder bolts, hinges, handles etc shall be in extruded aluminium construction.
- f. **In case of grid type false ceiling, the entire diffuser assembly with plenum shall be independently hung from the ceiling through adjustable GI wires and the same shall be connected to the main duct through a flexible round duct.**

All ducts shall be fabricated from galvanized steel/ aluminium sheets of the following thickness as indicated below:

TABLE-I
Standard with no intermediate bracing

Rectangular Ducts (GSS)	Pressure 250 Pa			Pressure 500 Pa		
	Duct Section Length 1.2 m (4 ft)			Duct Section Length 1.2 m (4 ft)		
Maximum Duct Size (mm)	Gauge	Joint Type	Bracing Spacing	Gauge	Joint Type	Bracing Spacing
1-550	26	C & SS	Nil	26	C & SS	Nil
551-750	26	C & SS	Nil	26	TDC/TDF/Slipon	Nil
751-900	26	TDC/TDF/Slipon	Nil	24	TDC/TDF/Slipon	Nil
901-1200	24	TDC/TDF/Slipon	Nil	22	TDC/TDF/Slipon	Nil
1201-1300	22	TDC/TDF/Slipon	Nil	20	TDC/TDF/Slipon	Nil
1301-1500	22	TDC/TDF/Slipon	Nil	20	TDC/TDF/Slipon	Nil
1501-1800	22	TDC/TDF/Slipon	Nil	18	TDC/TDF/Slipon	Nil
1801-2100	20	TDC/TDF/Slipon	Nil			
2101-2250	18	TDC/TDF/Slipon	Nil			
2251-2400	18	TDC/TDF/Slipon	Nil			
2401-2700	18	TDC/TDF/Slipon	Nil			

Abbreviations :

. 'C' - cleat

. 'S' – S cleat

a. 'SS' - Standing S cleat.

For Aluminium duct material should be one commercial gauge higher with 22 G as minimum.

Fabrication Standards & Equipment

All duct construction and installation shall be in accordance with SMACNA standard. In addition, the ducts shall be factory fabricated with the help of following machines to produce the requisite quality of duct work.

1. Coil (sheet metal in roll form) lines to facilitate location of longitudinal seams at corners/folded edges only, for required duct rigidity and leakage free characteristics. No longitudinal seams permitted along any face side of the duct.
2. All ducts, transformation piece, and fittings to be made on CNC profile cutter for requisite accuracy of dimensions, location and dimensions of notches at the folding lines.
3. All edges to be machine treated using lock formers, flanges and rollers for turning up edges.

2.4 Duct Construction

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

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

- b.) Ducts shall be straight and smooth on the inside with longitudinal seams shall be airtight and at corners only which shall be either Pittsburgh or Snap button as per SMACNA practice to ensure air tightness.
- c.) All ducts up to 750 mm width within conditioned spaces have slip and drive (C & S/SS) joints. The internal ends of slip joints shall be in the direction of airflow. Care should be taken to ensure that S/SS Cleats are mounted on the longer side of the duct and Cleats on the shorter side. Ducts and accessories including insulation within ceiling spaces, visible from air-conditioned areas shall be provided with two coats of mat black finish paint unless and otherwise specified.
- d.) All ducts over 750 mm duct size for pressure class 1 “ / 250 Pa (W.G.), and over 550 mm duct size for pressure class 2” / 500 Pa(W.G.) shall have transverse joints as specified in Annexure I.
- e.) Changes in dimensions and shapes of ducts shall be gradual (between 1:4 and 1:7) , Air –turns (vanes) shall be installed in all bands and duct collars designed to permit the air to make the turn without appreciated turbulence.
- f.) Ducts shall be fabricated as per details on Drawings. All ducts shall be rigid and shall be adequately supported and braced where required with standing seam, tees, or angels of ample size to keep the ducts true to shape and to prevent buckling, vibration or breaking.
- g.) All sheet metal connection, partitions and plenums, required to confine the flow of air to and through the filters and fans shall be constructed of 18 gauge GSS/ 16 gauge aluminium thoroughly stiffened with 25mm x 25mmx3mm galvanized steel angle braces and fitted with all necessary inspection doors as required to give access to all parts of the apparatus access doors shall be not less than 45cm x 45 cm in size.
- h.) Plenums shall be shop/factory fabricated panel type and assembled at site. Fixing of galvanized angle flanges on duct pieces shall be with rivets heads inside i.e. towards GS sheet and riveting shall be done from outside.
- i.) Self-adhesive Neoprene rubber/ UV resistant PVC lining of 5mm thickness instead of felt shall be used between mating flanges and duct supports for all ducting installation.
- j.) Towards fire protection, all kitchen extract ductwork shall be fabricated out of 18 gauge GSS and coated with approved fire retardant paint preferably sprayed at factory prior to dispatch in order to capture the flanges, corners and internal joints.

2.5 Duct Installation

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

- a. The contractor shall provide and neatly erect all sheet metal work as may be required to carry out the intent of these specifications and drawings. This work shall meet with the approval of the Architect/ Consultants in all its parts and details.
- b. All necessary allowances and provisions shall be made by the contractor for beams, pipes or other obstructions in the buildings, whether or not the same are shown on the drawings. Where it becomes necessary to avoid beams or other structural work, plumbing or other pipes, and or conduits, the ducts shall be transformed, divided or curved to one side, the required area being maintained as approved or directed by the Architect/Consultants.

- c. If a duct cannot be run as shown on the drawing, the contractor shall install the duct between the required points by any path available, subject to the approval of the Architect/ Consultants.
- d. All duct work shall be independently supported from building elements or as required by the Architect/Consultants. All horizontal ducts shall be rigidly and securely supported, in an approved manner, within hangers formed of wire rope suspension arrangement with hot dipped galvanized (HDG) perforated channel under the ducts. The distance between two successive supports shall not be greater than 2 meter center to center. All vertical duct work shall be supported by structural members at each floor.
- e. Ducting on top of the ceiling shall be supported from the slab above, or from beams with the help of adequate strength dash fasteners, after obtaining approval of the Architect/ Consultant. In no case shall a duct be supported from the ceiling hangers or be permitted to rest on a hung ceiling.
- f. All metal work in dead or closed down spaces shall be erected in time to occasion no delay to other contractors in the building.
- g. All ducts shall be totally free from vibration under all conditions of operations. Whenever duct work is connected to fans, that may cause vibrations in the duct, ducts shall be provided with two flexible connections located close to the unit in mutually perpendicular directions. Flexible connection shall be constructed of fire resistant flexible double canvas sleeves at least 100mm deep, secured properly and bolted at both ends. Sleeve shall be made smooth and the connecting duct work rigidly held by independent supports on both ends. The flexible connection shall be suitable for pressures at the point of installation.
- h. The two mating flanges of the ducts being joined with each other shall be made air tight by providing 2mm thick foam rubber insertion fixed on both mating flanges by means of good quality adhesive. Rubber strip shall also be provided between bottom surface of duct and angle iron at each duct support to avoid metal to metal contact.

2.6 Volume Control Dampers

- a. All dampers shall be multiblade type of robust construction of galvanized steel and tightly fitted. The design, method of handling, and control shall be suitable for the location and service required.
- b. Dampers shall be provided with suitable links, levers and quadrants as required for their proper operation control or setting devices shall be made robust, easily operable and accessible through suitable access doors in the ducts. Every damper shall have an indicating device clearly showing the damper position at all times.
- c. Dampers shall be placed in ducts and at each supply air collar, whether or not indicated on the drawings, for the proper volume control and balancing of the system.

2.7 Fire Cum Smoke Dampers

2.7.1 Bare Dampers

- a. All supply and return air ducts/return air spaces at AHU room crossings and at all floor crossings shall be provided with approved make motorized fire and smoke dampers of at least 90 minutes fire rating as certified by CBRI Roorkee, India as per clause 10 of UL:555-1995. These dampers shall be multi-leaf type -Ruskin.

- b. Fire damper blades and outer frame shall be formed out of 1.6mm (16G) galvanized steel sheet of length as mentioned in the approved for construction shop drawings titled as AHU Room Blow Up. The damper blade shall be pivoted on both ends using chrome plated spindles in self lubricated bronze bushes. Stop seals shall be provided on top and bottom of the damper housing made of 16 gauge galvanized sheet steel. For preventing smoke leakage, metallic compression side seals shall be provided. Dual side linkage shall be provided for better structural stability. The construction of the fire damper shall allow maximum free area to reduce pressure drop and noise in the air passage. In normal position damper blade shall be held in open position with the help of a 220 V operated electric actuators thereby providing maximum air passage without creating any noise or chatter.
- c. For wall mounted fire dampers retaining MS angles duly painted with black enamel paint shall be supplied and installed by HVAC Contractor as per established installation procedure. Whereas the fire damper is also to be used for Smoke management (Smoke and fire damper) the same shall be as per UL-555 S-Class-II.
- d. Every motorized fire damper/ Smoke and fire damper shall be tested for in the factory and will be certified by the manufacturer in form of the test certificate.
- e. Fire damper shall also be supplied with spring locke fusible link rated for 720 C (UL stamped) to close fire damper in event of rise in duct temperature.
- f. For fire dampers/ smoke fire dampers of size higher than one approved by certifying agency the damper shall be supplied in multiple units of size not exceeding the tested damper by CBRI. All the multiple units shall be housed in a common factory fitted sleeve.
- g. The fire dampers shall be mounted in fire rated wall with a duct sleeve 400mm/500mm long depending upon the wall thickness. The sleeve shall be factory fitted on fire damper. The joints at sleeve end shall be slip on type. Minimum thickness of galvanized sheet shall be 18 gauge.
- h. The damper shall be installed in accordance with the installation method recommended by the manufacturer.

2.7.2 Actuators

The actuator shall be maintenance free direct coupled spring return type suitable to work on 24 V electric supply. The torque rating of the actuator shall exceed at least by 15% over torque required to open/ close the damper. The selection of actuator size shall be the responsibility of the manufacture of the fire damper. Spring return time shall be 20 seconds or less at ambient temperature. Other features of the damper actuator shall be as under:

- a. Actuator shall have tamper proof housing with IP-54 protection rating.
- b. Actuator shall have mechanical integrity of at least one hour at 9000 C.
- c. Actuator shall have minimum 60000 safe position at rated torque. It shall be capable to withstand temperature of 750 C for 24 Hrs.
- d. Actuator shall have electronic over load or digital sensing circuit to prevent damage to actuator.
- e. Should be capable of changing direction of rotation by changing mounting orientation.
- f. Actuator shall have manual over ride facility.

Damper actuator shall be such that it should close the damper in the event of power failure automatically & open in the same manner in case of power being restored.

2.7.3 Control Panel

The Control panel shall be supplied by damper manufacturer fitted on damper compatible with damper actuators. The control panel shall have at least following features:

- a. Power on lamps with 230 V/ 24 V Transformer.
- b. Damper close and open indication.
- c. Reset push button.
- d. Push button for manual running of actuator for periodic inspection.
- e. Auxiliary contacts 24V & 230V.
- f. Contact points to receive signal from smoke detector/fire alarm panel.
- g. Additional terminal shall be provided to have signal (audio or visual) in central control room.

The control panel shall receive 230 V A/C supply & interconnecting wiring between control panel and actuator shall be carried out using fire proof cables. The Contractor shall ensure that all electrical connections are suitably terminated. The HVAC Contractor shall also check continuity of electrical circuit as recommended by the manufacture. Fire damper inspection door will be provided in AC duct to facilitate access to the system.

2.8 Supply Air Registers

Supply air registers shall be of approved make and of mild steel construction with individually adjustable bars. Supply air registers shall be double deflection type, with removable key-operated volume control dampers. The outer frame should be made out of 20 gauge and louvers of 24 gauge MS sheet.

- a. All registers shall be selected in consultation with the Consultants. Different spaces shall require horizontal or vertical face bars and different width of margin frames.
- b. All registers shall have a soft, continuous rubber gasket between the periphery of the register and the surface on which it has to be mounted. The effective area of the registers shall not be less than 80 percent.
- c. Registers shall be adjustable pattern as such grille bar shall be pivot able to provide pattern with 0 to 100 degree horizontal arc and up to 30 degree deflection up or down. Bars shall hold deflection settings under all conditions of velocity and pressure.
- d. Bars longer than 450 mm shall be reinforced by a set back vertical member.
- e. Registers shall be given a rust inhibiting prime coat and factory applied enamel finish of approved color.

2.9 Supply Air Diffusers

Diffusers shall be of approved make and of mild steel construction, square in shape with flush fixed pattern or adjustable flow pattern. Diffusers for different spaces shall be selected in consultation with the Consultant.

All supply air diffusers shall be equipped with removable key-operated volume control dampers. Anti-smudge ring may be required in specific applications. The outer shell and diffusing assembly shall be made out of 18 gauge and 24 gauge MS sheet respectively.

2.10 Extruded Aluminium Grilles & Diffusers

2.10.1 Rectangular/ Square Ceiling Diffusers

Rectangular /square ceiling diffusers shall be fabricated out of extruded aluminium sections powder coated in colour approved by Architects/Consultants. The four directional air flow diffuser shall consist of outer ring fixed to duct collar with concealed screws. Foam gasket shall be provided between outer ring and suspended ceiling.

The central core shall be clip fixed to the outer ring. Opposed blade volume control damper in extruded aluminium construction shall be fixed to the neck of diffuser. The damper shall be adjusted after removing the central core. The diffuser shall be equipped with anti-smudge ring.

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

2.10.2 Plaque Diffuser

The Plaque diffusers shall be constructed out of Extruded Aluminium powder coated sections is designed to integrate with suspended ceiling arrangement preferably grid type.

The diffuser shall consist of a rear pan and a removable heavy gauge front flat panel attached to the rear pan through spring loaded locking posts. The flat panel may be removed whenever need arises to facilitate adjustment of the damper for air balancing.

The front panel shall be aerodynamic in appearance, rigid and preferably in single piece construction and free from any welding or forming blemishes.

The horizontal air discharge pattern shall be 360 0 type. Blank off baffles shall be provided to obtain one, two or three way blow pattern if specifically asked for in the "Schedule of Quantities". Diffusers shall be provided with following accessories:

- I. Opposed blade damper
- II. Spigot to facilitate round duct connection at neck.

The performance criteria shall be in conformity with relevant ANSI/ASHRAE standards.

2.10.3 Swirl Diffuser

The diffuser face shall consist of fixed radially arranged air control blades. The supply air pattern shall permit specifically arranged internal air guidance elements or guide vanes. Such elements are not required for return/extract versions. Due to the rotary swirling motion of the air discharge, induction of room air occurs very quickly, resulting in decay of supply air velocity and temperature differential.

In order to stabilize horizontal discharge, all sizes must be mounted flushed with the suspended ceiling. The minimum height between floor & the diffuser face should be 2.6 M or less. The face plate shall be square. The supply air versions shall be supplied with top/side entry spigot with lip seals and Volume Control Damper.

The diffuser face shall be fabricated out of 1.2 mm thick galvanized steel sheet, pretreated and powder coated white. The spigot shall also be of 1.2 mm thick galvanized steel sheet & lip seal of soft rubber.

The performance criteria shall be in conformity with relevant ANSI/ASHRAE standards.

2.10.4 Multislot Linear Diffuser

Linear ceiling diffuser shall be multislot type. The diffuser shall be fabricated out of extruded aluminium sections. Each slot shall be 19mm wide. Each slot shall be equipped with air flow direction control louver mechanically fixed. Integral sliding type hit & miss type volume control damper in extruded aluminium construction shall be provided for each slot for fine control of air flow in supply air portion only. The damper shall be fabricated out of anodized extruded aluminium sections. Other sections of ceiling diffuser shall be powder coated in color & shade approved by the Consultants/Architects. The linear diffuser shall be fixed in to a plenum chamber with concealed screws. Side end pieces or corner pieces shall be provided if required.

2.10.5 Multi Louvered Grilles

For supply air double louvered grilles in extruded aluminium construction shall be provided with individually adjusted louvers along with volume control damper in extruded aluminium construction. The louvers shall be pivoted in Nylon bushes for smooth operation for return air grilles similar to supply air as described above will be provided but without volume control dampers. These grilles shall be painted as per approved powder coated shade.

2.10.6 Linear Grilles

Linear Grilles shall be fabricated out of extruded aluminium sections. Flanges shall be of 1.3mm thick extruded aluminium. Louvers shall be of extruded aluminium sections 3.7mm thick at the front and 2.2 mm at the rear with 15 degree deflection strong enough to withstand site abuse during installation. The sample of grille shall have to be got approved by the consultants before delivery. The linear grilles shall be provided with removable/fixed internal core.

All sections of linear grille shall be powder coated in color/shade approved by the Architects/Consultants.

The linear grilles shall be fixed into a plenum chamber having GI spacers with concealed screws. End pieces or corner pieces shall be provided as required.

2.11 Fresh Air Arrangements

Extruded aluminium construction duly anodized (20 microns and above) fresh air louvers with bird screen and extruded construction dampers shall be provided in the clear openings in the masonry walls of the air handling rooms having at least one external wall. Louvers, damper, pre-filters, ducts and fresh air fan, if required with speed regulator shall be provided as shown on drawings and in schedule of quantities. Fresh air dampers shall be of the interlocking, opposed-blade louver type. Blades shall be made of extruded aluminium construction and shall be rattle-free. Dampers shall be similar to those specified in "Air Distribution". Fresh air fans and fresh air intake shall be as per the schedule of quantities.

2.12 Air Transfer Door Grille

Air transfer grilles in extruded aluminium construction shall be provided at the door of pantry and toilets wherever required. The air transfer grille shall be complete with matching rear flange. The grilles shall be anodized or powder coated in color and shade as approved by the Architects/Consultants.

2.13 Testing And Balancing

After completion of the installation of the complete air distribution system, all ducts shall be tested for air leaks.

Before painting the interiors, air distribution system shall be allowed to run continuously for 48 hours for driving away any dust or foreign material lodged within ducts during installation.

The entire air distribution system shall be balanced using approved anemometer. Air quantities at the fan discharge and at various outlets shall be identical to, or less than 5 percent in excess of, those specified and quoted. Leakage in each air distribution system shall be within 3 percent so that supply air volume at each fan shall be identical to, or no greater than 3 percent in excess of, the total air quantity measured at all supply outlets served by the fan. Branch duct adjustments shall be made by volume or splitter dampers. Dampers shall be permanently marked after air balancing is complete so that these can be

restored to their correct position if disturbed at any time. Complete air balance report shall be submitted to the Consultants for scrutiny and approval, and six copies of the approved report shall be provided with completion documents.

3. Insulation

3.1 All chilled water piping/refrigerant piping, chilled water equipment and Duct work shall be insulated in the manner specified hereunder:

Material

Chilled water pipes shall be insulated with closed cell elastomeric insulation of properties as given below:

Average Physical Properties Of Insulation						Test Method
Cell structure	Closed cell					--
Density (gm/cm ³)	(0.04 - 0.07)					--
Thermal Conductivity (W/m.K)	Mean Temp.	-20°C	0° C	20°C	40°C	BS 874, Part 2 1986 DIN 52612
	K. Value	0.034	0.035	0.037	0.039	--
Service Temperature Limit	(-40 ° C to 105° C)					--
Water Vapour Permeability (i)	Minimum 7,000					DIN 52615
Water Absorption (% by volume)	1.5% Maximum					--
Ozone Resistance	Should be Excellent					--
Flammability	Class1 followed by Class 0					BS-476 Part 7& Part6

No insulation shall be applied on pipes until the pipes are satisfactorily tested, as specified in section "PIPING".

3.1.1 Application of Insulation

Cold insulation on pipes shall be applied as specified below:

- a. Pipes shall be thoroughly cleaned with brush & linen and rendered free from all foreign matter and grease.
- b. Apply SR -998 (or equivalent) adhesive on the bare surface of pipes.
- c. Closed cell Elastomeric Thermal insulation preferably in tubing form shall be fixed tightly to the surface. All joints to be sealed properly with vapour barrier compound.

Condensate drain piping and refrigerant piping shall be insulated in the manner specified above.

All valves, fittings, strainers, etc in chilled water piping shall be insulated to the same thickness as specified for the main run of piping and applied generally in the manner specified above, valves bonnets, yokes and spindles shall be insulated in such a manner as not to cause damage to insulation when the valve is used or serviced. Exposed CHW pipe insulation shall be provided with necessary treatment as under:

- a. Apply two layers of surface coating as under:
 - I. Apply a coat of composition prepared out of synthetic resin, cristalline silica & ethyl alchohal.

- II. Cover the insulated surface with lagging in the form of fire retardant glass fibre cloth, by wrapping it on wet coating.
- III. Subsequently, apply a coat of special composition and allow drying.
- IV. Apply second coating thereafter achieving sufficient mechanical strength.

3.2 AHU Room Acoustic/Thermal lining

3.2.1 Scope

The scope of this section comprises of supply and application of insulation conforming to these Specifications.

3.2.2 Material

Insulation material shall be processed Elastomeric, nitrile rubber or other approved equal. Samples of insulation material shall be submitted for approval to the Consultants prior to procurement. The physical properties of material shall be as given hereunder:

Average Physical Properties Of Insulation						Test Method
Cell structure	Open cell					--
Density (Kg/CuM)	(140 - 180)					--
Thermal Conductivity (W/mK)	Mean Temp.	-20°C	0° C	20°C	40°C	DIN : EN 12667
	K. Value	0.046	0.047	0.050	0.052	
Service Temperature Limit	(-20 ° C to 105° C)					--
Ozone Resistance	Should be Excellent					--
Flammability	Class I					BS-476 Part 7 - 1997
Tensile Strength	190 K Pa					--
Resistance to chemicals	Organic Solvents					Should be Excellent
	Dilute Inorganic acids					Should be good
	Mineral Oil					Should be good
Health aspects	Dust & Fibre free					--
Water Absorption	Non hygroscopic coating					

3.2.3 Application of Insulation

Acoustic lining of ducts wherever specified shall be applied as under:

- a. Clean the surface of AHU room wall to be thoroughly cleaned with wire brush & rendered free from bitumen or any other coating that exists.
- b. Basic surface preparation using sand paper.
- c. Adhesive to be applied thereafter, preferably in the evening and be left for overnight.
- d. Finally next morning Processed Nitrile rubber foam insulation to be applied & joints shall be sealed properly.

3.3 Duct Lining:

3.3.1 Scope

The scope of this section comprises of supply and application of acoustic insulation conforming to following Specifications.

3.3.2 Material

Insulation material shall be processed Elastomeric, nitrile rubber or other approved equal. Samples of insulation material shall be submitted for approval to the Consultants prior to procurement. The physical properties of material shall be as given hereunder:

Average Physical Properties Of Insulation						Test Method
Cell structure	Open cell					--
Density (Kg/CuM)	(140 - 180)					--
Thermal Conductivity (W/mK)	Mean Temp.	-20°C	0° C	20°C	40°C	DIN : EN 12667
	K. Value	0.046	0.047	0.050	0.052	
Service Temperature Limit	(-20 ° C to 105° C)					--
Ozone Resistance	Should be Excellent					--
Flammability	Class1					BS-476 Part 7 -1997
Tensile Strength	190 K Pa					--
Resistance to chemicals	Organic Solvents					Should be Excellent
	Dilute Inorganic acids					Should be good
	Mineral Oil					Should be good
Health aspects	Dust & Fibre free					--
Water Absorption	Non hygroscopic coating					

3.3.3 Application of Insulation

Acoustic lining of ducts wherever specified shall be applied as under:

- a. Clean the internal surface of the duct to make it free from dirt and dust.
- b. Apply adhesive on the the bare surface of duct.
- c. Processed Nitrile rubber foam shall be fixed tightly to the surface, joints sealed properly with tape of same material.

3.4 Duct Insulation

External thermal insulation of ducts shall be carried out with closed cell elastomeric insulation having thermal properties mentioned on first page of insulation sub head and thickness mentioned in schedule of quantities. The contractor shall ensure availability of all accessories as mentioned under appendices for achieving perfect workmanship. Insulation of ducts shall be applied strictly as per the recommendations of manufacturers amended from time to time. However, application procedure shall generally be as given hereunder:

- a. Apply SR 998 / equivalent adhesive on the bare surface after vigorously cleaning the duct using fresh linen.
- b. Closed cell elastomeric insulation material possessing class “O” properties in specified thickness to be fixed tightly to the surface with joints well butted.
- c. Longitudinal as well as vertical joints shall be sealed with the adhesive forming proper bonding.

Circular ducts shall be insulated internally following procedure as mentioned above. In addition, insulated surface shall be secured with circular GI strips spaced at regular intervals. A sample of insulated duct shall be displayed at site and approval sought prior to application.

3.5 Thermal Insulation of ducts exposed to atmosphere:

Duct insulation shall be applied as follows:

- a. Apply SR 998 / equivalent adhesive on the bare surface after vigorously cleaning the duct using fresh linen.
- b. Closed cell elastomeric insulation material of class “O” properties in specified thickness to be fixed tightly to the surface with joints well butted.
- c. Longitudinal as well as vertical joints shall be sealed with the adhesive forming proper bonding and taped over with same material.
- d. Apply two layers of surface coating as under:
 - I. Apply a coat of composition prepared out of synthetic resin, crystalline silica & ethyl alcohol.
 - II. Cover the insulated surface with lagging in the form of fire retardant glass fibre cloth, by wrapping it on wet coating.
 - III. Subsequently, apply a coat of special composition and allow drying.

4.0 Electrical Installation

4.1 Scope

The scope of this section comprises of fabrication supply, erection, testing and commissioning of electrical control panels, wiring and earthing for all components of the HVAC system.

4.2 General

Work shall be carried out in accordance with the Specifications, local rules, Indian Electricity Act 1910 as amended upto date and rules issued thereunder, regulations of the Local Fire Insurance Association and Indian Standard code of practice No. IS : 732-1963 (revised) including Indian Electricity Rules 1956.

4.3 Wiring System

All power wiring shall be carried out with 650/1100 volts grade PVC insulated, aluminum/copper conductor cables as per “Schedule of Quantities”, sized for starting current and continuous running current carrying capacity and by applying proper derating factor.

4.4 Motor Control Centre

a. Construction Features:

Motor Control Centre (MCC) shall comprise of all the switch gears as detailed in bill of quantities and design drawings. All the switch gears including the bus bar chamber on the same board shall be of the same manufacturer for facility of interchangeability. The motor control shall be metal enclosed sheet steel cubicles, indoor type, dead front, floor mounting type fabricated out of 14 gauge CRCA sheet steel. Removable gland plates shall be 3mm thick sheet. The size of the gland plate shall be sufficient enough to accommodate all cable sizes. The control panel shall be totally enclosed, completely dust and vermin proof. Gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust proof. The panel shall be in IP-54 enclosure. All doors and covers shall be fully gasketed with foam rubber and/or rubber strips and shall be lockable. All mild steel sheets used in the construction of control panels shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet metal shall be seam welded, all welding slag grounded off and welding pits wiped smooth with plumber metal. All panels and covers shall be properly fitted square with the frame and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with hank nuts. Self threading screws shall not be used in the construction of control panels. A base channel of 75mmx40mmx5mm thick shall be provided at the bottom.

Knockout holes of appropriate size and member shall be provided in the MCC in conformity with the location of incoming and outgoing cables.

Facility shall be provided for the entry of all types of cables from bottom or top of control panel as per site requirements. Panel shall have independent vertical & horizontal Bus Bar alleys & cable alleys accessible from front as well as back of the panel.

Bus bar chamber shall be made out of sheet steel of thickness not less than 2mm with detachable covers on all sides. The joints shall be continuous welded. The detachable covers shall be secured to the box with sufficient number of cadmium plated iron screws to ensure dust tightness. Bus bar chamber of size upto 900 mm shall have detachable end cover so that the same can be extended.

b. Bus Bars

Bus bar shall be made out of wrought aluminium alloy or electrolytic copper Grade E91 as the case may be of sufficient cross section so that a current density 100 Amps/Sqcm in case of aluminium and 150Amps/Sqcm in case of copper is not exceeded at nominal rating. The cross section of neutral bus-bar will be the same as that of the phase bus-bar of capacity upto 200Amps. The neutral bus bar should not be less than half the cross section of that of phase bus bar beyond 200Amps. The bus-bars should be suitably insulated with heat-shrinkable PVC sleeving and colour coded. Connections to bus-bars shall be made by the bolting arrangement by the aluminium alloy or the forged brass nuts and bolts, ensuring that the current density of the bus-bars at the point of connection does not exceed permissible limit and there is no heat due to bimetallic contact.

Minimum clearances between bus-bar throughout the panel shall be 32mm between phases and 25mm between phase to earth. Danger plate of approved shape and size be provided on each switch board without any extra charge. The bus-bar shall be supported on DMC/SMC and shall be rated for a fault level of 50KA for 1 sec & temperature rise on full load not to exceed 45 C above ambient i.e, total of 85 C.

4.5 Selection of Components In MCC

Contractor shall use only one make of component for ease in maintenance and interchangeability. The rating of other components i.e, contactor, fuse, circuit breaker, and overload relay, single phasing preventer etc. shall be as recommended in these specifications.

4.6 Selection of Cables/Wires

The size of cables and wires for individual connection to outgoing MCCB/SFU/Isolator shall be suitably rated. Above 100 Amps. solid links shall be used.

All power wiring shall be carried out with 650/1100 volt grade PVC insulated aluminium /copper conductor cables/wires sized for starting current and continuous rating of motors after applying derating factor as per the "Schedule of Quantities".

4.7 Cable Compartments

Cable compartment of minimum size of 400 x 400 mm or as shown in drawings shall be provided in the boards for termination of all incoming and outgoing cables entering from bottom or top. Adequate supports shall be provided in cable compartment to support cables. All incoming & outgoing switch terminal shall be brought out to the spring loaded terminal blocks in cable compartments and identified accordingly.

All the outgoing connections shall be brought on spring loaded (Elmex Type CSLT-1) terminals in the cable-alley. Minimum size of terminals for control and power wiring shall be 2.5 & 10 Sqmm respectively. No cable, however shall be terminated in to the switch/isolator/ MCCB/contactor/over load relay, under any circumstances.

4.8 Meters and Indications

All meters shall be housed in a separate compartment or as shown in design drawings and accessible from front only. Lockable doors shall be provided for the metering compartment. All switches, contactors, push buttons, push button stations, indicating lamps shall be distinctly marked with a small description of the service fed.

4.9 Painting

Entire sheet metal works shall undergo seven tank process including passivating, sprayed with a high corrosive resistant primer and baked in oven. The finishing treatment shall be of two coats of synthetic enamel paint of approved colour & shade.

Degreasing : Concentration of chemical : 5% - 7% & 40 deg C

Derusting : Concentration of chemical : 25%

Phosphatising : Concentration of chemical : 3.5% & 40-50 deg C

Passivation : Concentration of chemical : 0.05% - 0/1% & 60-70 deg C

Two coats of zinc chromate primer should be applied after the above processing before baking in oven.

Wherever necessary filler putty is applied to make the surface smooth. Properly rubbed surface is to be given a coat of surface and baked in oven.

4.10 Testing

Motor control centre shall be tested at manufacturer's works. The test certificates shall be got approved before dispatch of MCC to site.

4.11 Instrument Compartment

All instrument shall be flush mounted 144 mm square & suitably scaled. Instrument chamber should have sufficient space. Indicating lamps should have minimum 50mm space between them. They shall be accessible for testing and maintenance without any danger of accident and contact with live parts of circuits breaker and bus bar.

4.12 Control Cables and Terminals

All control wiring shall be with minimum area of 1.5 Sqmm copper conductor. These shall be ferruled coded and identified at both ends as per IS specifications. A horizontal wire way shall be provided along the length of panel for taking the control wiring from one section to another control wiring when terminated, shall be terminated on the terminal block and identified for the duties to be performed. Each terminal shall be separately identified. Minimum 10% spare terminals shall be provided on every terminal block.

4.13 Other Components

4.13.1 Moulded Case Circuit Breaker (MCCB)

The MCCB (moulded case circuit breaker) shall conform to the latest IEC 947-2 & IEC 947-3-1989. The Service Short Circuit Breaking Capacity (Ics at 415VAC) should be as specified at the required level. The MCCB shall be Current Limiting type and comprise of Quick Make – Break switching mechanism, preferably Double Break Contact system, arc extinguishing device and the Tripping unit, contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses. All MCCBs shall be capable of defined Variable overload adjustment. All MCCBs rated 200Amps and above shall have adjustable Magnetic short circuit pick up.

The trip command shall over ride all other commands. The MCCB shall employ maintenance free double break contact system to minimize the let thru' energies and capable of achieving discrimination up to the full short circuit capacity of the downstream MCCB. The manufacturer shall provide both the discrimination tables and let thru energy curves. The MCCB shall not be restricted to Line/ Load connections. The handle position shall give positive indication of 'ON', 'OFF' or 'Tripped' thus qualifying to Disconnection as per the IEC947-3 indicating the true position of all the contacts. In case of 4 pole MCCB the neutral shall be defined and capable of offering protection.

4.13.2 Miniature Circuit Breaker (MCB)

Miniature Circuit Breaker shall comply with IEC898 – 1996. The Miniature circuit breakers (MCB) shall be quick make and break type for 230 / 415 VAC 50 Hz application with thermal magnetic releases for over current and short circuit protection. The Breaking capacity shall not be less than 10 KA at 415VAC. MCBs shall be DIN mounted. The MCB shall be Current Limiting type (Energy Class-3). MCBs shall be classified (B,C,D as per the IEC 898 standards) as per their Tripping characteristic curves defined by the manufacturer. The MCB shall have the minimum power loss (Watts) per pole defined as per the IS/IEC and the manufacturer shall publish the values.

The housing shall be heat resistant and having a high impact strength. The terminals shall be protected against finger contact to IP20 Degree of protection . All DP, TP and TPN miniature circuit breakers shall have a common trip bar independent to the external operating handle.

4.13.3 Switch Fuse Units

- a. High rupturing capacity fuse (HRC Fuse) shall carry ISI mark on it and shall be rated for duty as indicated on the drawing/schedule of Quantities. The rating of HRC fuse shall be as per the rating of motor/equipment. The rating of fuse shall be selected so as to provide discrimination.
- b. The switch fuse units shall be three pole double break action with switched neutral. All switch fuse units shall be provided with the hinged doors duly interlocked with operating mechanism so as to prevent opening of the door when the switch is 'ON' position and also to prevent energizing the switch when the door is not properly secured. All contacts shall be silver plated and alive parts shall be shrouded. High rupturing capacity (HRC) fuse links shall be provided with switch fuse units and shall have rupturing capacity of not less than 31 MVA at 415 volts. All switch fuse units shall be provided with visible indicators to show that they are in 'ON or OFF' position. All switch units shall be of AC-23 category.

4.13.4 Motor Starter

The Motor Starter shall be a combination starter consisting of motor protection circuit breaker and suitable contactor for remote starting.

a. Motor protection circuit breaker

The motor protection circuit breaker must comply to the latest IEC 947-4 and the corresponding IS 13947-4. The motor protection circuit breaker should be suitable for AC3 duty at 415V. The motor protection circuit breaker should offer built in coordinated overload and short circuit protection. The motor protection circuit breaker should have built in single phase / phase loss preventor. The motor protection circuit breaker should offer separate ON/OFF indication and Fault signal contacts which should be wired onto the panel for indication. The motor protection circuit breaker should offer Type 2 coordination along with the contactor.

b. Contactors

The contactor should be suitable for AC3 duty at 415V and should comply to the latest IEC 947-4 and the corresponding IS 13947-4. The contactor should have minimum 10 x IE rated making / breaking capacity as per the latest standard. The same should be suitable for Type 2 coordination along with motor protection circuit breaker. The contactor should have Class H insulation for the coil to prevent heating and to facilitate frequent start / stop function without heating.

4.13.5 Earth Leakage CB/ Residual Current CB

The ELCB/RCCB shall comply with IEC 1008. The ELCB/RCCB shall current operated independent of the line voltage. ELCB / RCCB shall work on the principle of core balance transformer. The ELCB / RCCB shall be rated for current sensitivity of a Min of 30mA and a Max of 300mA at 240 / 415VAC. The terminals shall be protected against finger contact to IP20 degree of protection. The ELCB / RCCB shall have a minimum of 20,000 electrical operations.

Testing Provision for the Earth Leakage Circuit Breaker

A test device shall be incorporated to check the integrity of the earth leakage detection system and the tripping mechanism. When the unit is connected to service, pressing the test knob shall trip the ELCB and the operating handle shall move to the "OFF" position.

4.13.6 AIR CIRCUIT BREAKER (ACB) :

The ACB shall conform to IEC 947-2-1989 & IS 13947 (Part -2). The Service Short Circuit Breaking Capacity shall be as specified and equal to the Short circuit Withstand Values. The ACB shall be provided for controlling the in coming supply feeder or as required and specified in schedule. Shall be available in 3 or 4 pole with modular construction, fixed or draw out, manually or electrically operated versions as specified. ACB shall be capable of providing short circuit, overload and earth fault protection (in absolute values) if required, through microprocessor based control unit sensing the true RMS values to ensure accurate measurement meeting the EMI/ EMC requirement as per the standard.

The breaker should have 3 distinct positions – SERVICE / TEST/ ISOLATED within the cubicle. It should be possible to withdraw the breaker for testing with the door closed. Safety interlock must be provided to prevent the ACB from falling out in a fully withdrawn position. The ACB shall be provided with a door interlock. The contacts should be copper and silver plated only with a feature of contact wear inspection indicating the life of the contacts. The ACB shall have double insulation (Class-II) with moving and fixed contacts totally enclosed for enhanced safety and inaccessibility to live parts.

All electrical closing of breaker should be with Electrical motor wound stored energy spring closing mechanism with Mechanical indicator to provide. ON/OFF status of ACB.

For all ACBs the Operating handle should be provided for charging the spring in continuous action. The spring shall be released with ON / OFF push button command in one operation at the correct speed independent of operator speed. A direct mechanical coupling should indicate the ACB in ON or OFF position thus qualifying to Disconnection as per the IS/IEC indicating the true position of all the contacts. One set of NO / NC potential free contacts to be provided for operation on Building Management System. All accessories like shunt, under voltage motorized mechanism etc shall be front mounted, requiring no adjustments and can be fitted at site.

The manufacturer shall provide details of opening time and deration with temperature to ensure discrimination and proper selection for feeders protection. All ACBs of 4000 A and above shall be a single ACB and Tandem operated will not be acceptable.

4.13.7 Safety Features

1. The safety shutter shall prevent inadvertent contact with isolating contacts when breaker is withdrawn from the Cradle.
2. It should not be possible to interchange two circuit breakers of two different thermal ratings.
3. There should be a provision of positive earth connection between fixed and moving portion of the ACB either thru connector plug or sliding solid earth mechanism.
4. Earthing bolts must be provided on the cradle or body of fixed ACB. Arc Chute covers should be provided wherever necessary.
5. The incoming panel accommodating ACB shall be provided with indicating lamps for ON-OFF positions, voltmeter and ammeter of size not less than 96mm x 96mm, selector switches, fuses for potential circuit and current transformers.
6. It should be possible to bolt the draw out frame not only in connected position but also in TEST and DISCONNECTED position to prevent dislocation due to vibration and shocks.

4.13.8 Protections

1. The Electromagnetic and thermal release or Microprocessor based unit should be provided on circuit breaker for short circuit, over current and earth fault protection with adjustable settings.
2. Specific LED indications should be provided for over current and earth fault operation.
3. Relays should be CT operated through shunt trip for short circuit and earth fault protection.
4. Under voltage relays should be provided.
5. Minimum 6 NO and 6 NC auxiliary contacts shall be provided on each breaker. The contacts shall be rated 5 Amps.
6. Rated insulation voltage is 1000 volts AC.

4.13.9 Push Button Stations

Push button stations shall be provided for manual Start & Stop of equipment. Push button shall have ON & OFF indicating lamp in red and green colour. Push button shall be fabricated in 16 gauge sheet steel.

These station shall be factory fabricated. ON & OFF operations shall be carried out from front without opening the door. One set of NO & NC contact shall be provided in push button station as spare.

4.13.10 Toggle Switch

The toggle switch shall be of minimum 5 Amps rating.

4.13.11 Thermal Overload

The relay shall be factory calibrated, sealed and suitable for an ambient temperature at site or 50 deg C whichever is higher.

It should provide reliable and accurate protection against overload, single phasing and locked rotor conditions. Relays are to be provided with:

- (a) Trip alarm contact
- (b) Trip lever for testing
- (c) Auto reset facility

Rated insulation voltage shall be 660 volts AC.

4.14 INSTRUMENTS

a. General :

The specifications hereinafter laid down shall cover all the meters and instruments.

b. Instrument Transformers

(i). Current Transformers

Current transformers shall be in conformity with IS : 2705 (Part I,II,III & IV) in all respects. All current transformers used for medium voltage applications shall be rated for 1 KV. However, the rated secondary current shall be 5 A unless otherwise specified. The acceptable minimum class of various applications shall be as given below:

Measuring : Class 0.5 to 1

Protection : Class 10 p

Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault of 35 MVA on medium voltage system. Terminals of the current transformers shall be marked permanently for easy identifications of poles. Current transformers shall be provided with earthing terminals, for earthing chassis frame work and fixed part of the metal casing (If any). Each CT shall be provided with rating plate indicating the following:

- i. Name and make
- ii. Serial Number
- iii. Transformation Ratio
- iv. Rated Burden
- v. Rated Voltage
- vi. Accuracy Class

Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CT's shall be copper conductor, PVC insulated wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat & clean manner.

c. Potential Transformers

Potential transformers shall be provided if specifically called for potential transformers shall comply with the requirements of IS : (Part I,II,III) in all respects.

d. Measuring Instruments

i. General

Direct reading electrical instruments shall be in conformity with IEC-51, BS:89 or IS :1248. The accuracy of direct reading shall be 1.0 for voltmeters and 1.5 for ammeters. Other type of instruments shall have accuracy of 1.5. The meters shall be suitable for continuous operation between -10 deg C and +50 deg C. All meters shall be of flush mounting type with square pattern. The meter shall be enclosed in a dust tight housing . The meters shall be provided with white dials and black scale markings. The pointer shall be black in colour and shall have zero position adjustment device which could be operated from outside.

ii. Ammeters

Ammeters shall be of moving-iron type. The moving part assembly shall be with jewel bearings. The jewel bearing shall be mounted on a spring to prevent damage to pivot due to vibrations and shocks. The ammeters shall be manufactured and calibrated as per the latest edition of IS: 1248 or BS:89. Ammeters shall be instrument transformer operated, and shall be suitable for 5 A secondary. Upto 30 Amps the ammeter shall be direct operated without current transformer on one phase only. Beyond 30 Amps the ammeter shall be CT operated with selector switch.

iii. Voltmeters

Voltmeters shall be of moving-iron type. The range for 400volts, 3 phase voltmeters shall be 0 to 500 volts. The voltmeter shall be provided with protection fuse of suitable capacity

4.15 Earthing

a. General

All non-current carrying metal parts of the electrical installation shall be earthed as per IS-3043. All metal conduits, trunking, cable sheathes, switchgear, distribution boards and all other metal parts forming part of the work shall be bonded together and connected by two separate and distinct conductors to control panel. Earthing shall meet the requirements of IER 1956.

b. Earthing Conductor

All earthing conductors shall be of high conductivity copper as specified and shall be protected against mechanical damage and corrosion. The size of the earth conductor shall not be less than half of the largest size of the current carrying conductor. The connection of the earth continuity conductor of earth and earth electrodes shall be strong and sound and shall be rigidly fixed to the walls, cable trenches, cable trays or conduits and cables by using suitable clamps made of nonferrous metals. Incoming power supply along with earthing upto MCC/AHU control panel shall be provided by other agency. The panel shall be earthed to building main earthing. The motor shall be double earthed to the panel.

The earthing shall be done with wires/flat as under:

Sl. No.	Equipment	Size of Earth Wire/Strip	
		GI	Copper
1.	Motors Upto 5 HP	2 Nos 8 SWG	2 Nos. 14 SWG
2.	Motors Upto 15 Hp	2 Nos 8 SWG	2 Nos 12 SWG
3.	Motors Upto 30 HP	2 Nos 4 SWG	2 Nos. 8 SWG
4.	Motors Upto 50 HP	2 Nos 25x6mm Flat	2 Nos. 4 SWG
5.	Motors above 50 HP	2 Nos 32x6mm Flat	2Nos. 5x3mm Flat.

AHU electrical panel shall generally be wall mounted type. Above stated specifications shall also stand good where applicable. The AHU motor shall be double earthed with two independent earth conductors as per the Indian Electricity Rules & Regulations-1956.

4.16 Medium Voltage Cable

a. Type

Medium voltage cables shall be aluminium/copper conductor, PVC insulated, PVC sheathed and steel wire armored or steel tape armored construction.

b. Rating

The cable shall be rated a voltage of 660/1100 volts.

c. Construction

The conductors shall be made of electrical purity aluminium 3/4 or H temper/copper. The conductor shall be insulated with high quality PVC base compound. A common covering (bedding) shall be applied over the laid up cores by extruded sheath of unvulcanized compound.

Armouring shall be applied over the inner sheath of bedding. Over the armouring a tough outer sheath of PVC sheathing shall be extruded. The armouring shall be of single layer, galvanised steel round wire or flat strip. Wire armour should be used for cable dia over inner sheath upto 13mm and strip armour to be used for higher dia. The outer sheath shall bear the manufacturer's name and trade mark at every meter length.

d. Core Identification

Cores shall be provided with the following colour scheme of PVC insulation:

Core 1 : Red/Black/Yellow/Blue

Core 2 : Red & Black

Core 3 : Red, Yellow & Blue

Core 4 : Red, Yellow, Blue & Black

e. Current Rating

The current ratings shall be based on the following conditions:

- i. Maximum conductor temperature : 70 deg C
- ii. Ambient Air temperature : 43 deg C
- iii. Ground temperature : 30 deg C
- iv. Depth of laying : 75 CM

f. Short Circuit Rating

Short circuit ratings for the cables shall be as specified in IS: 1554-Part I.

g. Selection of Cables

The cables shall be suitable for effectively earthed A/C system 415 volts, 3 Phase 50 Hz.

Cables have been selected considering the conditions of the maximum connected load, switch rating ambient temperature, grouping of cables and the allowable voltage drop. However, the contactor shall recheck the sizes before the cables are ordered and brought to site. Discrepancy if any, shall be brought to the notice of Consultant.

h. Laying of Cables

For laying of cables along building steel structure and technological structures the cables shall be taken by clamping with MS saddles screwed to the MS flat welded to the structure. MS saddles and flats are to be galvanized after fabrication so that there is no rusting during maintenance period.

For laying cables along concrete walls, ceiling etc. The cables shall be taken by clamping with MS saddles screws to the MS flat welded on to the inserts. Where inserts are not available the saddles shall be directly fixed in the wall using rowl steel plugs of sufficient capacity and MS flat spacers of minimum 2mm thick.

The MS saddles shall be spaced at an interval, not more than 500mm both for horizontal and vertical runs. However, at the bends, it shall be spaced within 300mm and where terminating to the equipment/junction box the cable shall be clamped immediately before such terminations. In the area prevailing with corrosive atmosphere, PVC saddles instead of MS saddles shall be provided.

Underground cables shall be laid not less than 750mm below ground. The width of the trench shall be 300mm minimum for single cable. For additional cables additional width of 150mm for each cable is to be added. The sand should be spread in trench as under.

The cushion of sand to be provided below and above the cable joint boxes etc must not be less than 80mm i.e, total depth of sand shall be 160mm minimum. The sand should be spread in trench as under.

1. After laying the cable in trench 80mm of sand should be put over the cable. The cable should then be lifted and placed over the sand bed and the balance 80mm of sand put over it.
2. Where cable is laid in rocky situation extra thick cushioning of sand as may be decided by site in charges shall have to be done without any extra cost.

Filling of trenches shall be done after the sand cushioning and laying of tiles/bricks are carried out to the satisfaction of the engineer.

4.17 Cable Trays

1. Trays shall have suitable strength and rigidity to provide adequate support for all cables.
2. Shall not have sharp edges, burrs or projections injurious to cable insulation.
3. Shall be adequately protected against corrosion.
4. Shall include fittings factory fabricated or other suitable means for change of direction and elevation in run.

4.17.1 Installation of Trays

Trays shall be installed as complete system supported properly and rigidly from the building structure.

Each run of cable tray shall be completed before the installation of cables. Cable trays shall be accessible.

Noncombustible solid barriers shall be used for segregating the cables of different systems on the same cable tray. Cable trays shall be grounded by 2 Nos earth strips. Trays shall not be used as equipment grounding conductor.

4.18 Testing

- a. Cables shall be tested as per the requirements of IS 1554. The tests shall be incorporate routine test and acceptance tests. Type test certificate shall be furnished whenever demanded.
- b. Tests shall be carried out at site and submitted to project authorities.

4.19 Cable Identification Tag

Suitable cable identification tag shall be placed along the route of cable at every 10 meters and bends. The tags shall be of size 150mm x 100mm x2mm aluminium sheet. It shall be punched with similar details as given below.

Cable from MCC or AHP-1

Cable to CDWP-1 or CT-1

Size of cable 2 Nos 3Cx 6 Sqmm.

4.20 Drawings

Shop drawing for MCC/control panels and wiring of equipment showing the route of cables shall be got approved by the Consultants before starting the fabrication of panel and starting the work.

APPENDIX- I

GUARANTEE PROFORMA FOR HVAC INSTALLATION

Owner : Inland Waterways Authority of India
Location : A-13, Sector – 1, NOIDA (UP)

1. The Contractor shall furnish the following guarantee:
“We warrant that everything supplied by us including all components fitted into the equipment manufactured by others also, shall be in all respects free from all defects and faults in material, workmanship and manufacture and shall be of the highest grade and quality to acceptable standards for all materials of the type ordered and shall be in full conformity with all the specifications, drawings or samples if any and we shall be fully responsible for its efficient performance. This guarantee shall survive inspection for acceptance and payment for the equipment and installation, but shall expire (except in respect of the complaints notified to us) 12 months from the date of issue of completion certificate by the Architect/Consultants. The complaints, workmanship, manufacturer or performance of any of the equipment or part/parts thereof shall be notified by fax within 12 months from the date of issue of such completion certificate”.
2. The Contractor shall replace such of these parts which require replacement under these conditions free of cost, charge and expenses to the purchaser. In addition, the Contractor shall be responsible for a period of 12 months from the date of issue of completion certificate for any defect that may develop or appear under the conditions provided by the Contractor or use thereof arising from faulty material design or workmanship in the equivalent or any part thereof or faulty installation of the equipment by the Contractor but not otherwise and shall correct such defects within one week from the date of notification at his own cost when called upon to do so by the purchaser who shall state in writing in what respect the portion is faulty.
3. Any faulty component replaced or renewed under the clause shall also be guaranteed for a period of six months from the date of such replacement or removal of until the end of the above mentioned period whichever is later.
4. If defects are not rectified within a reasonable time as mentioned in the written notice, the Project Managers/Architects/Owners shall proceed to do so at the Contractor’s risk and cost without prejudice to any other right thereof.

Signature and Stamp of the Contractor

Date:

APPENDIX-II

HVAC TENDER DRAWINGS

Drg. No.	Title
AC-01	HVAC SYSTEM LAYOUT – SECOND FLOOR PLAN
AC-02	HVAC SYSTEM LAYOUT – THIRD FLOOR PLAN
AC-03	HVAC SYSTEM LAYOUT – FOURTH FLOOR PLAN
AC-04	HVAC SYSTEM LAYOUT – FIFTH FLOOR PLAN
AC-05	HVAC SYSTEM LAYOUT – SIXTH FLOOR PLAN
AC-06	HVAC SYSTEM LAYOUT – TERRACE PLAN
AC-07	SCHEMATIC – VRF SYSTEM
AC-08	MISCELLENEOUS DETAILS

APPENDIX-III

INTERNATIONAL CODES AND STANDARDS

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

- 1.1 ASHRAE – American Society for Heating, Refrigerating and Air conditioning Engineers.
- 1.2 SMACNA – Sheet Metal and Air Conditioning Contractors National Association or Indian Standards –1982 Edition or IS277/655 Standards.
- 1.3 UL - Underwriter’s Laboratory, USA.
- 1.4 AMCA - Air Movement & Control Association, International
- 1.5 AHRI - American Heating & Refrigeration Institute
- 1.6 ANSI - American National Standards Institute
- 1.7 CSA - Canadian Standards Association
- 1.8 ISO - International Standards Organization
- 1.9 IEC - International Electrochemical Commission
- 2.0 EUROVENT - European Certification Program

APPENDIX-IV
LIST OF BUREAU OF INDIAN STANDARDS CODES

IS : 277 - 1992	Galvanized steel sheet (Plain & corrugated) wire for fencing.
IS : 554 - 1985 (Reaffirmed 1996)	Dimensions for pipe threads where pressure tight joints are required on the threads.
IS : 655 - 1963 (Reaffirmed 1991)	Metal air ducts.
IS : 694 - 1990 (Reaffirmed 1994)	PVC insulated (HD) electric cables for working voltage upto and including 1100 volts.
IS : 732 - 1989	Code of practice for electrical wiring.
IS : 780 - 1984	Sluice valves for water works purposes.
IS : 822-1970 (Reaffirmed 1991)	Code of procedure for inspection of welds.
IS : 1239 (Part - I) – 1990	Mild steel tube
IS : 1239 (Part - II) - 1992	Mild steel Tubular and other wrought steel pipe fittings.
IS : 1255 – 1983	Code of Practice for installation and maintenance of Power Cables upto and including 33 KV rating (Second Revision)
IS : 1554 - 1988 (Part – I)	PVC insulated (Heavy Duty) electric cables for working voltages upto and including 1100 volts.
IS : 1897 - 1983(Reaffirmed 1991)	Copper bus bar / strip for electrical Purposes
IS : 2379 - 1990	Color code for the identification of pipelines.
IS : 2551 - 1982	Danger notice plate
IS : 3043 – 1987	Code of practice for earthing.
IS : 3103 – 1975 (Reaffirmed 1999)	Code of practice for Industrial Ventilation
IS : 3837 – 1976 (Reaffirmed 1990)	Accessories for rigid steel conduit for electrical wiring.
IS : 4736 – 1986 (Reaffirmed 1998)	Hot-dip zinc coatings on steel tubes.
IS : 4894 - 1987	Centrifugal Fan.
IS : 5133 -1969 (Part-I) (Reaffirmed 1990)	Boxes for the enclosure of electrical accessories.
IS : 5312 (Part-I) -1984 (Reaffirmed 1990)	Swing - check type reflux Non return valves for water works
IS : 5424 – 1989 (Reaffirmed 1994)	Rubber mats for electrical purposes.
IS : 5578 & 11353-1985	Marking and identification of conductors
IS : 6392 - 1971(Reaffirmed 1988)	Steel pipe flanges.
IS : 8623 – 1993	Low voltage switchgear and control gear Assemblies (Requirement for type / partly type tested assemblies)
IS : 8623 - 1993	Bus Bar trunking system(Part - II)
IS : 8828 - 1996	Circuit Breakers for over current Protection For house hold and similar installation.
IS : 9537 - 1981(Part II)	Rigid Steel Conduits for electrical wiring
IS : 10810 - 1988	Methods of test for cables.
IS : 13947-1993 (Part-I)	General rules for low voltage switch gears and control gears.

IS : 13947-1993 (Part-II) IEC 947 – 2	Circuit Breakers
IS : 13947 - 1993 (Part-III)	Switches, dis connectors and fuse for low voltage switch gear and control gear.
IS : 13947 - 1993 (Part-IV)	Low voltage switch gear and control Gear for contactors and motor starters
IS : 13947 – 1993 (Part-V)	Control Circuit Devices.
IEC	Relevant Sections.
NBC	National Building Code
ISHRAE	Indian Society for Heating, Refrigerating and Air-conditioning Engineers ISHRAE 2005 Edition.

APPENDIX-V
I.S. SAFETY CODES

IS : 659 – 1964 (Reaffirmed 1991)	:	Safety Code for Air Conditioning.
IS : 660 – 1963 (Reaffirmed 1991)	:	Safety code for Mechanical Refrigeration.
IS : 3016	:	Code of Practice for Fire Precautions in Welding and Cutting operations.
IS : 818	:	Code of practice for Safety and Health Requirements in Electrical & Gas Welding and cutting operations.
IS : 5216–1982 (Part-I) (Reaffirmed 1990)	:	Guide for safety procedure and Practices in electrical work.
IS : 3696	:	Safety Code for Scaffolds and Ladders.

APPENDIX- VI
PROFORMA FOR SCHEDULE OF TECHNICAL PARTICULARS

Aircooled Variable Refrigerant Flow System
Outdoor units (Heat Pump Type)

54 HP

50HP

- a. Make and model
- b. HP of Outdoor Unit
- c. Capacity in TR (Nominal)
- d. Quantity
- e. Type
- f. Permissible length of refrigerant piping from ODU to farthest IDU.
- g. Type of compressor
- h. No. of compressors (Each Outdoor unit)
- i. No. of inverter driven compressors (Each Outdoor unit)
- j. Air entering temp. condenser in deg C
- k. Dimension of ODU in mm (H x W x D)
- l. Are bigger ODUs, above 16 HP, provided with 2 separate inverter compressors for proper duty cycling and higher reliability as specified.
- m. Confirm whether dedicated Intelligent touch controller with colored graphic LED display provided to act as BAS for VRF system.
- n. Confirm whether inverter driven scroll compressor is DC inverter? Also provide following information:

External static pressure available in ODU.
 Type of anticorrosion treatment on fins of ODU .

Type of Heat exchanger in ODU

Set up availability for Night time db relaxation

Confirm availability of features for reduction in fan noise and pressure loss on ODU

Is it possible to incorporate automatic address setting of each IDU & ODU ? Otherwise specify alternate function available.

Indoor Units

Hi-wall

Ductable

- a. Manufacturer
- b. Type
- c. Capacity (TR)
- d. Airflow Min/Max. (Cfm)
- e. Sound level (Hi/Lo)

- f. Overall Dimensions(L xW x H)
- g. Unit weight (Kg)
- h. Is remote controller (corded) provided for each indoor unit (Yes/No)

**Centralized Controller – Touch Screen Type
(2 Nos. For complete VRF System)**

Detail of operation

Local Remote Controller

Detail of operation

Inline Fans

- a. Manufacturer
- b. Motor Characteristics
- c. Whether speed regulator provided for single phase fans
- d. Whether Bird Screen provided

Propeller Fans

- a. Manufacturer
- b. Motor Characteristics
- c. Capacitors Provided
- d. Speed Regulator
- e. Gravity Louvers
- f. Single Phase Preventor
- g Back Draft Damper
- h. Bird Screen
- i. Wire guard.

GI Drain Piping

- a. Make
- b. Material for pipes.

Ducting

Type of Material

Manufacturer

Class of GSS

- a. “K” value at 10 degree C mean temp.
- b. Thickness

Grilles, Diffusers and Dampers

Make, Material and Gauge of following items :

- a. Fire Dampers
- b. Grilles :
 - i. Extruded aluminium
 - ii. Mild Steel
- c. Diffusers :
 - i. Extruded aluminium
 - ii. Mild Steel
- d. Duct Dampers

e. Grille Dampers Insulation

A. Duct Acoustic Lining

- a. Material
- b. Manufacturer
- c. Density
- d. Thermal Conductivity
- e Thickness

B. Thermal Insulation of Ducts

- a. Material
- b. Manufacturer
- c. Density
- d. Thermal Conductivity
- e. Thickness

C. Exposed Duct Thermal Insulation

- a. Material
- b. Manufacturer
- c. Density
- d. Thermal Conductivity
- e Thickness

D. Drain Pipe Insulation

- a. Material
- b. Manufacturer
- c. Density
- d. Thermal Conductivity
- e Thickness

Electrical Accessories

Make of the following:

- a. Motor control centre
- b. MCCBs
- c. MCBs
- d. Change Over Switch
- e. Star Delta Starter
- f. Direct On Line Starter
- g. Contactors/Over |Load Relays
- h. Current Transformers
- i. Single Phase Preventors
- j. Push Buttons
- k. Ammeter And Voltmeter
- l. Indication Lamps
- m. Power Cables
- n. Control Cables & Wires

APPENDIX- VII
APPROVED MAKES OF EQUIPMENT & MATERIALS

List of approved makes of different equipment/materials to be used in this project.

S.NO.	DETAILS OF EQUIPMENT AND MATERIALS	MANUFACTURER'S NAME EQUIPMENT
1.	Variable Refrigerant Flow System	Voltas/ Blue Star/Daikin
2.	Centrifugal Fans	Greenheck/Nicotra/Comefri/ Kruger/ Chaysol
3.	Inline Fans	Caryaire/ System air (Sweden)/Ostberg (Sweden)/ Chaysol(Spain)
4.	Propeller Fans	Alstom/Khaitan
5.	Axial Flow Fans	Greenheck/Nicotra/ Alstom/Kruger/ Airflow
6.	V-Belts	Fenner India/Dunlop
7.	Voltage Stabilisers	Logicstat/Shilpa
8.	Extract Fan Sections	Nicotra/Zeco/ Roots / Edgetech/V-Hitech
9.	Strip Heaters	Dasspass
10.	Airwashers	Ambassador /Roots/ Edgetech
11.	Cellulose based Paper fills	Glacier-Cor/Munters
12.	Motors	Siemens/Bharat Bijlee/ ABB
13.	Air Curtains	Beacon/Thermadyne
14.	Copper Pipes	Mandev/ Rajco
15.	Split Units	Daikin/Toshiba/Voltas/BlueStar/LG
16.	Compressor	Voltas/ LG/ Tecumseh /Copeland

Sl.no.	DETAILS OF EQUIPMENT AND MATERIALS	MANUFACTURER'S NAME
AIR DISTRIBUTION		
1.	GS Sheet	SAIL/ ISCO/ TataSteel/ National/Jindal
2.	Factory Fabricated Ducts	Rolastar/Zeco/Techno Fabriduct/Ductofab
3.	Flanges & Accessories for the above ducts	Rolamate/ Zeco / Technomate/Ductofab
4.	Wire rope suspension arrangement	Gripple/ Ductmate/ Acrefine
5.	Pre Filters	Anfilco/Thermadyne/Spectrum/SAGI Cofim
6.	Fine Filters/ Hepa Filters/Activated carbon filters	Anfilco/Thermadyne/Spectrum/SAGI Cofim
7.	Metallic air Filters	Suvidha/ Zeco/ Edgetech/ Nutech
8.	Antivibration canvass sleeve	Suvidha/ Zeco/ Edgetech/ Nutech
9.	Extruded Aluminium grilles & diffusers	Dynacraft/Servex/ Air Master/ Precise
10.	Plaque Type diffusers	Dynacraft/Servex/ Air Master/Precise
11.	Swirl Diffusers	Dynacraft/Trox/ Air Master/Precise
12.	Jet Nozzles	Dynacraft/Trox/ Air Master/Precise
13.	Air transfer grilles	Dynacraft/Servex/ Air Master/Precise
14.	Smoke cum Fire Dampers a. Bare Dampers b. Actuators	Greenheck/Ruskin/Dynacraft/Servex Belimo/Joventa / Siemens
15.	Sound Attenuators	Intertec (Noida)/Titus/Sound Control

16.	Intake Louvers	Dynacraft/Servex/ Air Master/Precise
17.	Duct Dampers	Dynacraft/Servex/Easyflow
18.	Dash fastners/ suspension accessories with anti-seismic feature	HILTI/Fischer/ Canon
19.	Flexible Ducts	Caryaire/ Atco/ Global
20.	Fire retardant Flexible connections for ducts at building expansion joints	Resistoflex/Gerb/Easyflex
21.	Kitchen Hoods	Continental/ Aster Technologies

Sl.no.	Details of equipment and materials	Manufacturer's name
INSULATION		
1.	Fibre glass	UP Twiga/Owens Corning
2.	RP Tissue	UP Twiga/Owens Corning
3.	Closed/open cell Elastomeric Thermal/Acoustic Insulation	Armaflex/Eurobatex/Aeroflex/K-flex
4.	Adhesive for closed cell insulation	Pidilite/Aeroseal Glue/Paramount
5.	Expanded polystyrene	Beardsell/Styrene Packing
6.	Aluminium Tape	3M/Magic
7.	Aluminium foil	INDALCO/BALCO
8.	PUF pipe supports	Malanpur Entech/Bestopuf
9.	Mo Ply Polyster Membrane	Shelko/Bituplus
10.	External surface treatment of insulated surface to achieve mechanical strength & UV protection	Paramount Polytrete/Polybond

Sl.no.	Details of equipment and materials	Manufacturer's name
ELECTRICALS		
1.	MCC & AHU Panels Category A Category B	Tricolite/Advance/Adlec India Tech/Madhu Electrical/Neptune Systems/Jackson
2.	Air circuit Breaker	L&T/ Schneider/Siemens
3.	MCCB	L&T/ Schneider/Siemens
4.	MCB	Legrand/L&T/Schneider
5.	Cables	Gloster/Skytone/CCI/KEI/Rallison
6.	Cable Glands	Commet
7.	Cable Lugs	Dowels
8.	ELCB	Schneider/L&T
9.	Changeover switch	L&T/ Schneider/Siemens
10.	Contactors	L&T/ Schneider/Siemens
11.	Overload Relay	L&T/ Schneider/Siemens
12.	Indicting Lamp/Push button (LED type)	L&T (ESSBEE)/Vaishno (2XVLDIL-B1)/Siemens
13.	SFU/FSU	L&T/ EE/Siemens/GE Power
14.	HRC Fuses & fuse fittings	L&T/ EE/Siemens/GE Power
15.	Current Transformers	Automatic electric/ Kappa
16.	Rotary switches	Salzer/L&T/Kaycee

17.	Toggle switches	L&T/Kaycee
18.	Selector switches	Salzer/L&T/Kaycee
19.	Time delay relay	Telemecanique (France)
20.	Ammeter/Voltmeter (Digital)	Enercon/Schneider
21.	Ammeter/Voltmeter (Analog)	AE
22.	Time Clock	L&T/ Schneider
23.	KWH Metre (Digital Type)	L&T/ Schneider
24.	Under Voltage Relays	L &T/ C&S
25.	Over Voltage Relay	L &T/ C&S
26.	MS Conduits (ISI Marked)	BEC/ AKG
27.	PVC Conduits – FRLS	BEC/ AKG/ Polypack
28.	PVC Wires – FRLS (Halogen free)	Finoloex/ Skytone/ KEI
29.	Factory fabricated distributionboard	Legrand/ Schneider/ L &T

NOTE :

Make of any other equipment not mentioned above shall be got approved from the Consultants before execution.

APPENDIX – VIII

List of equipment & accessories which contractor has to bring, Keep and maintain, at his own cost, at site during the currency of the contract in good condition.

PLANT/EQUIPMENT	NUMBER
01. Floor mounted drill machine	1
02. Hand drill machine with drill bits	2
03. Hammer Drill machine with drill bits	2
04. Lock forming machine for duct fabrication	1
05. Hand held lock closing machine	1
06. Electric Pittsburg Seamer for closing pittsburg joints	1
07. Electric Slitting shear for making cut outs	1
08. Hand held Collar cutting machine	1
09. Mechanized saw for cutting angles & channels	1
10. Duct smoke test kit	1
11. For application of closed cell elastomeric insulation	
i. 1200 long steel scale	1
ii. 1200x900 size 40mm thick commercial ply board	1
iii. Sharp knives of different sizes	12
12. Tripods with chain pulley blocks	4

and any other equipment required for efficient execution of work within the stipulated period.

PREAMBLE

HVAC SERVICES SCHEDULE OF QUANTITIES

1. All equipment described hereafter shall be in accordance with the specifications.
2. All equipment shall be selected and installed for the lowest operating noise level.
3. Supply of various equipment shall include all expenses for correspondence with manufacturers, submission of shop drawings, documents and their approval by the Consulting Engineer/Project Managers, procurement of equipment, transportation, shipping, payment of all taxes and levies, storage, supply of equipment at the point of installation, furnishing all technical literature required, replacement of defective components and warranty obligations for the individual equipment.
4. Installation of various equipment shall include all material and labour associated with hoisting and lowering of equipment in position, insulation of the components and vibration isolation as required, grouting & anchoring or suspension arrangements and all incidentals associated with the installation as per the specifications and manufacturer's recommendation.
5. Vibration isolators as specified or as recommended by the manufacturer shall be installed with each component. Performance ratings, power consumption and sound power data for each component shall be verified at the time of testing and commissioning of the installation, against the data submitted with the tenders.
6. Shop coats of paint that have become marred during shipment or erection shall be cleaned off with mineral spirit, wire brushed and spot primed over the affected areas, then coated with enamel paint to match the finish over the adjoining shop painted surfaces.
7. Testing and commissioning shall include furnishing all labour, materials, equipment, instruments and incidentals necessary for complete testing of each component as per the specifications & manufacturer's recommendations, submission of test results to the Consulting Engineer/Project Managers, obtaining their approval and submission of necessary completion documents & drawings.
8. All ducts shall be fabricated and installed conforming to the relevant Indian Standards, approved shop drawings and the specifications.
9. Duct installation shall include fabricating and installing the ducts, splitter dampers, turning vanes, distribution grids within the ducts in position extruded aluminium hardware fittings such as handles, thunder bolts, hinges, factory fabricated access door and providing , installing , MS hangers with dash fasteners, foam rubber insertions, nuts, bolts and screws as required. Making all joints air tight using rubber insertions. Multi-louvered manually adjustable dampers shall be provided in various branch ducts as required or shown on drawings for proper balancing of air flow. All primer coated MS hangers, dampers, base frames etc. shall be painted with black enamel paint.
10. All registers and diffusers shall be provided with a soft continuous rubber gaskets between their periphery and the surface on which these have to be mounted.
11. MS registers and diffusers shall be given, at the factory, a rust resistant primer coat and enamel paint finish of approved colour. Aluminium grilles and diffusers shall be fabricated out of extruded aluminium sections.
12. After completion of the installation, the entire air distribution system shall be tested for leaks and balanced in accordance with the specifications.

13. Mode of Measurement

The mode of measurement for the various items, unless otherwise specified, shall be as follows:

13.1 Ducting

Payment for ducting shall be made on the basis of the external surface area of the ducting including all material and labour for installed duct.

The rates per SqM/Sft of the external surface shall include MS angle iron/ GSS flanges, gaskets for joints, nuts & bolts , duct supports & hangers, vibration isolation pads or suspenders, dash fasteners, inspection doors, dampers, turning vanes, major hardwares such as thunder bolts, hinges, handles in extruded aluminium construction and any other item which will be required to complete the duct installation except external insulation and acoustic lining.

The external area shall be calculated by measuring the overall width and depth (including the corner joints) in the centre of the duct sections and overall length of each duct section from flange face incase of duct lengths with uniform cross section. Total area will be arrived at by adding up the areas of all duct sections.

In case of taper pieces average width and depth will be worked out as follows :

W1 = width of small cross section

W2 = width of large cross section

D1 = depth of small cross section

D2 = depth of large cross section

$$\text{Average width} = \frac{W1 + W2}{2}$$

$$\text{Average depth} = \frac{D1 + D2}{2}$$

Width and depth in the case of taper pieces shall be measured at the edge of the collar of the flange for duct sections fitted with angle iron flanges, otherwise at the bottom of the flange where flanges are of duct sheet. For the circular pieces the diameter of the section mid-way between large and small diameters shall be measured and adopted as the mean diameter for calculating the surface at the taper piece. For the face length of taper piece shall be the mean of the lengths measured face to face from the centre of the width and depth of flanges. Duct measurements for calculation of area shall be taken before application of insulation. For the special pieces like bends, branches, and tees etc. same principle of area measurement as for linear lengths shall be adopted except for bends and elbows, the length of which shall be the average of the lengths of inner and outer periphery along with curvature or angle of the piece.

13.2 Duct Insulation

This item is provided separately for various thickness and shall be paid for on area basis of uninsulated duct. The area of the duct to be insulated shall be measured before application of insulation.

13.3 Grilles & Diffusers

All extruded aluminium grilles and diffusers shall be paid on the basis of actual measurement at site. Area of extruded aluminium diffusers shall be derived from neck size i.e. 225x225,300x300,375x375 & 450x450. However, payment of 600x600 diffusers shall be paid based on the actual diffuser size excluding flanges and not the neck size.

13.4 Refrigerant Piping

Refrigerant piping shall be measured on linear length basis including bends and fittings.

13.5 Exhaust Hoods

All kitchen exhaust hoods shall be measured and accounted for the area derived from plan dimensions.

14. All quantities indicated in this schedule are for Contractor's guidance only.
15. Appropriate troughs in the suspended ceiling be provided for terminating duct collars for diffusers & grilles by other agencies to achieve desired interior finishes.

PROFOMETREA FOR EXPERIENCE

DETAILS OF SIMILAR WORKS CARRIED OUT BY THE Firm

(SEPARATE SHEETS TO BE ATTACHED)

S. No	NAME OF ORGANISTON	NAME OF WORK	CONTRACT VALUE	SCHEDULED DATE and ACTUAL DATE OF COMPLECTON (EXTN. OF TIME, IF ANY)	ACTUAL REASON FOR DELAY IN COMPLEETION, IF ANY

FOMETREAT OF BANK GUARANTEE FOR PERFORMETREANCE SECURITY

To,
The Chairman,
Inland Waterways Authority of India,
A-13, Sector-I,
NOIDA – 201301.

WHEREAS..... (name and address of contractor) hereinafter called “the contractor” has undertaken, in pursuance of Contract No. Datedto execute..... (Name of Contract and brief description of Works) (hereinafter called “the contract”).

AND WHEREAS it has been stipulated by you in the said contract that the Contractor shall furnish you with a Bank Guarantee by a Nationalised/Scheduled bank of India for the sum specified therein as performance guarantee for compliance with his obligations in accordance with the Contract;

AND WHEREAS we have agreed to give the Contractor such a Bank Guarantee:

NOW THEREOF we hereby affirm that we are the guarantor and responsible to you on behalf of the Contractor, up to a total of Rs..... (amount of guarantee) (Rupees..... (in words), such sum being payable in the types and proportions of currencies in which the Contract Price is payable, and we undertake to pay you, upon your first written demand and without cavil or argument, any sum or sums within the limits of (amount of guarantee) as aforesaid without your needing to prove or to show grounds or reasons for your demand for the sum specified therein.

We hereby waive the necessity of your demanding the said debt from the Contractor before presenting us with the demand.

We further agree that no change or addition to or other modification of the terms of the contract or of the works to be performed there under or of any of the contract documents which may be made between you and the Contractor shall in any way release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.

This guarantee shall be valid until 28 days from the date of issue of the Defects Liability Certificate.

Signature and seal of the Guarantor.....

Name of the Bank

Address.....

Date.....

In the presence of

1.....

(Name of Occupation)

An amount shall be inserted by the Guarantor, representing the percentage of the Contract Price specified in the Contract and denominated in Indian Rupees.

PROFORMA FOR AGREEMENT

(TO BE SUBMITTED ON RS.100/- NON JUDICIAL STAMP PAPER)

CONTRACT AGREEMENT FOR THE WORK OF

Made this Day of.....

Between..... M/s

Hereinafter called the “Contractor” (which terms shall unless excluded by or repugnant to the context include its successors and permitted assigns) of the one part; and Inland Waterways Authority of India, A- 13, Sector- 1 Noida- 201301 (U.P.) hereinafter called the “OWNER” (which terms shall unless excluded by or repugnant to the context include its successors and permitted assigns) of the other part.

WHEREAS

- a) OWNER being desirous of getting executed the WORK mentioned, enumerated or referred to in the Bid Document including Notice Inviting Tender, Instruction to Bidders, General Condition of Contract, Special Conditions of Contract, Specifications, Time Schedule, Letter of Acceptance of Bid and other documents has invited Bids.
- b) CONTRACTOR has inspected SITE and surroundings of WORK specified in the Bid Documents and satisfied himself by careful examination before submitting his Bid as to the nature of the quantities, nature and magnitude of WORK, availability of equipment etc. necessary for the execution of WORK, the means of access to SITE, the position of supply of power and water thereto and the accommodation he may require and has made local and independent enquiries and obtained complete information as to the matters and things referred to, or implied in the Bid Document or having any connection therewith, and has considered the nature and extent of all probable and possible situation, delays, hindrances or interferences to or with the execution and completion of WORK, to be carried out under this CONTRACT, and has examined and considered all other matters condition and things and probably and possibly contingencies, and generally all matters incidental thereto and ancillary thereof effecting the execution and completion of WORK and which might have influenced him in making his Bid.
- c) The Invitation to Bid, instructions to Bidders, General Conditions of Contract, Description of Works and specifications, Plans, Time Schedule, Letter of Acceptance of Bid any and any other documents and enclosures, copies of which are hereto annexed are included in the expression “CONTRACT” :

AND WHEREAS

OWNER accepted the Bid of CONTRACTOR for the provision and the execution of WORK at the CONTRACT PRICE as indicated in the letter of award of work upon the terms and subject to the conditions of Contract.

Now this CONTRACT AGREEMENT witnesseth and it is hereby agreed and declared as follows:

1. In consideration of the payment to be made to CONTRACTOR for WORK to be executed by him, CONTRACTOR hereby covenants with OWNER that CONTRACTOR shall and will duly provide, execute and complete the work and things in CONTRACT, mentioned or described or which are to be implied therefrom or may be reasonably necessary for completion or stipulations mentioned in CONTRACT.

2. In consideration of the due provision, execution and completion of WORK by the CONTRACTOR in accordance with the terms of the CONTRACT, the Owner does hereby agree with CONTRACTOR that OWNER will pay to Contractor the respective amount for the work actually done by him and approved by Owner as per Payment Terms accepted in CONTRACT and payable to CONTRACTOR under provision of Contract; such payment to be made at such time and such manner as provided for in the CONTRACT.

AND

3. In consideration of the due provision, execution and completion of WORK, CONTRACTOR does hereby agree to pay such sums as may be due to OWNER for the services rendered by Owner to Contractor as set forth in CONTRACT and such other sums as may become payable to Owner towards loss, damage to the OWNER's equipment, materials etc. and such payments to be made at such time and in such manner as in provided in the CONTRACT.

IN WITNESS WHEREOF Parties executed these presents on the day and the year above written.

Signed and Delivered for
and on behalf of
CONTRACTOR

.....
.....

Date:
Place:

Signed and Delivered for
and on behalf of
OWNER (IWAI)

.....
.....

Date:
Place:

In presence of Witness (Signature with Name & Address)

1.
.....
2.
.....

1.
.....
2.
.....



Supply, installation, testing and commissioning of HVAC system are using Variable Refrigerant Flow (VRF) system at vertical expansion (2nd to 6th floors) of IMAI office cum R & D complex at A-13, Sector - 1, Noida.

DRAWINGS



Supply, installation, testing and commissioning of HVAC system are using Variable Refrigerant Flow (VRF) system at vertical expansion (2nd to 6th floors) of IWA office cum R & D complex at A-13, Sector - 1, Noida.

PART – II

PRICE BID

Bill of Quantities

Item	Description	Unit	Qty.	Rate	Amount																								
1.0	EQUIPMENT																												
1.1	OUTDOOR UNITS Supply, Installation, Testing and Commissioning of air cooled variable refrigerant flow modular type condensing units, each comprising of multiple scroll compressors at least one inverter driven, full charge of refrigerant gas (R-410a), lubricating oil and all accessories as per the specifications. The condensing units shall be suitable to work on cooling as well as heating mode . The condensing units shall be suitable for operation on 415 ±10% volts, 50Hz, 3 phase AC power supply and the condensing units shall be of following capacities: a. 54 HP (44.5 TR) nominal capacity b. 50 HP (41.2 TR) nominal capacity	No	1																										
		No	4																										
1.2	CUSTOMISED INDOOR UNITS - VERTICAL																												
	Supply, Installation, Testing & Commissioning of sheet metal sectionalised construction double skin air handling units with 25 mm thick injected PUF of density not less than 40 Kg/Cum. The air handling units shall be complete with pre-filter section with synthetic fiber filters, coil section with multirows deep DX cooling/heating coil of copper tube & aluminium fin construction, fan section complete with floor standing forward curved DIDW centrifugal fan, EFF-1 squirrel cage induction motor, belt drive package, stainless steel drain pan and vibration isolation pads all complete as per specifications. AHUs shall be selected for a maximum face velocity of 500 FPM. The units shall be compatible with VRF outdoor units. The unit shall be supplied with inbuilt DOL starter for motor, electronic expansion valve/s (Dx), thermostats, control wiring & all accessories as required for completing installation. Fan outlet velocity shall not exceed 2000 FPM (10.1 MPS).																												
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>AHU No.</th> <th>Capacity (Cfm)</th> <th>SP (mm WG)</th> <th>No. of Rows</th> <th>Motor Rating(HP)</th> <th>Ref. Load</th> </tr> </thead> <tbody> <tr> <td>AHU-1</td> <td>9000</td> <td>40</td> <td>4</td> <td>5</td> <td>20 TR</td> </tr> <tr> <td>AHU-2</td> <td>9500</td> <td>40</td> <td>4</td> <td>5</td> <td>21 TR</td> </tr> <tr> <td>AHU-3</td> <td>9000</td> <td>40</td> <td>4</td> <td>5</td> <td>20 TR</td> </tr> </tbody> </table>	AHU No.	Capacity (Cfm)	SP (mm WG)	No. of Rows	Motor Rating(HP)	Ref. Load	AHU-1	9000	40	4	5	20 TR	AHU-2	9500	40	4	5	21 TR	AHU-3	9000	40	4	5	20 TR				
AHU No.	Capacity (Cfm)	SP (mm WG)	No. of Rows	Motor Rating(HP)	Ref. Load																								
AHU-1	9000	40	4	5	20 TR																								
AHU-2	9500	40	4	5	21 TR																								
AHU-3	9000	40	4	5	20 TR																								
		No	1																										
		No	1																										
		No	1																										

	AHU-4	9500	40	4	5	21 TR	No	1		
	AHU-5	9000	40	4	5	20 TR	No	1		
	AHU-6	9500	40	4	5	21 TR	No	1		
	AHU-7	9000	40	4	5	20 TR	No	1		
	AHU-8	9500	40	4	5	21 TR	No	1		
	AHU-9	10000	40	4	5	22 TR	No	1		
	AHU-10	11000	40	4	5	23 TR	No	1		
1.3	CENTRALISED CONTROLLER Supply, Installation, Testing and Commissioning of main centralised controller as per specifications to hook up indoor units as mentioned above. Controller shall however, be suitable for 16 groups of indoor units. The cost shall be inclusive of wiring & conduits.						No	1		
1.4	SPLIT PACKAGES Supply, Installation, Testing & Commissioning of split type air-conditioning units, each comprising of an outdoor and a single indoor unit. Condensing unit shall be complete with hermetically sealed rotary/ scroll compressor/s, with aluminium fins, thermostatic expansion valve and air cooled condenser with fan. Evaporating unit shall consist of a fan section with dynamically balanced centrifugal fan/s driven by FHP/TEFC squirrel cage induction motor, multirows deep cooling coil of copper tubes and aluminium fins etc. Enclosures shall be fabricated as specified. The evaporating unit shall be equipped with synthetic fiber filters, insulated drain pan, safety controls, thermostat all complete in a unit. The outdoor unit enclosure shall be factory painted to a smooth finish. The quoted price shall be inclusive of refrigerant piping, refrigerant charge, vibration isolation pads, associated electrical work and MS base frame duly painted with black enamel paint for mounting of condensing units. Ductable three phase units shall be complete with phase reversal kit and motor protection device.									
A.	Three phase non ductable split units : a. 2.2 TR nominal capacity split unit with single high wall non-ductable indoor unit with cordless control.						No	2		
B.	Single phase Non- ductable split units : a. 1.5 TR nominal capacity split unit with single high wall type non-ductable indoor unit with cordless control.						No	2		

C.	Supply, Installation, Testing and Commissioning of single phase preventer associated with the above split packages as required.	No	2																				
D.	Supply, Installation, Testing & Commissioning of copper refrigerant piping complete with closed cell elastomeric insulation material with Class "O" fire rating in tubing form and Electrical work including power wiring associated with the above split packages as required. a. Pair of soft refrigerant piping duly insulated.	M	100																				
1.5	Supply, Installation, Testing and Commissioning of PLC for Auto Sequencing of above mentioned split units with microprocessor based controller along with enclosure/ accessories having facility for configuration of the same as per requirement for sequenced Start/Stop for split units as follows : a. For two number split packages including one standby.	Set	2																				
1.6	INLINE FANS Supply, Installation, Testing and Commissioning of circular/rectangular inline fans for exhaust air as shown on drawings, complete with sheet metal casing, direct driven centrifugal fan, motor with proper protection and inspection door, gravity louvers etc. as per the specifications. Fan should be suitable for operation on 415±10% volts, 50 Hz, three phase or 220_+10 %, 50 Hz, single phase AC power supply as required. Single Phase inline fans shall be provided with speed regulators. Fan shall be suitable for installation or as shown on drawings and shall be of following capacities :																						
	<table border="1"> <thead> <tr> <th>Fan No.</th> <th>Capacity (Cfm)</th> <th>SP (mmWG)</th> <th>Electrical Characteristics</th> <th>Area being Extracted</th> <th>Type</th> </tr> </thead> <tbody> <tr> <td>IF-1</td> <td>650</td> <td>12</td> <td>220V/1 Ph</td> <td>Toilets</td> <td>Circular</td> </tr> <tr> <td>IF-2</td> <td>100</td> <td>12</td> <td>220V/1 Ph</td> <td>Pantry</td> <td>Circular</td> </tr> </tbody> </table>	Fan No.	Capacity (Cfm)	SP (mmWG)	Electrical Characteristics	Area being Extracted	Type	IF-1	650	12	220V/1 Ph	Toilets	Circular	IF-2	100	12	220V/1 Ph	Pantry	Circular				
Fan No.	Capacity (Cfm)	SP (mmWG)	Electrical Characteristics	Area being Extracted	Type																		
IF-1	650	12	220V/1 Ph	Toilets	Circular																		
IF-2	100	12	220V/1 Ph	Pantry	Circular																		
		No	5																				
		No	5																				
1.7	FRESH AIR FAN SECTIONS Supply, Installation, Testing and Commissioning of sheet metal sectionalized construction double skin air handling units with 25 mm thick injected PUF of density not less than 40 Kg/Cum, for supply of fresh air to AHU Rooms. The units shall be complete with fan section complete with floor standing backward curved DIDW centrifugal fan, belt drive package, EFF-1 squirrel cage induction motor, MERV-8 pre-filter, MERV-13 fine filter and activated carbon filter. Fan Filter Unit shall be suitable for floor installation as shown in the drawings. Fan shall be suitable for operation on 415 ±10% volts, 50 Hz, 3 phase AC																						

	power supply. The price shall be inclusive of necessary vibration isolation pads etc. as called for in working drawings. The quoted price shall include cost on account of factory fabricated plenums of same material as fan section, as shown in design drawings. Fan outlet velocity shall not exceed 2000 FPM (10.1 MPS) and the filter face velocity shall not exceed 500 FPM (2.5 MPS). Fan sections shall be of following design parameters :																
	<table border="1"> <thead> <tr> <th>FFU No.</th> <th>Capacity (Cfm)</th> <th>S.P (mmWG)</th> <th>Motor Rating (HP)</th> <th>No. of Fans</th> <th>Type</th> </tr> </thead> <tbody> <tr> <td>FFU-1</td> <td>5400</td> <td>60</td> <td>1x5</td> <td>1</td> <td>FM</td> </tr> </tbody> </table>	FFU No.	Capacity (Cfm)	S.P (mmWG)	Motor Rating (HP)	No. of Fans	Type	FFU-1	5400	60	1x5	1	FM	No	1		
FFU No.	Capacity (Cfm)	S.P (mmWG)	Motor Rating (HP)	No. of Fans	Type												
FFU-1	5400	60	1x5	1	FM												
1.8	<p>LIFT WELL PRESSURISATION FANS</p> <p>Supply, Installation, Testing and Commissioning of approved make fan sections for supply air complete with 16 gauge pre-painted GSS casing, DIDW centrifugal fan of approved make, belt drive package, squirrel cage induction motor, canopy as called for in working drawings and specifications. Fan section shall be suitable for floor installation. Fan shall be suitable for operation on 415±10% volts, 50Hz, 3 phase AC power supply. The price shall be inclusive of necessary vibration isolation arrangement including VI pads etc. Fan outlet velocity shall not exceed 2000 FPM. The fan characteristics shall be as follows :</p> <table border="1"> <thead> <tr> <th>Fan No.</th> <th>Capacity (Cfm)</th> <th>S.P (mmWG)</th> <th>Motor Rating (HP)</th> <th>Area being fed</th> <th>Type</th> </tr> </thead> <tbody> <tr> <td>LPF-1-2 Mounted</td> <td>8100</td> <td>25</td> <td>1x3</td> <td>Liftwells 1-2</td> <td>Floor</td> </tr> </tbody> </table>	Fan No.	Capacity (Cfm)	S.P (mmWG)	Motor Rating (HP)	Area being fed	Type	LPF-1-2 Mounted	8100	25	1x3	Liftwells 1-2	Floor	No	2		
Fan No.	Capacity (Cfm)	S.P (mmWG)	Motor Rating (HP)	Area being fed	Type												
LPF-1-2 Mounted	8100	25	1x3	Liftwells 1-2	Floor												
1.9	Supply, Fabrication and Installation of MS frame using channels/angle iron sections as required for mounting of air cooled remote condensers and air cooled condensing units. The frame work shall be applied with red oxide primer and thereafter, two coats of enamel paint of approved colour. The general arrangement drawing for frame work shall be gotten approved from the Architects/Structural Engineers prior to commencement of fabrication.	KG	200														
Total Carried to Summary- Equipment (Rs.)																	
2.0	REFRIGERANT PIPING																
2.1	COPPER PIPING																
	Supply, Installation, Testing & Commissioning of high pressure copper refrigerant piping suitable for R 410a refrigerant of suitable size as required and duly insulated with 19mm/13mm thick closed cell elastomeric insulation in tubing form. External Refrigerant piping shall be laid on GI covered cable																

	trays. Piping inside occupied spaces shall be supported using MS hangers duly painted with black enamel paint. Entire refrigerant piping work is carried out in accordance with the specifications. Piping shall be of following sizes :				
	Pipe Size Size (O.D.)	Min. Wall Thickness	Insulation Thickness		
a.	41.3 mm	1.43 mm	19 mm	M	145
b.	34.9 mm	1.21 mm	19 mm	M	190
c.	28.6 mm	0.99 mm	19 mm	M	10
d.	22.9 mm	0.80 mm	13 mm	M	10
e.	19.1 mm	0.80 mm	13 mm	M	350
f.	15.9 mm	1.00 mm	13 mm	M	10
2.2	FITTINGS Supply, Installation, Testing and Commissioning of following imported fittings to be provided in refrigerant pipe line. Material of construction for fittings shall be similar to refrigerant piping.				
a.	Y- Joints for refrigerant piping.			No	5
b.	Copper Headers suitable to connect multiple indoor units			No	--
2.3	Anti-Corrosion Treatment for remote air-cooled condensers, Piping, Joints, U Bends & Refrigerant Piping between outdoor and indoor units, those exposed to atmosphere.				
	a. 54 HP remote air cooled condenser			Set	1
	b. 50 HP remote air cooled condenser			Set	4
	c. Pair of Refrigerant piping between outdoor and indoor units			M	725
2.4	Providing & fixing in position the following GI medium class pipes for condensate drain cut to required lengths and installed with all screwed joints and providing & fixing in position the necessary elbows, tees & reducers.				
	a. 50mm dia			M	10
	b. 40mm dia			M	40
	c. 25mm dia			M	10
Total Carried to Summary (piping) (Rs.)					

3.0	ELECTRICAL INSTALLATION				
3.1	FRESH AIR FAN PANEL (FAFP-1) (Terrace)				
a.	32 A TP MCB for 5 HP motor-01 set.				
b.	Digital type ammeter to read (0 - 32) Amp, digital type Voltmeter (0-500)V, A set of CT's, RYB LED type phase indication lights -- 01 set.				
c.	Fully automatic DOL Starter with built-in single hasing preventor, over load relay and (0-30) seconds adjustable timer suitable for 5 HP motor - -01 set.				
d.	Auto-Manual type selector switch/timer to facilitate auto start of fan after restoration of power.				
e.	Control wiring & safety circuit as required with Start-Stop PB's stay put or lockable type and LED type 'ON' & 'OFF' indication lights. Panel casing shall have adequate ventilation provisions. Panel should exhibit IP-65 protection.				
	Electrical Panel as described above.	No	1		
	Notes : 1. The fabricator shall have the bus-bar chamber tested & approved at CPRI for 50 KA/1 sec. 2. MCCBs should not be less than 25 KA rating and shall be provided with magnetic thermal release. 3. The outgoing starter feeders for FAFS shall be provided with push buttons, LED type indicating lamps for status indication.				
	4. Bimetal overload relay for all the starters shall have built-in single phasing prevention feature. 5. Electrical interlocking wiring shall be provided as per system requirement. System fault/trip reset arrangement shall be provided as required. 6. Power cabling/wiring with necessary earthing from source to panel shall be provided by other agencies. 7. Panels shall be compatible with BMS and necessary provisions to be made in each panel accordingly.				
3.2	POWER CABLING				
	Supply, laying, affecting connections and Testing of the following sizes of 1.1 KV armoured PVC insulated aluminium/copper conductor cables. Cables shall be inclusive of all clamps, saddles, screws, cable identification tags, cable terminal joints including terminal lugs, insulating tapes, affecting terminal Connections to the equipment as per the specifications and as required. Quoted price shall be inclusive of GI perforated cable trays & supports.				
	a. 4C x 35 Sqmm cable (Copper)	M	100		

	b. 4C x 6 Sqmm cable (Copper)	M	20		
	c. 4C x 4 Sqmm cable (Copper)	M	20		
3.3	CONTROL WIRING Supply, laying, affecting connections and testing of the following sizes of control cum transmission wiring to be laid in MS conduits between indoor units and outdoor units. 2C x1.5 Sqmm copper wiring	M	725		
3.4	EARTHING Providing & fixing in position the following bare GI tape/Cu wire including providing all fixing accessories & effecting proper connections. a. 40mm x 3mm tape	M	5		
	b. 25mm x 3mm tape	M	100		
	c. 8 SWG Cu Wire	M	5		
	d. 14 SWG Cu Wire	M	40		
	Note: Electrical panel with MCCBs for all outdoor units would be part of Panels BOQ (Electrical Consultant's Scope), the HVAC vendor shall co-ordinate with relevant agencies to make the installation complete and include the cost for the same.				
Total Carried To Summary (Electrical) (Rs.)					
4.	AIR DISTRIBUTION				
4.1	Ductwork				
a.	Factory Fabricated Ductwork Supply, Installation, Testing of factory fabricated ductwork complete with fire retardant gaskets, slip on flanges, wire rope suspension arrangement, GI perforated 'C' channel supports etc. in accordance with the approved shop drawings and specifications.				
	a. 1mm-750mm (26 gauge) GSS	Sq.m.	850		
	b. 751mm -1000mm (26 gauge) GSS	Sq.m.	60		
	c. 1001mm -1500mm (24 gauge) GSS	Sq.m.	70		

	d. 1501mm -1800mm (22 gauge) GSS	Sq.m.	60		
	e. 1801mm -2100mm (20 gauge) GSS	Sq.m.	2		
	f. 2101mm and above (18 gauge) GSS	Sq.m.	2		
b.	Conventional site fabricated ducts using Lock Forming Machines Supply, Fabrication, Installation and Testing of sheet metal ducts in accordance with the approved shop drawings and specifications. Ducts shall be fabricated using lock forming machine.				
	a. 0.63mm (24 gauge) GSS	Sq.m.	50		
	b. 0.8 mm (22 gauge) GSS	Sq.m.	5		
	c. 1.0mm (20 gauge) GSS	Sq.m.	2		
	d. 1.25mm (18 gauge) GSS	Sq.m.	2		
c.	Supply, Fabrication, Installation and Testing of round sheet metal ducts in accordance with the approved shop drawings and specifications.				
	a. 1.0mm (20 gauge) GSS	Sq.m.	2		
4.2	Supply, Installation and Testing of 125mm deep Anti-vibration Flexible Joints made out of imported fire retardant fabric with extruded aluminium frame/ flange on both sides of approved make.	M	25		
4.3	Supply, Installation and Testing of multi blade type key operated louver dampers of galvanised steel sheet for collars to be provided with suitable links, levers and quadrants for manual control of volume of air flow and for proper balancing of the air distribution system as per the approved shop drawings and specifications.	Sq.m.	7		
4.4	Supply, Installation and Testing of multiblade box type galvanised steel sheet dampers for ducts to be provided with suitable links, levers and quadrants for manual control of volume of air flow and for proper balancing of the air distribution system as per the approved shop drawings and specifications.	Sq.m.	5		

4.5	<p>Supply, Installation, Testing and Commissioning of smoke cum fire dampers of at least 90-120 minutes fire rating as per the approved shop drawings and specifications. Interlocking of fire dampers using copper control wiring shall be affected as required.</p> <p>a. Bare fire dampers</p> <p>b. Actuator with control panel, temperature sensor and spring return action and suitable for 16 NM Torque.</p> <p>c. Actuator with control panel, temperature sensor and spring return action and suitable for 8 NM Torque.</p>	Sq.m.	6		
4.6	<p>Supply, Installation, Testing and Balancing of square supply air diffusers as per the approved shop drawings and specifications. Each diffuser shall be equipped with fixed air distribution grid, removable key-operated volume control damper. The diffusers shall be anti-smudge ring/flush type. Powder coated extruded aluminium diffusers of approved colour & shade of following sizes:</p> <p>a. 600x600 diffusers having neck size as mentioned in the "Approved for Construction" shop drawings suitable for fixing in grid ceiling.</p> <p>b. 300x300 diffusers suitable for fixing in Gypsum ceiling.</p> <p>c. 225x225 diffusers for toilet exhaust.</p>	No	100		
4.7	<p>Supply, Installation, Testing and Balancing of square diffusers same as supply air diffusers but without volume control dampers for return air as per the approved shop drawings & specifications. Powder coated extruded aluminium diffusers of approved colour & shade of following sizes:</p> <p>a. 600x600 diffusers suitable for fixing in grid ceiling.</p> <p>b. 300x300 diffusers suitable for fixing in Gypsum ceiling.</p>	No	100		
4.8	<p>Supply, Installation, Testing and Balancing of powder coated Swirl diffusers with Spiggot to facilitate round duct connection for supply air as per the specifications.</p> <p>a. 600x600 size diffusers with spiggot for supply air.</p> <p>b. 600x600 size diffusers without spiggot for return air.</p>	No	2		

4.9	<p>Supply, Installation, Testing and Balancing of one way blow linear supply cum return air grilles complete with removable inner core as per approved shop drawing and specifications. The grilles shall be of approved colour & shade.</p> <p>a. Powder coated aluminium grille of extruded sections with integral flanges on both sides & ends as required.</p> <p>i. 100/150/200 mm High</p>	Sq.m.	0.5		
4.10	<p>Supply, Installation, Testing and Balancing of multi-slot type linear slot diffusers as per the approved shop drawings and specifications. Each diffuser shall be complete with HIT & MISS' type extruded aluminium dampers at supply air portions.</p> <p>a. Powder coated extruded aluminium diffusers of approved colour & shade.</p> <p>i. 2/3/4 slot diffusers having width of slots as 25mm/35mm</p>	Sq.m.	10		
4.11	<p>Supply, Installation, Testing and Commissioning of pre-insulated factory fabricated flexible ducts inner as well as outer skin constructed out of aluminium sheet. Ducts shall be of following sizes :</p> <p>a. 300mm dia</p> <p>b. 250mm dia</p> <p>c. 200mm dia</p> <p>d. 150mm dia</p>	M	10		
		M	165		
		M	25		
		M	100		
4.12	<p>Supply, Installation and Testing of extruded aluminium powder coated air transfer grilles to be provided at toilets & kitchen doors.</p>	Sq.m.	1.5		
4.13	<p>Supply, Installation, Testing and Balancing of powder coated Plaque diffusers with Spiggot to facilitate round duct connection for supply air as per the specifications.</p> <p>a. 600x600 size diffusers with spiggot for supply air.</p> <p>b. 600x600 size diffusers without spiggot for return air.</p> <p>c. 300x300 size diffusers with spiggot for supply air.</p> <p>d. 300x300 size diffusers without spiggot for return air.</p>	No	2		
		No	2		
		No	2		
		No	2		

4.14	Supply of spigots of different sizes to facilitate flexible duct connection. b. 300mm dia c. 250mm dia d. 200mm dia e. 150mm dia	No	10		
		No	200		
		No	20		
		No	90		
Total Carried to Summary (air distribution) (Rs.)					
5.0	INSULATION				
5.1	Supply and Application of acoustic lining of supply/return air ducting using open cell elastomeric insulation with adhesive as per the specifications and drawings. a. 16 mm thick	Sq.m.	25		
5.2	Supply and Application of external thermal insulation of ducting using closed cell elastomeric insulation with adhesive, longitudinal & transverse joints sealed with adhesive as per specifications. a. 16mm thick b. 9 mm thick	Sq.m.	25		
		Sq.m.	475		
5.3	Supply and Application of 9 mm thick closed cell elastomeric insulation in tubing form for condensate drain piping as per the specifications. a. 50mm dia b. 40mm dia c. 25mm dia	M	10		
		M	40		
		M	10		
5.4	Supply and Application of thermal/acoustic lining of walls & ceiling of AHU rooms using open cell elastomeric insulation with adhesive as per the specifications and drawings. a. 25mm thick b. 16mm thick	Sq.m.	10		
		Sq.m.	350		
Total Carried to Summary Insulation (Rs.)					

Summary of Prices

Sl.no.	Description	Amount (Rs.)
1.	Equipment	
2.	Refrigerant Piping	
3.	Electrical	
4.	Air Distribution	
5.	Insulation	
	Total (Rs.)	

Amount in words:

Signature of tenderer