INDIRA GANDHI INSTITUTE OF DEVELOPMENT RESEARCH
GOREGAON (EAST), MUMBAI

TENDER DOCUMENT FOR

Supply, Installation, Testing and Commissioning of Central Cooling System (Revamping the old Centrally AC system) at IGIDR

NIT No: IGIDR/Tender/2025/ED/20 Date: 24.09.2025

INDIRA GANDHI INSTITUTE OF DEVELOPMENT RESEARCH
Gen. A.K. Vaidya Marg, Film City Road, Santosh Nagar, Goregaon (East), Mumbai-400065.
Telephone: 022 6909 6200 / 513. Fax: 022 6909 6399.

INDIRA GANDHI INSTITUTE OF DEVELOPMENT RESEARCH, MUMBAI

Notice Inviting Tender

"NAME OF THE WORK: **Supply, Installation, Testing and Commissioning of Central Cooling System (Revamping the old Centrally AC system),** at INDIRA GANDHI INSTITUTE OF DEVELOPMENT RESEARCH, GOREGAON, MUMBAI – 400 065."

1. The institute invites bids from reputed/qualified vendors/contractors/service providers for the following services:

Name of work	Completion Period	EMD
1)	**(2)**	**(3)**
Supply, Installation, Testing and Commissioning of Central Cooling System (Revamping the old Centrally AC system) at IGIDR	**4 months**	**Rs. 3,20,000.00**

2. The tenders are being invited for the above-mentioned work. IGIDR reserves its right to award the work to the successful bidder.
3. The bidder has to submit an Earnest Money Deposit of **Rs. 3,20,000.00 (Rupees Three Lakh twenty thousand)** along with the bid.
4. The tender bids in two bid systems are invited through two separate Emails to tender@igidr.ac.in: **"Email-1: EMD, Pre-qualification, and Technical Bid" and "Email-2: Financial Bid"**. The subject of the email should be mentioned as **"Email-1: EMD, Pre-qualification, and Technical Bid for Supply, Installation, Testing and Commissioning of Central Cooling System (Revamping the old Centrally AC system) at IGIDR,"** and **"Email-2: Financial Bid for Supply, Installation, Testing and Commissioning of Central Cooling System (Revamping the old Centrally AC system) at IGIDR,"** respectively. **All the bid documents should be attached as a PDF document or a zip file. The financial bid file shall be protected with a password.**
5. Last date of submission of the tender document shall be **on 14.10.2025, at the End of the day.**
6. The Institute reserves the right to reject any prospective bids without assigning any reasons whatsoever.
7. **Before submitting the bid, the intended bidder must visit the IGIDR and understand the scope and nature of the work.**

REGISTRAR

SECTION – A*

LETTER OF OFFER

Date _____

To,

The Registrar,

Indira Gandhi Institute of Development& Research,

Gen. A.K. Vaidya Marg, Film city Road,

Goregaon (East), Mumbai 400065.

Subject: Tender for **Supply, Installation, Testing and Commissioning of Central Cooling System (Revamping the old Centrally AC system) at IGIDR, MUMBAI**
Reference: NIT No. IGIDR/Tender/2025/ED/20 Date: 24.09.2025

Dear Sir,

With respect to your above-mentioned tender, I / We hereby submit my / our tender in the required format along with a Company Profile and supporting documents.

Should this tender be accepted, I/We hereby agree to abide by and fulfil the terms and provisions of the said Conditions of Contract annexed hereto so far as they may be applicable or in default thereof to forfeit the EMD and pay to the IGIDR the amount mentioned in the said Conditions.

I/We have deposited Rupees Three Lakh twenty thousand only through NEFT/DD/FDR/BG or MSME Certificate as earnest money to the IGIDR, which will not bear any interest.

Should I/We fail to execute the contract when called upon to do so. I/We do hereby agree that this sum shall be forfeited by me/us to the IGIDR.

I / We have carefully gone through the terms and conditions prescribed, and I / We accept the same without any alterations/modifications.

Yours faithfully,

Signature

Name & seal of bidder

**To be submitted on company letterhead with sign and stamp.*

SECTION-B

GENERAL INSTRUCTIONS TO BIDDER

The tender bid should be addressed to The Registrar, Indira Gandhi Institute of Development Research, Goregaon (East), Mumbai-400065 and superscripted ~ **Tender for "Supply, Installation, Testing and Commissioning of Central Cooling System (Revamping the old Centrally AC system)" at IGIDR, Goregaon (E), Mumbai.**

1. Bidder has to submit Earnest Money Deposit of **Rs. 3,20,000.00 (Rupees Three Lakh twenty thousand)** through NEFT/DD/FDR/BG to "INDIRA GANDHI INSTITUTE OF DEVELOPMENT RESEARCH, MUMBAI" Account no. 010220100010001, IFSC code: BKID0000102, Branch name: IGIDR, Bank Name: Bank of India and UTR number with a screenshot of the transaction should be included in the part of the tender document towards Earnest money.
2. **The bidders registered under MSME are exempted from the submission of EMD, but they should submit the necessary copy of the MSME certificate for exemption.**
3. The tender bids in two bid systems are invited through two separate Emails to tender@igidr.ac.in: **"Email-1: EMD and Pre-qualification/Technical Bid" and "Email-2: Financial Bid"**. The subject of the email should be mentioned as "**Email-1: EMD and Pre-qualification/Technical Bid for Supply, Installation, Testing and Commissioning of Central Cooling System (Revamping the old Centrally AC system) at IGIDR**" and "**Email-2: Financial Bid for Supply, Installation, Testing and Commissioning of Central Cooling System (Revamping the old Centrally AC system) at IGIDR**," respectively. **All the bid documents should be attached as a PDF document or a zip file. In case the bidder cannot attach a single bid file to an email, then they can split their bid and submit it in multiple emails with mentioning in the email subject as Part-I, II, III, …. etc.**
4. All the required documents should be scanned and merged either into a single PDF file or zipped into a single file and attached to the respective Emails. **The Financial bid should be attached as a PDF document protected with a password, and the password is to be shared at the time of the financial bid opening through an online meeting. The vendor should keep their password securely with them and be required to give it only when asked in an online meeting for financial bid opening.**
5. The bids will be received up to **14th October 2025**, at the end of the day**.** Each copy of the tender document is under their stamp and signature. No tender will be accepted after **14.10.2025** under any circumstances whatsoever.
6. The Email bid with the subject "EMD & Pre-qualification/Technical Bid for Supply, Installation, Testing and Commissioning of Central Cooling System (Revamping the old Centrally AC system) at IGIDR," shall be opened by the tender opening committee on the next day, **15.10.2025, at 2:30 PM** through the online meeting platform. The link to the meeting will be shared with participating bidders. In case the holiday is declared by the Government on the day of opening the bids, the bids will be opened on the next working day at the same time.
7. The Email bid with the subject **"Financial bid for Supply, Installation, Testing and Commissioning of Central Cooling System (Revamping the old Centrally AC system) at IGIDR,"** of only qualified bidders will be opened. The date of opening of the price bid shall be informed by the institute to the qualified bidders.

The date of opening of the financial bid and link for the online meeting shall be informed by the institute to the qualified bidders. **The bidders should provide the password of the financial bid PDF file during the opening of the financial bid. In case the bidder can NOT provide a password for the financial bid at the opening, then their bid shall be rejected.**

8. Tenders shall remain valid for acceptance by the Institute for a period of four months from the date of opening of the tender, which period may be extended by mutual agreement, and the bidder shall not cancel or withdraw the bid during this period.
9. The bidder must use only the forms issued by the Institute to fill in the rates. Any addition/alteration in the text of the Tender form made by the bidder shall not be valid and shall be treated as null and void.
10. The Tender form must be filled in English. If any of the documents are missing or unsigned, the tender may be considered invalid by the Institute at its discretion.
11. Rates should be quoted both in figures and in words in the columns specified. Overwriting of figures is not permitted. Failure to comply with either of these conditions will render the tender void at the Institute's option. No advice whatsoever, especially on any change in rate specifications after the opening of the tender, will be entertained.
12. Each Page of the tender documents should be stamped and signed by the authorized person or persons submitting the Tender in token of his/their having acquainted himself/themselves with the General terms & conditions, specifications, special conditions of contract, etc., as laid down. Any Tender with any of the documents not so signed will be rejected.
13. A tender bid that is not accompanied by EMD will not be considered. The EMD will be returned to the bidder if their tender is not accepted by the Institute, but without Interest. The EMD paid by the successful bidder shall be held/encashed by the IGIDR as security for the execution and fulfilment of the contract. No interest shall be paid on this deposit. The Earnest Money Deposit (EMD) of the successful bidder may be converted into a Performance Security Deposit. The security deposit of the successful bidder will be forfeited if they fail to comply with any of the conditions of the contract. No interest will be paid on the Security Deposit withheld by the Institute.
14. The Institute does not bind itself to accept the lowest or any tender and reserves to itself the right to accept or reject any or all the Tenders, either in whole or in part, without assigning any reasons for doing so.
15. On receipt of intimation from the Institute of the acceptance of their tender, the successful vendor/contractor shall be bound to sign the formal contract, and within seven days thereof, the successful vendor/contractor shall sign an agreement in accordance with the draft agreement and the Schedule of Conditions but the written acceptance by the Institute and the Contractor so, whether such formal agreement is or is not subsequently executed. The cost of necessary Stamp paper for the execution of the agreement shall be borne by the successful vendor/contractor.
16. The rates quoted in the bid shall include all charges wherever applicable. The rates quoted shall be final and shall not be subject to any variations in material and labour conditions or other conditions whatsoever.
17. Tender bids must include in their rates applicable GST and any other tax and duty or other levy in force levied by the Central Government or any State Government or Local Authority, if applicable.

18. The intending bidders are requested to visit the Indira Gandhi Institute of Development Research to understand the nature and scope of the work. The intending bidder can obtain any clarifications regarding the EOI document, employee details, previous policy details etc., if any, by contacting **Mr. Amit Gaikwad (Estate Officer)** on his **Contact Number 022 6909 6507** or through email **estateofficer@igidr.ac.in** or the Estate Office of the Indira Gandhi Institute of Development Research, Goregaon, Mumbai-400 065 on any Institute`s working day from Monday to Friday.
19. **Pre-bid meeting: A pre-bid meeting will be scheduled on 01.10.2025 at 11:30 AM at IGIDR.**

    The intended bidder should complete the mandatory site visit before the pre-bid meeting and attach a site visit certificate signed by the Estate officer to their PQ/Technical bid.

20. **Contact details of a Technical Consultant of the Institute:**

    M/s Meticulous Consulting Services

    Mr. Manjeet Singh

    Email: meticulousengineers@gmail.com

    Mobile- 09416506198.

I/We hereby declare that I/we have read and understood the above instructions, and the same will remain binding upon me/us.

Place: Signature of the Bidder with company seal

Date:

SECTION-C

GENERAL TERMS AND CONDITIONS

1. The bidders should mandatorily attend the Pre-Bid meeting to understand the institute's requirements and clarifications regarding the work expected.
2. **Completion Period:** The time limit for completion of the work is **4 months** from the date of the order issued. The time shall be the essence of this contract, and the entire work as titled above is to be completed in all respects within the given time from the date of issue of the work order. The successful bidder has to submit the time & activity chart for the completion of work.
3. **Defect Liability Period:** The defect liability period (DLP) for the work done (overall project executed) by the contractor should be for **one year** from the date of completion and handing over of work. Any defect or fault which may appear during **one year** from the date of completion and handing over of work/or in full as specified under the contract, shall be rectified by the contractor at their own cost.
4. **Comprehensive Annual Maintenance Contract (CAMC):**

   The Comprehensive Annual Maintenance Contract (CAMC) shall be for four years after the completion of the Defect Liability Period. The contractor should submit the CAMC rates on an annual basis in the Financial bid.

5. **Performance Security Deposit (PSD):**

   a. The successful bidder shall be required to submit a PSD amount of **5%** of the contract value through NEFT/DD/FDR or Bank Guarantee through a commercial scheduled bank on account of Performance Security deposit in favour of "Indira Gandhi Institute of Development Research" payable at Mumbai within 7 working days of the receipt of the formal work order. The Performance security deposit will be valid up to 60 days beyond the date of completion of the contract.

   b. After submission of the security deposit, the EMD shall be returned to the successful bidder.

   c. The Performance security deposit will be encashed to the extent of any financial liabilities that the successful bidder owes to IGIDR, Mumbai, for violation of any terms and conditions of the contract. If the financial liabilities are more than the Performance security deposit, the successful bidder will be legally bound to pay the balance liability within 15 days, with 10% interest from the date of issuance of notice of demand by the Institute.

   d. Failure to adhere to the period of commencement of services shall lead to the forfeiture of the Performance security deposit.

6. **Retention Money Deposit (RMD):**

   The Retention money deposit (RMD) **@ 10 %** of the work order or each invoice value will be deducted from the final or each running bill, and the same will be released after successful completion of the defect liability period of **5 years** from the date of completion of the Work. The Security deposit deducted from the bills will only be released after submission of a bank guarantee for an amount equal to the RMD.

7. **Penalty Clause:**

   Time allowed for carrying out the work is **4 months**, which shall be strictly observed by the successful bidder and it shall be reckoned from the 4th day of issue of work order. The work shall throughout the

stipulated period of the contract be preceded with all the due diligence and if the Contractor fails to complete the work within the specified period he shall be liable to pay compensation at the rate of **1% per week** subject to a maximum amount of **10%** of the contract amount. The Tender shall before commencing work prepare a detailed work program which shall be approved by the Institute's Engineer.

Any damage caused to any of the Institute's properties shall be made good by the successful bidder at their own cost.

8. Termination Clause:

8.1 Without prejudice to any other remedy available to the Institute, in case of default on the part of the contractor in the performance of this contract or in the discharge of any contractual obligations arising out of this contract or if the contractor commits substantial breach of his obligations and such breach is not corrected within 7 (seven) days from the date of receipt of the notice specifying the breach, by the contractor, the Institute may terminate this contract by giving a 15 (fifteen) days written notice of intended termination to the contractor.

8.2 In the event of this Contract being terminated, the Institute shall be liable to make payments of the amount due under this Contract up to the effective date of termination for which services (including parts thereof) have been rendered by the Contractor, subject to clause 8.5 hereunder.

8.3 Notwithstanding anything contained herein above, the Institute may terminate this contract at any time by giving one month's notice to the Contractor without assigning any reason thereof and without prejudice to the rights of the Institute to recover any money becoming due and payable to the Institute under this Contract. The Contractor may terminate this Contract at any time by giving two months' notice to the Institute without assigning any reason thereof.

8.4 Forthwith on the expiry or earlier termination of this Contract, the Contractor shall return to the Institute all materials and equipment belonging to the Institute with regard to this Contract. The Institute shall also inform the Contractor of the time when it can collect its equipment stored in the Institute, and the Contractor shall collect the same. In the event that the Contractor does not collect its equipment by the appointed time, the Institute shall not be liable for the same thereafter.

8.5 Forthwith on the expiry or earlier termination of this Contract, the Institute shall determine the costs of execution, the cost of remedying any defects (if any) and the cost of completion of the work (if required). The Institute shall be entitled to recover from the Contractor the extra costs, if incurred, after adjusting the same against the Performance Security Deposit made by the Contractor.

8.6 On the earlier termination of this Contract due to failure to discharge its duties, the Performance Security Deposit shall stand forfeited by the Institute.

9. Agreement:

If required by IGIDR, Mumbai (hereinafter to be referred to as IGIDR, MUMBAI), the successful Bidder has to execute a contract Agreement with IGIDR, MUMBAI on the non-judicial stamp paper of **Rs. 500/- (Rupees Five hundred only**). The cost of stamp paper shall be borne by the successful Bidder. IGIDR, MUMBAI reserves the right to amend the terms & conditions of the contract after Mutual discussions and shall only be in writing.

10. Legal dispute: Any dispute, which may necessitate legal redressal, will be restricted to the jurisdiction of the civil courts at Mumbai (Maharashtra) only.

11. **Payment terms:**

    a. 60% payment will be released against the supply of material at the site in good condition on a pro-rata basis.

    b. Balance final payment will be released after satisfactory completion of the work, including testing & commissioning, after deduction of 10% retention money deposit (RMD) from the bill.

    c. The payment for the CAMC shall be made on a quarterly basis after successful completion of maintenance service.

12. **Inspection:**

    Physical inspection and Testing to be done for the plant as mentioned in the Technical Specification.

13. **Indemnity:** The Contractor shall indemnify and keep indemnified the Institute against all losses and claims for injuries and or damages to any person or property. The successful bidder shall abide by and observe all statutory laws and regulations in matters of Labour Laws and shall keep the Institute indemnified against all penalties and liabilities**.**

14. **Compliance with institute's rules and regulations:** The successful bidder shall comply with all norms stipulated by the institute, such as Gate Passes, Checking, Maintenance of Cleanliness, Discipline & Decency at and around the work site, Safety Precautions, and Safety Regulations.

15. **Assignment and sub-contracting:** The Service provider shall not assign, sub-contract, or sublet the whole or any part of the contract in any manner. In case of unavoidable circumstances, the contractor will be able to do it with the approval of the institute.

16. **Canvassing:** Any attempt to canvass for the candidature of any bidder directly or indirectly will lead to the disqualification of such bidder/firm from the whole process.

17. **Rejection clause:** The firm that does not fulfil any of the PQ conditions or submit incomplete documents in any respect is liable to be rejected summarily.

18. **Selection of Vendor:** Through Techno-Commercial evaluation as detailed in **SECTION-F.**

I/We hereby declare that I/we have read and understood the above instructions, and the same will remain binding upon me/us.

Place: Signature of the Bidder with company seal

Date:

SECTION 'D'

SPECIAL CONDITIONS

1. The workmen will not be allowed to stay within the premises.
2. The electric power and water required for the work can be drawn from the supply available at the site free from the Institute; however, the necessary arrangements shall be made by the contractor.
3. The debris/dust or any wastage generated out of the above work shall be cleaned as frequently as required and as instructed by the Institute's Engineer away from the Institute's premises.
4. The work has to be carried out with the least inconvenience to the community.
5. Permission required from the local bodies, if any, shall be obtained by the successful bidder at his cost.
6. The successful bidder shall employ an adequate number of manpower as required for satisfactory fulfilment of his contractual obligations as per this agreement and shall provide an adequate number of manpower with appropriate training and experience, at their own expense, for the proper discharge of the responsibilities entrusted to them.
7. The successful bidder shall decide the mode and manner of work to be done by his workmen.
8. The contractor shall, before commencing work, submit a detailed work schedule/program, which shall be approved by the Institute, and the time schedule should be strictly adhered to.
9. The Contractor shall arrange to get all the samples of materials to be used in the work approved from the institute. The proposed materials should be of approved brands.
10. The successful bidder shall only use the materials of brands approved by the institute.
11. Any damage caused to any of the Institute's properties shall be made good by the contractor at their own cost.
12. The Contractor shall make their own arrangements for storing their tools/equipment at the site.
13. The contractor should submit the following documents within 7 days of issuance of the work order.
    a. Workmen's Compensation Policy for all the employees/workers to be deputed on the site as per the Workmen's Compensation Act.
    b. Documents of workmen engaged, mentioning their biodata and photocopy of Aadhar & Pan Card, etc.
14. Contractor shall keep the Institute indemnified against all claims, if any.
15. **Before quoting the rates, the bidder should inspect the site and understand the nature and scope of the work.**
16. The supervision of work shall be done by the **Project Management Consultant (PMC)** appointed by the Institute. The successful bidder should coordinate with the PMC and carry out the work as per the instructions of the PMC and the Institute's Engineer-in-charge.

17. **The measurement of work done shall be done jointly by the successful bidder, a consultant and the Institute engineer. The successful bidder should submit their bill along with the certification from the consultant.**

18. **The Institute reserves the right to omit or delete tender items from the scope of work, reduction in quantity of work/item or alterations in the BOQ during the execution as per the Institute's requirement. The successful bidder shall accept the Institute's decision and be bound to it.**

We hereby declare that I/we have read and understood the above terms and conditions that form part of the Formal Contract to be executed between us and the Institute. The same shall be binding upon me/us upon being declared as the Successful Bidder.

Place:

Date: Signature of the Bidder with seal

SECTION-E

PRE-QUALIFICATION AND TECHNICAL CRITERIA

- **Minimum Pre-Qualification Documents to be submitted by Bidder along with Pre-Qualification Bid:**

1. The bidder should be registered with the appropriate registration authorities. Copy of Registration of Certificate of Incorporation or Partnership Deed/Memorandum of Association to be submitted.
2. The bidder should have a minimum of **05** years' experience in executing the HVAC works in the last 07 years.
3. The bidder should submit a copy of the Registration of Goods and Services Tax and PAN.
4. The bidder should have an average annual turnover of **INR 300.00 Lakh** from execution of HVAC and Centrally Air-conditioning projects only in the last three financial years, i.e., FY2024-25, FY2023-24, and FY2022-23. The bidder will submit the audited balance sheet, Profit and Loss account statements, or Turnover certificate from CA for three financial years with positive net worth in each year, duly certified by CA.
5. The bidder should have successfully completed Similar HVAC or centrally air-cooled system works during the last 07 years ending till the previous month of the date of publication of this tender, either of the following-
   i. At least one similar work of costing not less than **INR 128.00 Lakh** in one organization **or**
   ii. At least 02 similar works of costing not less than **INR 80.00 Lakh** in different organizations **or**
   iii. At least 03 similar works of costing not less than **INR 64.00 Lakh** in different organizations

   (Copy of Work orders/completion certificates/Agreement to be submitted).
6. The bidder should have a solvency certificate of **INR 64.00 Lakh** issued by his banker within the period of the last one Year ending on 31.08.2025.
7. Bidder should submit details of at least two clients along with the name and contact number of their representatives.
8. The bidder should have either the Registered Office or a Branch Office located in the **territory of MMRDA** with regular presence of technical and execution staff. Should provide valid address proof and the list of staff present in the office.

Bidders must submit documentary proof in support of meeting each of the above minimum qualification criteria. A simple undertaking by the bidder for any of the stated criteria will not suffice for the purpose. All documentary proof must be listed on the letter pad of the company and enclosed in a cover, to be submitted along with the qualification/technical bid (Email-1), duly stamped and signed by the authorized person of the agency.

Presentations:

Only the Pre-Qualified Bidders will be invited for Presentation & Interaction with the evaluation committee.

I/We hereby declare that I/we have read and understood the above instructions, and the same will remain binding upon me/us.

Date: Signature of the Bidder with company seal

SECTION-F

BID SUBMISSION AND BID EVALUATION CRITERIA

- **Bid Submission:**

Part I: PQ-cum-Technical Bid

The following documents (scanned copy), duly signed and stamped by the bidder, are to be furnished along with the **PQ-cum-Technical Bid:**

Mandatory Bid Documents are to be submitted online with Email-1.

- Particulars of bidders **(Annexure I)**
- Bid Security Declaration (**Annexure II)**
- Undertaking for willingness to provide services as per the terms and conditions of the Bid document **(Annexure-III)**
- The bidder should submit the technical staff details **(Annexure-IV).**
- Supporting documents for eligibility PQ criteria as detailed in **SECTION-E.**
- Information about the firm with details about culinary capabilities or experience of similar services, a list of organizations with work orders or experience certificates, testimonials, and any other documents that will consolidate the position of the bidder in the Technical Evaluation
- Operational Plan – (to be submitted with the technical bid).

Part II – Price Bid

The Price Bid is to be mandatorily submitted **online through email-2** only with a password-protected file.

- **Bid Evaluation Scheme:**

1. Only those bids that qualify in the PQ criteria will be invited for technical presentations.
2. The bids will be evaluated on a Techno-Commercial basis.
3. The price bids of only those bidders shall be considered for opening and evaluation whose bid is determined to be technically acceptable to IGIDR, MUMBAI.
4. Evaluation of price bid shall be taken up to determine the competitive prices of the techno-commercially acceptable bids and include the following:

4.1.1 During Price bid opening, only the average technical score of the agency will be read out by the institute authorities before the opening of Price Bids.

4.1.2 Bidders getting less than 60% marks in the technical bid will not be considered for opening the price bid.

4.1.3 The Rates as per the Price Bid will be considered for comparison.

4.1.4 IGIDR, MUMBAI reserves its right to negotiate with the lowest bidder on the quoted price.

4.1.5 The Technical Bid – PQ-Technical Bid and Presentation will be assessed for 60 marks.

4.1.6 The Price Bid will be assessed for 40 marks.

4.1.7 The bidder getting the Highest Composite Techno-Commercial score will be considered for the award of the contract.

5. For proper evaluation and comparison of Bids, the Consultant or Bid Evaluation Committee may, at its discretion, ask the Bidder for any clarification of the Bid. The request for clarification and the response shall be in writing, but no changes in the price of the Bids shall be offered or permitted.
6. The technical bids will be evaluated by the Consultant and Bid Evaluation Committee based on experience in similar organizations, resources available with the firm/Individual, visit of the Committee to the site where the contractor is currently handling similar work, etc.
7. The Bid Evaluation Committee will first evaluate the Technical Bids to determine the substantial responsiveness of the Technical Bids. A substantial Responsive Bid is one that conforms to all the terms and conditions as indicated in the Bid Document and which also establishes the Bidder's qualification to deliver the services according to technical specifications. After the evaluation of all the Technical Bids, Financial Bids corresponding to only substantial responsive Technical Bids will be taken up for evaluation.
8. All non-substantial Technical Bids will be rejected as non-responsive, and corresponding Financial Bids shall be excluded from further evaluation.
9. The Bid Evaluation Committee may, at its discretion, decide to waive off any minor non-conformity in a Bid which does not constitute a material deviation with regard to services and pricing.
10. While evaluating Financial Bids, if there is any discrepancy between the unit price and the total price, the unit price will prevail, and the total price shall be corrected. However, if the Bidder does not accept the correctness of the errors, his Bid will be rejected.
11. The Bidder must have supplied the information required in the bid document. A Bidder not fulfilling any criteria stipulated, their Bid is considered non-responsive and may be rejected.
12. The Bidders who have duly complied with the Eligibility Criteria will be eligible for further processing.

13. The successful bidders of the Technical Bids will qualify for opening of the Financial Bids.

14. The Bids which have been established as responsive in all respects will be compared for its price competitiveness. Based on technical and financial evaluation, substantially responsive and most advantageous.

A. <u>The Technical Score will be arrived at based on the following parameters</u>

Sr. No.	Parameters	Marks
1	Experience of the firm for similar works i. Up to 7 years: 5 Marks ii. More than 7 and less than 15 years: 10 marks iii. More than 15 years: 15 marks	**15**
	Average Annual Turnover for the last three financial years i. Up to 3 Cr: 5 Marks ii. More than 3 and less than 3.5 Cr: 7 marks iii. More than 3.5 Cr: 10 marks	**10**
2	**10 Marks** for having Experience in the installation of new chiller based centralized HVAC plant in the last 7 years as on 30.04.2025 for **Private Institutes/Corporate companies/Organizations/MNCs** for i) Three similar completed projects capacity of chiller based HVAC plant not less than 80 Tr. each Or ii) Two similar completed projects, capacity of chiller based HVAC plant not less than 100 Tr each Or ii) One similar completed project capacity of a plant not less than 120 Tr. **15 Marks**: for having Experience in installation of new chiller based centralized HVAC plant in the last 7 years as on 30.04.2025 for **Public Sector Organizations / Public Sector Banks** for i) Three similar completed projects, capacity of chiller based HVAC plant not less than 80 Tr each Or ii) Two similar completed projects, capacity of chiller based HVAC plant not less than 100 Tr each Or iii) One similar completed project, capacity of plant not less than 120 Tr. **20 Marks**: for having Experience in installation of new chiller based centralized HVAC plant in the last 7 years as on 30.04.2025 for **Central Government / State Government / Government Institutes or Universities** for i) Three similar completed projects capacity of chiller based HVAC plant not less than 80 Tr. each Or ii) Two similar completed projects capacity of chiller based HVAC plant not less than 100 Tr each Or iii) One similar completed project capacity of a plant not less than 120 Tr.	**20**
3	ISO Certifications of the Company	**10**

	ISO 9001 Certificate: 5 Marks ISO 9001 and 14001 Certificate: 10 Marks No Certification: 0 Marks	
4	Feedback from clients a) No response: 0 Mark b) Satisfactory Response: 10 Marks c) Positive Response with Appreciation: 15 Marks	**15**
5	Accredited HVAC Contractor with ISHRAE membership a) ISHRAE membership: 10 marks b) No ISHRAE membership: 0 mark	**10**
6	Presentation by the Pre-qualified bidders to the bid evaluation committee on their approach to this project, execution plan, and team involvement.	**20**

Note:

1) Bidders getting less than **60%** in the technical score will not be considered for opening the price bid.
2) Bidders getting the highest technical score will be considered as **60**, and the scores of others will be adjusted on a pro-rata basis. This will become the technical score = X.

   X = Technical Score of a bidder = (Marks obtained by the bidder x 60) / Marks obtained by the highest scorer.

B. <u>Price Bid Score</u>

The lowest Rate quoted by a Bidder will be given a score of **40.**

For calculating the score of other bidders, the following formula will be used.

Y = Price bid Score of a bidder = 40 x (Lowest Rates quoted) / Price quoted by the bidder

C. <u>Composite Score</u>

Total Score of a bidder out of 100 = X + Y.

The bidder getting the highest composite techno-commercial score (X+Y) will be considered for the award of the contract.

Notes:

1) IGIDR, MUMBAI N reserves the right NOT to award the work to the highest scorer.

2) IGIDR, MUMBAI reserves the right to reject any or all bids without assigning any reason.
3) IGIDR, MUMBAI reserves the right to increase or decrease the scope of work.
4) IGIDR, MUMBAI may ask the selected vendor to submit the Pricing plan of the rates quoted and make a decision on the feasibility of the price quoted.

I/We hereby declare that I/we have read and understood the above instructions, and the same will remain binding upon me/us.

Place: Signature of the Bidder with seal

SECTION-G

DETAILED SCOPE OF WORK

1.1 INTRODUCTION:

The work is to be executed at IGIDR, Mumbai. All equipment will be required to operate under the climatic conditions of the above-mentioned location.

The tenderers are advised to visit the site for familiarization with site conditions and the collection of any information considered vital for submission of the tender. The department will not take any responsibility for the same.

1.2 SCOPE OF WORK:

a) GENERAL:

The work shall be executed as per the general specifications **GENERAL SPECIFICATIONS for HEATING, VENTILATION & AIR-CONDITIONING (HVAC) WORKS (2017)** as amended up to the present date, **GENERAL SPECIFICATIONS for Electrical Work -Internal Work Part I** as amended up to the present date & **CPWD Specifications for Civil Works - 2009 Vol. I & II** with correction slips up to the last date of submission of the bid. These additional specifications/conditions are to be read in conjunction with these specifications. In case of variations, the decision of the Engineer-in-charge is final& binding. Nothing extra shall be payable on account of any variations.

1.3 SCHEME

It is proposed that Buildings have to comply with the National Building Code of India 2016 (NBC2016) for the design of the HVAC system.

It is proposed to provide the following HVAC system for the above-mentioned building:

The work shall be carried out in accordance with the drawings and design as would be issued to the Contractor by the Design Consultant, duly signed and stamped by him. The contractor shall not take cognizance of any drawings, designs, specifications, etc., **not** bearing the Design Consultant's signature and stamp. Similarly, the Contractor shall not take cognizance of instructions given by any other Authority except the instructions given by the Project Manager's Representative in writing.

The work shall be executed and measured as per the metric dimensions given in the Bill of Quantities, drawings, etc.

The Contractor shall acquaint himself fully with the partial provisions for supports that may be available in the structure and utilize them to the extent possible. In any case, the Contractor shall provide all the support regardless of provisions that have already been made. Nothing extra shall be payable for situations where insert plates (for supports) are not available or are not useful.

Shop coats of paint that may be damaged during shipment or erection shall be cleaned off with mineral spirits, wire brushed, and spot primed over the affected areas, then coated with paint to match the finish over the adjoining shop-painted surface.

The Contractor shall protect/handle the material carefully, and if any damage occurs while handling by the Contractor, then the sole responsibility shall be of the Contractor. Such damages shall be rectified/recovered by the Contractor at no extra cost whatsoever.

The Contractor shall, within twenty-one (21) days of receipt of the Notice of Award for the project, where applicable, complete the submission of shop drawings to the Project Manager's Representative for approval by the design consultants to conform to the contract schedule.

The contractor should provide the RCC drawings for the foundation/pedestals before the equipment installation, like Chillers, AHUs, and Pumps, etc., according to the manufacturer's specifications. The contractor shall construct the necessary foundations/pedestals blocks as per the RCC construction drawings.

Measurements:

All measurements shall be taken in accordance with relevant IS codes, unless otherwise specified.

SECTION-H

TECHNICAL SPECIFICATIONS

SECTION H-1.0: TECHNICAL SPECIFICATIONS FOR HVAC/VRF SYSTEM

1.0 INTRODUCTION AND SCHEME

Air-cooled type scroll chiller product specification

1. Basic Construction Features - Casing
1) It should have a structure that is easy for disassembly and assembly for easy maintenance/repair.
2) It should have a beautiful exterior, and it should be insulated to prevent dew condensation.
3) It should have the structure preventing vibration and abnormal noise.
4) It should have a structure that can be grounded.
5) Chiller should be AHRI certified for its performance as per AHRI 551 /591.

2. Compressor
1) R410A refrigerant should be used, the case shape should be sealed type, format should be the combination of fully inverter scroll compressors, it should be flexible to respond to load, and it should be a high efficiency system that can optimize energy efficiency through inverter control.
2) Vibration prevention rubber should be used to prevent transfer of noise and vibration during operation.
3) The frequency variable boundary of inverter scroll compressor should be minimum 15Hz and maximum 125Hz.
4) Alternating operation should be possible to have the uniform average operation time of the compressors.
5) Each Compressor should have a 100% independent refrigerant circuit.

3. Condenser
1) Condenser heat pipe should use purity 99.9 % or above Phosphorus Deoxidized Copper without joint, and it should have the structure with Al fin attached to increase the heating area. (Cross fin & Tube type)
2) Use wide louver fin for Al fin, and pipe extension should be carried out for efficient heat transfer.
3) Condenser air cooled type heat exchanger arrangement should be 3 rows 48 levels 15FPI.
4) The pressure endurance test for high pressure part refrigerant side should be carried out at 4.18 MPa or above (designed pressure 3.8 MPa), and there should be problems such as leakage or deformation.
5) The condensing coil that passed pressure endurance test should be vacuumed to completely remove moisture inside.
6) Use propeller type Fan, and it should be able to give sufficient wind amount required for condensing. Also, it should have sufficient strength for the number of rotations, and it should be operated silently through balance test.
7) Motor should be BLDC type that can increase efficiency.
8) Fan and Motor should be connected directly.
9) Fins should have a protective coating which can sustain salt spray test of at least 3000 Hours.

4. Electronic Expansion Valve
1) It is the part that insulates and expands high pressure fluid refrigerant at condenser exit in low temperature
• low pressure state, and during cooling operation, line shape electronic expansion valve should be activated to adjust adequate refrigerant amount according to the evaporator load.
2) Based on data of various sensors installed in the chiller, microcomputer unit should be able to analyze operation status of the system and compressor to control the most adequate refrigerant amount linearly.
3) By applying electric pulse signal to stepping motor, it should be able to play the role of adjusting the refrigerant flow amount.

5. Evaporator
1) Evaporator should be shell & tube type heat exchanger, and the material should be carbon steel and copper tube.
2) There should be no water leakage, and the durability should be guaranteed.
3) It should have the structure that can connect to chilled water pipe.
4) Heat exchanger should be sensible heat exchange structure that the refrigerant and coolant are not mixed.
5) It should be a structure that each of coolant and refrigerant are flown into counter current structure heat exchanger

and after heat is exchanged with each other through the thin valve inside heat exchanger, discharged outside heat exchanger.
6) Chiller should have 3 independent evaporator to ensure 100% redundancy in refrigerant circuit.

6. Control equipment
1) It is the controller to operate overall system in optimal condition with the microcomputer unit installed in the chiller, and based on the 4 measurement values including intake refrigerant gas pressure, discharged refrigerant gas pressure, discharged refrigerant gas temperature, and heat
exchanger refrigerant temperature, it should be able to control electronic expansion valve, compressor(inverter), etc.
2) There should be a function that can check all sensors connected to the chiller and various operation statuses.
3) It should be equipped with self-protection equipment and system protection function.
4) Module type control interface should be applied so that simple product control is possible in series installation, and relocation and re-installation of HMI controller should be possible without separate control equipment.

7. Ref. Piping

1) Refrigerant pipe should be purity 99.9% or above Phosphorus Deoxidized Copper without joint, and it should be piped for fluent refrigerant flow between each component.
2) Install check valve at compressor discharge side to prevent reverse flow of the discharged refrigerant.
3) Install strainer in the pipe to absorb moisture inside the pipe and to filter foreign objects.
4) The pipe from expansion valve to evaporator should be insulated to prevent moisture condensation on the surface of the pipe and to prevent flash gas generation of refrigerant fluid at the same time.

8. Safety devices

1) Refrigerant pressure (Normal refrigerant pressure)
A. High pressure switch
B. High voltage protection (Sensor)
2) Temperature
A. compressor discharge temperature overheating detection (Sensor)
B. IPM temperature detection (Sensor)
C. Freeze and burst protection (Sensor)
D. Power Module application (Sensor)
3) Chilled water flow
A. Chilled water flow switch
4) Voltage and current (control logic)
A. Revere phase detection and protection (Voltage monitoring system)
B. Compressor over-current protection
C. Fan motor over-current protection
5) Fuse

Manufacturing specification

1. Use the parts and material of standard products or equivalent products for those not specified in this specification, and all parts should be designed with structure that is easy for replacement, repair, and inspection.
2. If there is a problem in the chiller, or if there is an abnormal status of chilled water temperature and flow amount, etc., immediately stop the chiller operation and you have to be equipped with marking equipment or function that can easily identify these.
3. There should be a protection circuit to prevent chiller damage by blackout or frequent voltage variation.
4. Chiller should be able to operate silently without abnormal noise or abnormal vibration
5. Chiller should be composed of the central controller and the circuit possible for wired/wireless Start/Stop operation.
6. Easy combination should be possible with compact product design and module type design, and basic module insertion and assembly installation should be possible regardless of the volume.
7. It should be the structure possible for substitute operation even if compressor or some cycle parts fail and cooling operation should be possible during parts replacement, repair, or inspection.

8. The main power cable equivalent or above the specification presented in the product specification of each corresponding model should be used for the chiller; each communication line and power cable should use cable pipe for protection, and the cable pipe with a material that can block external noise according to the installation environment should be used.

CHILLER PACKAGE -DETAILS TO BE FURNISHED BY TENDERER ALONG WITH OFFER			– DATA SHEET B
S. No.		Description	Bidder To Furnish*
1.0		Air Cooled Chilling Unit	
		General Data	
	1.1	Number of chillers	
	1.2	Location	
	1.3	Make and country of origin	
	1.4	Model number and year of introduction model from same factory	
	1.5	Detailed list of installations of that model in India from same factory	
2.0		Operating Parameters	
	2.1	Minimum refrigeration capacity (TR)	
	2.2	Minimum chilled water flow rate (USGPM)	
	2.3	Maximum chiller pressure drop (Feet of water)	
	2.4	Entering chilled water temperature (deg F)	
	2.5	Leaving chilled water temperature (deg F)	
	2.6	Evaporating temperature (deg F)	
	2.7	Fouling factor for chiller	
	2.8	KW/TR at full load conditions	
	2.9	OA Temperature (deg F)	
3.0		Compressor	
	3.1	Manufacturer	
	3.2	Model	
	3.3	Type of compressor	
	3.4	Speed (operating)	
	3.5	Speed (maximum)	
	3.6	Refrigerant used	
4.0		Evaporator	
	4.1	Manufacturer	
	4.2	Model (No)	
	4.3	Shell dia. (mm)	
	4.4	Tube length (m)	
	4.5	No of tubes (No.)	
	4.6	Material of tubes (Name)	
	4.7	Dia. of tubes (mm)	
	4.8	No of integral fins / cm (No.)	
	4.9	No of refrigerant circuits (No.)	
	4.10	No of water passes (No.)	
5.0		Compressor Motor	
	5.1	Manufacturer	
	5.2	Type	
	5.3	Motor Voltage	
	5.4	Rated output	

	5.5	Power characteristics	
	5.6	No of Motors	
6.0		Starter for Compressor Motor	
	6.1	Manufacturer	
	6.2	Type of starter	
7.0		Miscellaneous Details	
	7.1	Type of capacity control	
	7.2	Noise level of chiller (in dBA) at 1 m distance	
	7.3	Equipment's size (LXBXH)	
	7.4	Equipment's operating weight (kg) / pounds	
	7.5	Full refrigerant charge quantity	
8.0		Documents to be furnished with bid.	
	8.1	Computerized printout (certified) from chiller manufacturer indicating power consumption in IKW/TR at full load and various part load conditions as per AHRI format	
	8.2	Catalogues furnishing detailed technical data for compressor, evaporator, condenser, microprocessor or micro-computer control panel, etc.	

SECTION H– 2.0: PUMPS - SPECIFICATIONS

1. SCOPE

1.1 This section of specification covers the supply, installation, testing, and commissioning of water pumps along with accessories conforming to these specifications and in accordance with the requirements of drawings, 'Technical Schedule of Equipment' and of the 'Schedule of Quantities'

2. CODES AND STANDARDS

2.1 The design, materials of construction, manufacture, inspection, performance and testing of Vertical Inline Long Coupled with outside type mechanical seal / Centrifugal Pumps shall comply with all currently applicable statutory regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall be construed to relieve the VENDOR of this responsibility. The equipment supplied shall comply with the latest applicable Indian, American, British or equivalent standards.

3. TYPE

3.1 All chilled, condensing water pumps shall be of capacity, efficiency and size in accordance with the requirements indicated in the drawings and 'Schedule of Quantities'. Pumps shall conform to relevant IS standards/codes.

4. MATERIAL OF CONSTRUCTION

The pumps shall be of centrifugal Vertical Inline Long Coupled with outside type mechanical seal type as specified in "Schedule of Quantities" with the following material of construction.

Type	End Suction Back	Pull Out Mono block	Vertical Inline Long Coupled pump
Duty	Chilled/Hot Water Supply Chilled/Hot water supply	Chilled/Hot Water Supply Chilled/Hot water supply	Chilled/Hot Water Supply Chilled/Hot water supply
Casing	Cast Iron	Cast Iron	Cast Iron
Impeller	Bronze / Gunmetal machined to close tolerance	Bronze / Gunmetal machined to close tolerance	Bronze / Gunmetal machined to close tolerance
Shaft	High quality alloy steel EN8 grade	High quality alloy steel EN8 grade	High quality alloy steel EN8 grade
Bearings	Heavy duty ball/roller	Heavy duty ball/ roller	Heavy duty ball/roller

Base plate	Cast iron/fabricated MS channel in all welded construction	Cast iron/ fabricated MS channel in all welded construction	NA
Seal	Mechanical	Mechanical	Outside Type Mechanical Seal
Flanges	Standard companion As per IS standards IS -1536/1960	Standard companion As per IS standards	Standard companion As per IS standards
Speed (Max)	1450 RPM	1450 RPM	1450 rpm
Drive	TEFC Motor	TEFC Motor	TEFC Motor
Starter	Star Delta Or VFD	Star Delta Or VFD	Star Delta or VFD
Other Components	Wearing rings, sleeves and any other std accessories	Wearing rings, sleeves and any other std accessories	Wearing rings, sleeves and any other standard accessories

5 ACCESSORIES AND FITTINGS

Pump shall be complete with

5.1 Lubrication fittings.

5.2 Gland drains (25mm min) piping up to nearest floor drain point.

5.3 Test and air vent cocks.

5.4 Water seal piping connections

5.5 Suction, discharge pressure gauge (not less than 150 mm diameter) of appropriate range, with globe valves.

5.6 Suction and discharge shut off valves.

5.7 Discharge check valve

5.8 Y type strainer at suction of each pump

5.9 Suction guide and triple duty valves

5.10 Flexible couplings (at section & discharge) with control rods.

5.11 However quantities of item (5.5) to (5.9) are separately quantified under 'Schedule of Quantities' and as such, cost of these valves should not be included in the cost of pump. Also GI gland drain piping (Item 5.2) up to nearest drain point will be paid under piping item, as such cost of same should not be included in the cost of pump.

6. DESIGN REQUIREMENTS

6.1 The pump shall be capable of developing the required total head at rated capacity for continuous operation. The variable pump should have the capability to display head and flow of the pump on the VFD/ Controller for better and precise control. The variable pumps should have capability to adjust the pump control curve as per site requirements.

6.2 Pumps shall run smooth without undue noise and vibration. The noise level shall be limited to 85 db A at a distance of one meter.

6.3 The guaranteed output of the pump shall be at that frequency of electric supply, which is normally available at site, instead of rated frequency of 50 Hz, if, specified in Data Sheet 'A'.

6.4 Pump motor shall be TEFC squirrel cage type & suitable for 415 +/- 5% V, 3-phase 50 CPS AC power supply.

7. FEATURES OF CONSTRUCTION

7.1 Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. Components of identical pumps shall be interchangeable.

7.2 Mechanical seals shall be provided

8. INSTALLATION & TESTS

8.1 The pump sets shall be mounted on cement concrete foundation, which shall be provided by the contractor himself. However, grouting nuts, bolts, channels, shims, etc. shall be provided by the HVAC contractor.

9. MECHANICAL BALANCING

9.1 The impeller shall be statically and dynamically balanced.

10. VISUAL INSPECTION

10.1 Pumps shall be offered for Visual inspection (if specifically asked for) before dispatch. The components of the pumps shall not be painted before inspection.

11. MATERIAL TEST CERTIFICATE

11.1 Materials of the various pump components shall be tested in accordance with the relevant standard and Test Certificates shall be furnished along with the Pumps.

12. FIELD TESTING

12.1 After installation, the pumps shall be subjected to testing at site also. If the performance does not meet the requirements regarding capacity, power consumption, vibration and noise etc. as specified, then the equipment shall be rectified or replaced by the VENDOR, at no extra cost to the CUSTOMER.

13. TENDER DRAWINGS

13.1 The following drawings shall be submitted by the tenderers along with their Bids:

13.1.1 Preliminary outline dimensional drawing of pump. (Suction and discharge connections and foundation details shall also be indicated).

13.1.2 Performance curves (capacity vs. total head, efficiency, NPSH and KW requirement) ranging from zero to maximum capacity.

13.1.2.1 Pump Catalogues.

14. NAME PLATE

14.1 Each pump shall be provided with a name plate indicating the following details:

a) Design capacity
b) Total head
c) Speed
d) Motor rating
e) Model number
f) Manufacturer's serial number
g) Weight of equipment
h) Tag number

15. PAINTING

15.1 All ferrous surfaces shall be painted with one coat of red oxide primer paint followed by two coats of synthetic enamel paint (approved shade).

16. INSULATION

16.1 The Pump casings for chilled water along with its accessories and fittings shall be insulated with class F insulation. The cost of this insulation should be included in the cost of the pump.

16.2 Pumps shall be insulated only after they have been tested and test results have been approved by the engineer.

Note: - All the hardware required for the installation and equipment required for testing & commissioning shall be supplied by the Contractor.

SECTION H- 3.0: FLOOR MOUNTED AIR HANDLING UNITS

1 SCOPE

This section of the specification covers the supply, installation, testing and commissioning of double skin construction air handling units along with its accessories, conforming to these specifications and in accordance with the requirements of the 'Schedule of Quantities', Drawings and 'Technical Schedule of Equipment'.

2 TYPE

The air handling units shall be double skin modular, draw-through type, comprising various sections such as mixing chamber (wherever R. AIR and F.AIR are ducted.), pre-filter section, chilled water coil section, fan section, supply air plenum as per details given in Drawings and Schedule of Equipment. AHU should be Eurovent Certified/BIS certified in equivalence of Eurovent Certification.

3 CAPACITY

The air handling capacities, maximum motor HP, and static pressure shall be as shown on Drawings and as indicated in 'Schedule of Quantities'.

4. CONSTRUCTION

4.1 AHU HOUSING / Casing:

4.1.1 The AHU housing shall be of double skin construction with main structure made of extruded aluminum hollow sections. The panels shall be double skin sandwich type with 0.8 mm pre-painted GSS/ pre-plasticized on the outside and 0.8 mm galvanized sheet inside with 40 mm thick PUF insulation or equivalent material injected in between. These panels shall be screwed with soft rubber gaskets fixed in built-in groove of aluminum frame in between to make the joints airtight or specification as mentioned in BOQ/Schedule of Quantities.

4.1.2 Framework for each section shall be joined together with a soft Neoprene rubber gasket in between to make the joints airtight. Suitable airtight access doors /panels with nylon hinges and locks shall be provided for access to various sections for maintenance. The entire housing shall be mounted on roller-formed GSS channel framework having pressure die-cast aluminum jointers.

4.2 Drain Pan

The drain pan shall be of 18 G stainless steel with a necessary slope to facilitate fast removal of condensate. It shall be provided with a drain connection of suitable size, complete with 25 mm rigid insulation. Necessary arrangement will be provided to slide the coil in the drain pan. The drain pan shall be insulated with 12 mm thick closed-cell Nitrile insulation (self-adhesive) or equivalent.

4.3 Cooling / Heating Coil

The chilled /hot water coil shall be of seamless copper tubes not less than 0.5 mm thick and 12mm OD. Coil face areas shall be such as to ensure rated capacity from each unit and such that air velocity across each coil shall not exceed 150 meters per minute. The coil shall be pitched in the unit casing for proper drainage. The fins shall be spaced by collars forming an integral part of the fins. The tubes shall be staggered in the direction of airflow.

The fins shall be uniformly bonded to the tubes by mechanical expansion of the tube for minimum thermal contact resistance with fins. Fin spacing shall be 11to 13 FPI. The coils shall be tested against leaks at a hydraulic pressure of 21-kg/sq. cm. This pressure shall be maintained for a period of at least 2 hours. No drop should be observed indicating any leaks. The water headers shall be complete with water in /out connections, vent plug on top and drain at bottom and designed to provide water velocity between 2 to 6 FPS.

4.4 Fan Section with Fan

The fan shall be backwards-curved, double inlet, double-width type. The wheel & housing shall be fabricated from heavy-gauge galvanized steel. The fan impeller shall be mounted on a solid shaft supported to housing with an angle iron frame & pillow block heavy-duty ball bearings. The fan shall be selected for a speed not exceeding 1000 RPM. The impeller & fan shaft shall be statically and dynamically balanced. The fan outlet velocity shall not be more than 550 MPM. Fan housing with motor shall be mounted on a common extruded aluminum base mounted inside the air handling housing on anti-vibration spring mounts or cushy foot mounts of at least 90% vibration isolation efficiency. The fan outlet shall be connected to the casing with the help of fire retardant double canvas or Neoprene rubber of imported Origin. The fan shall be selected for a noise level of less than 70 DB (A) at one-meter distance.

4.5 **FILTERS**

4.5.1 **General**

This section covers the general requirements for special type of filters to be installed in air moving equipment or air ducts.

4.5.2 **Pre-filters (fabric type)**

Synthetic fibre Pre-filters shall be in lightweight aluminium framed with nonwoven synthetic fibre replaceable media. The filter shall have an efficiency of 90 percent down to 10 microns particle size when tested as per B.S.2831 standards. The filter frame shall be of aluminium and shall be suitable for mounting in Air handling units or ducts as required at site. The velocity across the face of the filter shall not exceed 500 FPM, and the pressure drop across the filter shall not exceed 4mm. The filters shall be suitable for operation under 100 percent relative humidity and 120 deg.C temperature conditions.

4.5.3 **Microvee filters (fine filters)**

Microvee filters shall be of dry type. Filters media shall be made from washable non-woven synthetic fibre replaceable media reinforced with HDPE cloth & Aluminium mesh, specially treated with antifungal and bactericidal agents to prevent growth of microorganisms. The filter media shall be treated to permit washing with water several times before discharge. The media shall be properly supported and spaced so that air flow through the filter is uniform. The filter shall be housed in aluminium frame work. Filters shall be designed to remove particle down to 5 microns size and with an efficiency of 98.0 percent tested as per BS 2831 using Test Dust II. The filters shall be installed in the air handling units after the chilled water coils. They shall be capable of being replaced or removed for servicing without the use of special tools.

5. FRESH AIR INTAKES

Extruded aluminum construction duly anodized fresh air louvers with bird screen, and extruded construction dampers shall be provided in the clear opening in masonry walls of the air handling unit room having at least one external wall. Fresh air louver, damper, pre-filters, ducts and fresh air fan with speed regulator (wherever specified in 'Schedule of Quantities') shall be provided. Fresh air dampers shall be of the interlocking, opposed blade louver type. Blades shall be rattle-free. Damper shall be similar to those specified in 'air distribution'. Fresh air fans and fresh air intakes shall be as per the requirements of 'Schedule of Quantities'.

6. ACCESSORIES

Each air handling unit shall be provided with a manual air vent at the highest point in the cooling /heating coil. In addition, the following accessories may be required at air handling units. Their detailed specifications are indicated in individual sections and quantities separately identified in 'Schedule of Quantities'.

- Stem type thermometer at each AHU coil inlet and outlet with tubing and gauge cocks and specification as per the section, 'Automatic Controls and Instruments'
- Pressure gauge with globe valves at inlet and outlet of each AHU coil with tubing and specifications as per the section, 'Automatic Control and Instruments'.
- Butterfly valves at inlet and outlet of each coil.
- PICB valves at the outlet of each coil.
- Y strainer at inlet of each coil.
- Union and condensate drain piping from the unit up to the drain trap as described in section piping.
- Motorized three-way mixing valves located in chilled /hot water lines connected to the coil. This valve shall be operated by the cooling/heating thermostat and shall control the flow of chilled/hot water as per section 'automatic controls and instruments'.
- Cooling /heating thermostat as per section
- 'Automatic Controls and Instruments' shall be located in the return air stream.
- Flexible connection between the fan outlet and duct.
- Vibration isolators of at least 90% efficiency.

7. SAFETY FEATURES

Each handling unit must have safety features as under:

- The fan access door must have a micro switch interlocked with the fan motor to enable switching off the fan motor automatically in the event of door opening.

The access door shall further have a wire mesh screen as an added feature, bolted onto the unit frame.

- Fan and motor base shall be properly earthed from the factory.

- All screws used for panel fixing and projecting inside the unit shall be covered with PVC caps to avoid human injury.

8. DRIVE

Fan drive shall be 3phase-squirrel cage totally enclosed fan cooled motor suitable for 415±10%V, 50 HZ AC supply. Motor shall be specially designed for quiet operation and motor speed shall not exceed 1440 RPM. Drive to fan shall be provided through belt drive arrangement with required no. Of belts for power transmission without slippage. Belts shall be of an oil-resistant type of approved make only.

9. DESIGN DATA FOR AIR HANDLING UNITS

- Fan outlet velocity shall not exceed 660 MPM.
- The air velocity across coil shall not exceed 150 MPM.
- The air velocity across the air pre-filter shall not exceed 150 MPM.
- Motor ratings shall be suitable for the duty. The motor shall be selected with a safety factor of at least 20% over and above the brake power.

The AHU fan shall be selected for a total static pressure as indicated in 'Schedule of Quantities'.

10 INSTALLATION

Air Handling Unit shall be installed inside the AHU room to permit the removal of all the parts of AHU for any maintenance work without dismantling other equipment such as plenum, pipes, ducts etc. Air handling unit installation shall be carried out as per manufacturer's recommendation and mounted on serrated rubber pads. The serrated rubber pads shall be in two layers with 16G GI sheet sandwiched in between.

11. PERFORMANCE DATA

Air handling unit shall be selected for the lowest operating noise level of the equipment. Fan performance rating and power consumption data with operating points clearly indicated shall be submitted and verified at the time of testing, commissioning of the installation.

12. TESTING

Cooling/Heating capacity of various air-handling unit models shall be computed from the measurements of airflow and dry and wet bulb temperatures of air entering and leaving the coil.

Flow measurements shall be by anemometer and temperature measurements by an accurately calibrated mercury in glass thermometer. Computed result shall conform to the specified capacities and quoted ratings. Consumption shall be computed from measurements of incoming voltage and input current.

13. VARIABLE FREQUENCY DRIVES (For AHUs):

13.1 It comprises the following:

- Built in dual 5% impedance DC link reactor (harmonic filters) on the positive and negative rails of the DC bus of the Variable Frequency Drive
- Built in EMC filters (electromagnetic compatibility filters) for restriction of conducted emissions to comply with IEC61800:3 (unrestricted distribution): 2004 Category C 1 (50 meter)
- Three feedback PID controllers having the capability to simultaneously accept 3 feedback signals from temperature sensors or pressure sensors for process optimization and accordingly control the speed of the AHUs or pumps.
- Integral graphical keypad.

Note: (i) Cost of temperature sensor and control cables not included.
(ii) Separate Starter not required for switching on motor and pump.

13.2 Product compliance – The drive shall comply with the following standards

- Low Voltage Directive 73/23/EEC with supplements
- EMC Directive 89/336/EEC with supplements
- Quality assurance system ISO 9001 and ISO 14001
- CE, UL, Ulc and C-tick

13.3 Mechanical Protection

13.3.1 The enclosure shall be plastic type and tested in UL tests according to the ball impact test stated in UL746C.

The protection class shall be IP55.

13.4 Operating Parameters

- The drive shall be suitable for an ambient temperature of 40 deg C.
- The drive shall give an alarm signal when the heat sink temperature of the drive reaches 90 deg C and shall trip when the temperature reaches 95 deg C.
- To predict the noise level of the motor switching frequency shall be user selectable and can be selected according to the load conditions: 4 kHz or 8khz (for low noise operations)
- Overload Capacity: The drive shall be able to deliver 100% of the nominal current and 110% for 1 min. every 10 mins. (if repeatability is not mentioned, the drive shall be selected to ensure the proper RMS current rating)
- The drive shall have at least 2 critical frequency (band) selection to avoid the mechanical resonance problem.
- The drive shall have at least 7 programmable constant speeds ranging from 0-250 Hz.

13.5 Programming

- Control Panel: The drive shall have an alphanumeric control panel with LCD display and multiple languages. The control panel can be connected to and detached from the converter at any time. The panel can also be used to copy parameters to other converters with the same software revision.
- It shall be possible to view the Output Current, % Torque, the reference Frequency and one output variable (frequency, voltage, etc. as per requirement. If not, then a separate display shall be provided to view the above parameters.
- At any point of time, the status of the drive can be known through the Control Panel, i.e. remote/local, run/stop/fault, etc.
- The drive shall have a sleep function to provide energy saving at low frequency. When the reference falls below a certain level, the drive shall go into energy optimizing mode.
- The drive shall have a Fan controller.

13.6 Protection features

- Over current
- Over voltage
- Under voltage
- Over temperature
- Output earth fault
- Output short circuit
- Input phase loss (3 phase)
- I/O terminal short circuit protection
- Motor overload protection: If the motor current I (out) exceeds nominal current I_N of the motor for a prolonged period, the drive shall automatically protect the motor against overheating by tripping. The trip time shall depend on the extent of the overload (I out / I_N), the output frequency and f_{nom}. Times given shall also apply to a “cold start”. Drive shall provide overload protection in accordance with the National Electric Code (US).
- Output over voltage protection: In the event of an overload, the drive shall first show an alarm and then trip.
- Stall protection
- Under load

- Stall protection
- Output over current
- Output short circuit
- Ground fault, motor cable
- Under load
- Network failure
- Low input signal level (AI<min)
- Panel fault
- Over voltage
- Under voltage
- External fault
- Automatic fault reset, under voltage
- Automatic fault reset, over voltage, over current
- Fault history 3

13.7 Functions

- Start; normal/flying/torque boost
- Start; premagnetising
- Stator resistance (IR) compensation
- Stop; ramp/coasting
- Stop; DC brake
- DC hold
- U/f -ratio; linear/square
- Acceleration/deceleration 1 (s) 0.1 … 1800
- Acceleration/deceleration 2 (s) 0.1 … 1800
- S-ramp; fast/medium/slow
- 7 Preset speeds
- 2 Critical frequencies
- Slip compensation
- Parameters in logical menus
- Motor field optimization for energy optimization
- Selectable switching frequency 4 / 8 kHz

13.8 Mains Connections

- Voltage: 3-phase, 380-480V +/-10%
- Frequency: 48-63hz
- Power Factor: 0.9

13.9 Motor Connections

- Voltage: 3-phase from 0 – U supply
- Frequency 0-250hz
- Acceleration time: 0.1 to 1800 secs
- Deceleration time: 0.1 to 1800 secs

13.10 Programmable control connections: The drive shall have at least the following inputs and Outputs.

13.10.1 Two analog inputs:

Voltage signal: 0 (2) to 10 V, 200 kW single-ended

Current signal: 0 (4) to 20 mA, 500 W single-ended

Potentiometer reference value: v10 V ±2% max. 10 mA, 1 kW £ R £ 10 kW

Response time: £ 60 ms

Resolution: 0.1%

Accuracy: ±1%

13.10.2 One analogue output: 0 (4) to 20 mA, load <500 Auxiliaire voltage: 24 V, max. 250 Ma

13.10.3 Five digital inputs:

- 12 V 24 V DC with internal or external supply, PNP and NPN
- Input impedance: 1.5 kW
- Response time: £ 9 ms

13.10.4 Two relay outputs:

- Switching voltage: 12 to 250 V AC or max 30 V DC/0.5 A
- Maximum continuous current: 10 mA to 2 A

Serial communication for the control panel or external control: Seamless communication with Modbus or N2 protocol on RS-485.

Design features

The drive shall have an in-built choke at the DC input side.

The distance between the motor and the drive is approximately 100 mts. An output choke shall be used as applicable.

SECTION H- 4.0: AUTOMATIC CONTROLS AND INSTRUMENTS -SPECIFICATIONS

1. SCOPE

The scope of this section comprises the supply, installation, testing and commissioning of automatic controls and instruments conforming to these specifications and in accordance with the requirements of drawings and 'Schedule of Quantities'

2. PRODUCTS

2.1 PICB /Two / Three Way Valve

PICB/Two way or Three way motorized / modulating valve for each air handling units shall be provided in the chilled water line at each air handling units as shown on the Drawings and included in Schedule of Quantities. Each valve shall be actuated by a space or duct mounted thermostat. Constant space condition shall be maintained by continuous proportional modulation of the chilled water through the coil. The valve shall revert to fully bypass position when fan is shut off. Motor shall be proportional modulating motor. Motor shall be suitable for 24 volts supply and shall have a cover mounted 220/24 volts transformer factory-installed. The unit shall be suitable for outdoor installation in the open space.

Two way or Three-way motorized valve for each fan coil unit shall be provided in chilled water lines at each fan coil unit as shown on Drawings and included in Schedule of Quantities. The valve shall be actuated by a space thermostat. Constant space conditions shall be maintained by allowing all of the chilled water to either pass through the coil or bypass the coil and mix with the chilled water return. The valve shall revert to fully bypass position when fan is shut off.

Valve shall be similar to Honeywell two-position diverting valves 15 cm (1/2 inch) diameter with flare connection. Valve shall be selected for a water flow rate of 5-6 USGPM. Pressure drop across the valve shall not exceed 2 psi. Valve shall have the facility to replace motor & actuator without removing the valve body.

2.2 **Flow switches** shall be provided in the condensing water line (outlet) and chiller water line (outlet) only near the chilling machine. The control supply of chilling units shall be interlocked with these flow switches.

2.3 **Thermostats** shall be electrical mode, fixed differential type with sensing element located in the return air stream.

2.4 **Proportional control thermostats** for air conditioning application for actuating the two-way or three-way modulating valve at each air-handling units, as shown on drawings and included in Schedule of Quantities. Thermostat shall be similar to Honeywell model T921B/T92A or equivalent, line voltage-cooling thermostat. Range shall be 56-84 degree F, differential shall be 3 degree F.

2.5 SNAP acting fixed differential thermostat **for FCU shall be of Honeywell make and model T649A or T4039 cooling thermostat or any approved equivalent with temperature range of 13-29 degree C differential 37 deg C with ON/OFF, HI/LOW fan switch, normal-cool setting switching off must break fan circuit.**

3. INSTRUMENTS

3.1 **Thermometer**: Thermometers shall be dial type 100 mm dia or V form industrial type. Body shall be aluminum alloy, anodized gold colored surface. The casing shall be adjustable sideways for reading from the front. The glass capillary shall be triangular in shape with blue mercury filled in glass for better visibility. Scale of reading shall be of the range 0 deg C to 60 deg C & +32 deg F to 150 deg F. Graduation of scale shall be 1 deg in both readings. Ranges of scales shall be 30-90 degrees F (0-50 deg C) for all conditioning applications of cooling only.

Thermometer shall be suitable for 15mm connection. Thermometer for chilled water shall be with long stem so that the thermometer is removable without damaging the insulation ms socket to be welded on pipes shall be provided with a thermometer. Thermometer shall be installed of chilled water supply and return at each air handling unit, supply and return of each chiller, and condenser.

3.2 Pressure gauge - shall be installed on suction header and at discharge side of each pump in the chilled water supply and return at each air handling unit, at inlet and outlet of each chiller. Suction side gauge at pump suction header shall be a compound gauge with 150 MM dia, range 75 cm vacuum to 10 kg pressure. Discharge side gauge at pumps and at all other locations shall be 150mm range 0-10 kg per sq cm (0-150 PSI) Pressure

SECTION H – 5.0: SHEET META WORKS AND ACCESSORIES - (MANUAL FABRICATION)

1. **SCOPE**

The scope of this section includes supply, fabrication, installation & testing of all sheet metal ducts, supply, installation, testing & balancing of all grills & diffusers as per specifications & drawings.

Except as otherwise specified, all ductwork and related items shall be in accordance with these specifications.

Duct work shall mean all ducts, casings, dampers, access doors, joints, stiffeners, hangers & all accessories.

2. **DUCT MATERIALS**

The ducts shall be fabricated from galvanized steel sheets class VIII - Light coating of Zinc conforming to ISS: 277-1962 (REVISED) and with a galvanizing thickness of nominal 120 gm. per SQM surface area.

i. Only new, fresh, clean (unsoiled) and bright GI/Aluminum sheets shall be used. The CLIENT/MES reserve the right to summarily reject the sheets not meeting these requirements. Fabrication of ducts shall be through Lock forming machines.

Longer size of Duct	Sheet Thickness GI (MM)	Type of Joints	Bracing
Up to 750	0.63	GI Flange	-
751-1000	0.80	25x25x3 mm angle iron frame with 8 mm Dia nuts & bolts	25X25X3 MM @ 1M
1001-1500	0.80	40x40x5 mm angle iron frame with 8 mm Dia nuts & bolts	40x40x5 MM @1M
1501-2250	1.00	50x50x5 mm angle iron frame with 10 mm Dia nuts & bolts at 125 mm center	40x40x3 mm @ 1.2m to be braced diagonally.
2251 & above	1.25	50x50x6 mm angle iron frame with 10 mm Dia nuts & bolts at 125 mm center	40x40x3 mm @ 1.6m diagonally braced

ii. All duct work, sheet metal fabrication unless otherwise directed, shall strictly meet requirements, as described in IS:655-1963 with Amendment-I (1971 Edition) or latest.

iii. Ducts larger than 450 mm shall be cross broken, duct sections up to 1200 mm length may be used with bracing angles omitted.

iv. Changes in section of ductwork shall be affected by tapering the ducts with as long a taper as possible. All branches shall be taken off at not more than 45 Deg. Angle from the axis of the main duct unless otherwise approved by the Engineer-in-Charge.

v. All ducts shall be supported from the ceiling/slab by means of M.S. rods of 10 MM Dia with M.S. angle at the bottom of size 40 mm x 40 mm x 6 mm for sizes up to 1500 mm at 3 m intervals. Above size 1500 mm upto 2250, support shall be provided with 10 mm dia. MS rod and MS angle size 50 mm x 50 mm at bottom at 2.5 m intervals. Above size 2250 mm support shall be provided with 12 mm dia MS rod and MS angle size 50 mm x 50 mm at bottom

3. **INSTALLATION**

i. All ducts shall be fabricated and installed in workman like manner, generally conforming to relevant BIS codes. Round exposed ducts shall be die formed for achieving perfect circle configuration

a. Ducts so identified on the drawing shall be acoustically lined and thermally insulated as described in the section 'Insulation' and as indicated in 'Schedule of Quantities. Duct dimensions shown in drawings are overall sheet metal dimensions inclusive of the acoustic lining where required and indicated in 'Schedule of Quantities'.

b. Ducts shall be straight and smooth on the inside with neatly finished joints. All joints shall be made airtight.

c. All exposed ducts upto 60 cm width within conditioned spaces shall have slip joints. The internal ends of the slip joints shall be in the direction of airflow. Ducts and accessories within ceiling spaces visible from air-conditioned areas shall be provided with two coats of matt black finish paint.

d. Change in dimensions and shape of ducts shall be gradual. Air turns shall be installed in all vanes arranged to permit the air to make the turn without appreciable turbulence.

e. Ducts shall be fabricated as per details shown on drawings. All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees of ample size to keep the ducts true to shape and to prevent buckling, vibration or breaking.

f. All sheets metal connections, partitions and plenums required to confine the flow of air to and through the filters and fans shall be constructed of 18 Gauge GSS thoroughly stiffened with 25mm x 25mm x 3mm angle iron braces and fitted with all necessary inspection doors as required to give access to all parts of the apparatus. Doors shall be not less than 45cm X 45cm in size.

g. Plenums shall be panel type and assembled at site. Fixing of MS angle iron flanges of duct pieces shall be with rivet heads inside i.e. Towards G.S. sheet and riveting shall be done from outside.

h. Rubber gasket 3 mm thick shall be used between duct flanges and between duct and duct supports instead of felt in all ducting installation for complete sealing.

ii. During the construction, the Contractor shall temporarily close duct openings with sheet metal covers to prevent debris-entering ducts and to maintain opening straight and square, as per direction of Engineer-in-Charge.

a. Great care should be taken to ensure that the ductwork does not extend outside and beyond height limits as noted on the drawings.

b. All duct work shall be of high quality approved galvanized sheet steel guaranteed not to crack or peel on bending or fabrication of ducts. All joints shall be tight and shall be made in the direction of airflow.

c. The ducts shall be reinforced where necessary, and must be secured in place so as to avoid vibration of the duct on its support.

d. All air turns of 45 degrees or more shall include curved metal blades or vanes arranged so as to permit the air to make the abrupt turns without an appreciable turbulence. Turning vanes shall be securely fastened to prevent noise or vibration. All ducts shall be fabricated and installed in accordance with modern design practice. The sheet metal gauges and fabrication procedures as given in I.S. specifications shall be adhered to and shall be considered as an integral part of these specifications.

e. The ductwork shall be varied in shape and position to fit actual conditions at building. All changes shall be in accordance with accepted duct design and subject to the approval of the engineer-in-charge. The Contractor shall verify all measurements at building and shall notify the Engineer-in-Charge of any difficulty in carrying out his work before fabrication.

f. Sponge rubber or approved equal gaskets shall be installed between all connections of sheet metal ducts to walls. Sheet metal connections shall be made to walls and floors by means of galvanized steel angles anchored to the building structure with anchor bolts and with the sheet bolted to the angles. Sheet metal connections shall be as shown in the drawings or as directed by Engineer-in-Charge.

g. All ductwork shall be independently supported from building construction. All horizontal ducts shall be rigidly and securely supported, in an approved manner, with trapeze hangers formed of galvanized steel rods and galvanized steel angel/channel under ducts. All vertical ductwork shall be supported by structural members on each floor slab. Duct supports may be through galvanized steel insert plates left in slab at the time of slab casting. Galvanized steel cleat with a hole for passing the hanger rods shall be welded to the plates. Trapeze hanger formed of galvanized steel rods and angles / channels shall be hung through these cleats. Wherever use of metal insert plates is not feasible, duct support shall be through dash / anchor fastener driven into the concrete slab by electrically operated gun. Hanger rods shall then hang through the cleats.

h. Where ducts pass through brick or masonry openings, it shall be provided with 25 mm thick TF quality thermo Cole around the duct prior to sealing of the opening.

i. All ducts shall be totally free from vibration under all conditions of operation. Whenever ductwork is connected to fans, air handling units or blower coil units that may cause vibration in the ducts, ducts shall be provided with a flexible connection, located at the unit discharge. Flexible connections shall be constructed of fire retarding flexible heavy canvas sleeve at least 100 mm long but not more than 200 mm, securely bonded and bolted on both sides. Sleeve shall be made smooth and the connecting ductwork rigidly held by independent supports on both sides of the flexible connection. The flexible connection shall be suitable for pressure at the point of installation.

j. Flanges and supports are to be black, mild steel and are to be primer coated on all surfaces before erection and painted with aluminum thereafter. Accessories such as damper blades and access panels are to be of materials of appropriate thickness and the finish similar to the adjacent ducting, as specified.

k. The ductwork should be carried out in a manner and at such time as not to hinder or delay the work of the other agencies especially the boxing or false ceiling Contractors.

4. **DAMPERS**

At the junction of each branch duct with main duct and split of main duct, volume control dampers must be provided. Dampers shall be rigid in construction to the passage of air.

The volume dampers shall be of an approved type, lever operated and complete with suitable level links & quadrants, locking devices, which will permit the dampers to be adjusted and locked in any position.

The dampers shall be of opposed blade or louver type. The damper blade shall not be less than 1.25 mm (18) gauge and shall not be over 225 mm wide. Automatic and manual volume opposed blade dampers shall be complete with frames and bronze bearings as per drawings. Damper frames shall be constructed of 16 gauge steel

After completion of the ductwork, dampers are to be adjusted and set to deliver the required amount of air as specified in the drawings.

5. **ACCESS PANEL**

A hinged and gasket access panel shall be provided on ductwork before each control device that may be located inside the ductwork. Doors shall be provided with neoprene rubber gaskets. Angle joints shall be provided with neoprene rubber gaskets for leak tightness of the joints. Access door/panels shall be provided: - Near each smoke sensor Any other place specifically mentioned in the drawing or if asked by CLIENT/MES during execution stage.

6. **MISCELLANEOUS**

a. Sponge rubber gaskets also to be provided behind the flange of all grills.

b. Each shoot from the duct, leading to a grille, shall be provided with an air deflector to divert the air into the grille through the shoot.

c. Inspection doors measuring at least 450 mm x 450 mm are to be provided in each system at an appropriate location, as directed by Engineer-in-Charge.

d. Diverting vanes must be provided at the bends exceeding 600 mm and at branches connected into the main duct without a neck.

e. Proper hangers and supports should be provided to hold the duct rigidly, to keep them straight and to avoid vibrations. Additional supports are to be provided where required for rigidity or as directed by Engineer-in-Charge.

f. All duct supports, flanges, hangers and damper boxes etc. Shall be given 2 coats of red oxide paint before installation and one coat of aluminum paint after the erection, at no extra cost.

g. All angle iron flanges are to be welded electrically and holes to be drilled.

h. All the angle iron flanges are to be connected to the GSS ducts by rivets at 100 mm centers.

SECTION H- 6.0: GRILLS / DIFFUSERS

1. SUPPLY AND RETURN AIR DIFFUSERS

Supply and return air diffusers shall be made of extruded aluminum section as specified in BOQ. The diffusers shall be powder coated in finish. Supply air diffusers shall be provided with screw operated opposed blade volume control devices of extruded aluminum in black anodized finish. The diffusers shall be suitable for concealed fixing arrangement and as approved by Engineer-in-charge/MES

The diffusers shall be provided with removable central core.

All diffusers shall be selected as per selection curves and in consultation with Engineer-in-charge / MES All diffusers shall have soft continuous rubber/foam gasket between the periphery of the diffusers and the surface on which it has to be mounted.

a. LINEAR GRILLS:

Linear continuous supply or return air grills shall be extruded aluminum construction with fixed horizontal bars at 15 0 inclination with flanges on both sides. The thickness of fixed bar louvers shall be 5mm in front and the flange shall be 20mm wide with round edges. The grille shall be suitable for concealed fixing and horizontal bars of the grille shall be mechanically crimped from the back to hold them.

Volume control device of extruded aluminum construction in black anodized finish shall be provided in S.A. duct collars.

b. DOUBLE ADJUSTABLE LOUVERED SUPPLY/ RETURN AIR GRILLS WITH HORIZONTAL /VERTICAL OR VERTICAL/ HORIZONTAL LOUVER ARRANGEMENT:

The grille shall be adjustable as each louver shall be pivoted to provide pattern with 00 to plus or minus 150 ARC upto 300 deflection down towards. The louvers shall hold deflection settings under all conditions of velocity and pressure. The rear louver of the register shall be in black shade.

Volume control device of extruded aluminum construction with black anodized finish shall be provided in S.A. grills.

c. EXHAUST AIR REGISTER:

Exhaust air register shall be made of extruded aluminum with fixed horizontal louvers at 40 degree angle setting on a 20 mm louvers pitch. The register shall have 20 mm wide flange with round edges all around. The register shall be suitable for front screw fixing.

Volume control device of extruded aluminum construction with black anodized finish shall be provided.

d. MULTI SLOT CEILING DIFFUSERS:

Multi slot ceiling diffuser shall be made of extruded aluminum with various slot width and air pattern deflectors. Deflectors in each slot provide an adjustable air pattern of 180 degree full. A special plenum shall be provided for each supply air diffuser. The linear diffuser shall have alignment strips to give straight look while installation.

Hit & miss type volume control damper of extruded aluminum construction with mill finish shall be with multi-slot supply air diffuser.

e. LINEAR CEILING MOUNTED DIFFUSERS:

Linear ceiling mounted air terminals shall be made of extruded aluminum surface mounted one way or two way pattern. The linear terminal shall have alignment strips to give straight look while installation. Volume control device of extruded aluminum construction in mill finish shall be provided in S.A. diffuser.

f. FRESH AIR INTAKE LOUVERS:

Fresh air intake louvers 50 mm deep (minimum) wherever required as per shop drawing will be made of extruded aluminum construction duly anodized or powder coated. Bird/insect screen will be provided with the intake louvers. The blades are inclined at 450 on a 40 mm blade pitch to minimize water ingress. The lowest blade of the assembly shall extend out slightly to facilitate disposal of rainwater without falling in door/wall on which it is mounted.

Wherever specified, the intake louvers shall be provided with factory fitted all aluminum construction volume control dampers in black anodized finish.

g. LAMINAR FLOW DIFFUSERS

i. Introduction

Diffusers are available for flush mounting in the ceiling. Suitable angle frames are also provided for the modular panel construction. The units are available in three standard sizes for top entry complete with opposed blade dampers

ii. Description

LFD laminar flow diffusers are constructed from 18 swg Aluminium sheet,perforated face with approx 50% perforation. The perforated front face is openable hinge type complete with key operated dampers from front.

iii. Sizes

Available in standard sizes of 600 x 600 mm, 900 x 600 mm & 1200 x 600 mm or as mentioned in the BOQ.

iv. Features

- Suitable for modular panel assemblies.
- Top entry with opposed blade dampers.
- Pivoting type face plate for damper operation from front.
- Easy maintenance and cleaning

v. Finishesd Standard

a) Epoxy Polyester Powder Coated off white/pure white
b) Natural anodised.

2.MOTORIZED COMBINED SMOKE & FIRE DAMPERS – SPRING RETURN

All supply and return air ducts at AHU room crossings (or ducts as applicable) and at all floor crossings shall be provided with approved make fire and smoke dampers of at least 90 minutes fire rating certified by CBRI ROORKEE as per UL 555:1973

Fire damper blades & outer frame shall be formed of 1.6 mm galvanized sheet steel. The damper blade shall be provided on both ends using chrome-plated spindles in self-lubricated bronze bushes. Stop seals will be provided on top and bottom of the damper housing made of 16 g galvanized sheet steel. For preventing smoke leakage side seals will be provided.

In normal position damper blade shall be held in open position with the help of a 24 V operated electric actuators thereby providing maximum air passage without creating any noise or chatter.

The damper shall be actuated through electric actuator. The actuator shall be energized with the help of a signal from smoke detector installed in AHU room/R.A. duct/damper. The A/C Contractor shall also provide smoke detector. The fire damper shall also close due to Temp. rise in S.A. ducts thru the electric temp. sensor factory set at 165 Deg. F micro switches with bake lite base will be provided to stop fan motor and give open & close signal at remote panel in case of motorized actuator.

Each dampers in case of motorized smoke-cum-fire damper shall have its own panel which will incorporate necessary circuit required to step down voltage available from power supply to shown status of the damper (open or close), to allow remote testing of damper & indication in event of damper closure due to signal from smoke sensor/temp. sensor& reset button. Additional terminal will be provided to have signal (sound beep or visual) in central control room.

Damper actuator shall be spring return so as to close the damper in the event of power failure automatically and open the same in case of power being restored.

Spring return action of the actuator shall be an in-built mechanism and shall not be mounted externally.

The damper shall be installed in accordance with the installation method recommended by the manufacturer.

3.PAINTING

All grilles, and diffusers shall be powder coated in color as approved by Engineer-in-charge/MES before installation. All ducts immediately behind the grilles/diffusers etc.Are to be given two coats of black paint in Matt finish.

4.TESTING

After completion, all duct system shall be tested for air leakage.The entire air distribution system shall be balanced to supply the air quantity as required in various areas and the final balance of air quantity through each outlet shall be submitted to the engineer-in-charge for approval. Measured air quantities at fan discharge and at various outlets shall be identical to or less than 5% in excess of those specified and quoted. Branch duct adjustments shall be permanently marked after air balancing is completed so that these can be restored to their correct position if disturbed at any time.

SECTION H- 7.0: SHEET METAL WORKS – (FACTORY FABRICATED)

1.GENERAL

i. The work under this part shall consist of furnishing labour materials, equipment and appliances as specified necessary and required to install all sheet metal and other allied work to make the air conditioning supply, ventilating, and exhaust system ready for operation as per drawings.

ii. Except as otherwise specified all duct work and related items shall be in accordance with these specifications.

iii. Ductwork shall mean all ducts, casings, dampers, access doors, joints, stiffeners and hangers.

2. DUCT MATERIALS

i. 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).

ii. All duct work, sheet metal thickness and fabrication unless otherwise directed, shall strictly meet requirements, as described in IS:655-1963 with Amendment-I (1971 edition)

iii. GOVERNING STANDARDS: Unless otherwise specified here, the construction, erection, testing and performance of the ducting system shall conform to the SMACNA-1995 standards ("HVAC Duct Construction Standards-Metal and Flexible-Second Edition-1995" SMACNA)

3.RAW MATERIAL

i. Ducting.

ii. All ducting shall be fabricated of LFQ (Lock Forming Quality) grade prime G.I. row material furnished with accompanying Mill Test Certificates.

iii. Galvanizing shall be of 120gms/sq.m. (total coating on both sides).

iv. In addition, if deemed necessary, samples of raw material, selected at random by CLIENT/ MES's site representative shall be subject to approval and tested for thickness and zinc coating at contractor's expense.

v. The G.I. raw material should be used in coil-form (instead of sheets) so as to limit the longitudinal joints at the edges only irrespective of cross-section dimensions.

vi. Duct Connectors and Accessories

All transverse duct connectors (flanges/cleats) and accessories/related hardware are such as support system shall be zinc-coated (galvanized)

4.FABRICATION STANDARDS

i. All ductwork including straight sections, tapers, elbows, branches, show pieces, collars, terminal boxes and other transformation pieces must be Rolastar factory-fabricated or Techno Fabriduct or equivalent. Equivalency will require fabrication by utilizing the following machines and processes to provide the requisite quality of ducts and speed of supply.

ii. Coil lines to ensure location of longitudinal seams at comes/folded edges only to obtain the required duct rigidity and low leakage characteristics. No longitudinal seams permitted along any face side of the duct.

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

iv. All edges to be machine treated using lock formers, flanges and roller for fuming up edges.

v. Sealant dispensing equipment for applying built-in sealant in Pittsburgh lock where sealing of longitudinal joints are specified.

5.SELECTION OF G.I. GAUGE AND TRANSVERSE CONNECTORS

Duct Construction shall be in compliance with 1" (250 Pa) w.g. static norms as per SMACNA.

All transverse connectors shall be the Rolamate 4-bolt slip-on flange system or Techno Fabriduct imported makes of similar 4-bolt systems with built-in sealant if any to avoid any leakage additional sealant to be used.

The specific class of transverse connector and duct gauge for a given duct dimensions will be 1"(250 Pa) pressure class.

Non-toxic, AC-applications grade P.E. or PVC Casketing is required between all mating flanged joints. Gasket sizes should conform to flange manufacturer's specification.

6.DUCT CONSTRUCTION

The fabricated duct dimensions should be as per approved drawings and all connecting sections are dimensionally matched to avoid any gaps.

7.DIMENSIONAL TOLERANCES:

a. All fabricated dimensions will be within +/- 1.0 mm of specified dimension. To obtain required perpendicular, permissible diagonal tolerances shall be +/- 1.0 mm per meter.

b. Each and every duct pieces should be identified by color coded sticker which shows specific part numbers, job name, drawing number, duct sizes and gauge.

c. Ducts shall be straight and smooth on the inside Longitudinal seams shall be airtight and at comers only, which shall be either Pittsburgh or Snap Button Punch as per SMACNA practice, to ensure air tightness.

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

e. Plenums shall be shop/factory fabricated panel type and assembled at site.

f. Factory Fabricated ducts shall have the thickness of the sheet shall be as follows.

g. The gauges, joints and bracings for sheet metal duct work shall further conform to the provisions as shown on the drawings.

h. Ducts larger than 600 MM shall be cross broken, duct sections up to 1200 MM length may be used with bracing angles omitted.

i. Changes in section of ductwork shall be affected by tapering the ducts with as long a taper as possible. All branches shall be taken off at not more than 45 DEG. Angle from the axis of the main duct unless otherwise approved by the Engineer-In-Charge.

j. All ducts shall be supported from the ceiling/slab by means of M.S. Rods of 10 MM (3/8") DIA with M.S. Angle at the bottom. The rods shall be anchored to R.C. Slab using metallic expansion fasteners.

8.INSTALLATIONS

i. During the construction, the contractor shall temporarily close duct openings with sheet metal covers to prevent debris entering ducts and to maintain opening straight and square, as per direction of Engineer-In-Charge.

ii. Great care shall be taken to ensure that the duct work does not extend outside and beyond height limits as noted on the drawings.

iii. All duct work shall be of high quality approved galvanized sheet steel guaranteed not to crack or peel on bending or fabrication of ducts. All joints shall be air tight and shall be made in the direction of air flow.

iv. The ducts shall be re-inforced with structured members where necessary, and must be secured in place so as to avoid vibration of the duct on its support.

v. All air turns of 45 degrees or more shall include curved metal blades or vanes arranged so as to permit the air to make the abrupt turns without an appreciable turbulence. Turning vanes shall be securely fastened to prevent noise or vibration.

The duct work shall be varied in shape and position to fit actual conditions at building site. All changes shall be subjected to the approval of the Engineer-In-Charge. The contractor shall verify all measurements at site and shall notify the Engineer-In-Charge of any difficulty in carrying out his work before fabrication.

vi. Sponge rubber or approved equal gaskets of 6 MM maximum thickness shall be installed between duct flanges as well as between all connections of sheet metal ducts to walls, floor columns, heater casings and filter casings. Sheet metal connections shall be made to walls and floors by means of wooden member anchored to the building structure with anchor bolts and with the sheet screwed to them.

vii. Flanges bracings and supports are to be Rolamate or Techno Fabriduct. Accessories such as damper blades and access panels are to be of materials of appropriate thickness and the finish similar to the adjacent ducting, as specified.

viii. Joints, seams, sleeves, splitters, branches, takeoffs and supports are to be as per duct details as specified, or as decided by Engineer-In-Charge.

ix. Joints requiring bolting or riveting may be fixed by Hexagon nuts and bolts, stove bolts or buck bolts, rivets or closed centre top rivets or spot welding. Self-tapping screws must not be used. All jointing material must have a finish such as cadmium plating or Galvanized as appropriate.

x. Fire retarding flexible joints are to be fitted to the suction and delivery of all fans. The material is to be normally double heavy canvass or as directed by Engineer-In-Charge. On all circular spigots the flexible materials are to be screwed or clip band with adjustable screws or toggle fitting. For rectangular ducts the material is to be flanged and bolted with a backing flat or bolted to mating flange with backing flat.

xi. The flexible joints are to be not less than 75 MM and not more than 250 MM between faces.

xii. The duct work should be carried out in a manner and at such time as not to hinder or delay the work of the other agencies especially the boxing or false ceiling contractors.

xiii. Duct passing through brick or masonary, wooden frame work shall be provided within the opening. Crossing duct shall have heavy flanges, collars on each side of wooden frame to make the duct leak proof.

9.DOCUMENTATION TO MEASUREMENTS

For each drawing, all supply of ductwork must be accompanied by computer-generated detailed bill of material indicating all relevant duct sizes, dimensions and quantities. In addition, summary sheets are also to be provided showing duct areas by gauge and duct size range as applicable.

Measurement sheet covering each fabricated duct piece showing dimensions and external surface area along with summary of external surface area of duct gauge-wise.

All duct pieces to have a part number, which should correspond to the serial number, assigned to it in the measurement sheet. The above system will ensure speedy and proper site measurement, verification and approvals.

10.TESTING

After duct installation, a part of duct section (approximately 5% of total ductwork) may be selected at random and tested for leakage. The procedure for leak testing should be followed as per SMACNA-"HVAC Air Duct Leakage Test Manual: (First Edition).

A. Ducts

SCOPE

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

Insulation material shall be non-toxic, chemically inert, non-combustible, non-ignitable, shall have zero ozone depletion potential, zero calorific value no heat evolution and shall be inherently proof against rotting, mould and fungal growth and attack by vermin.

The materials shall comply with following standards.

BS 476: Part 4 – Non Combustible
BS 476: Part 5 – Not easily Ignitable (Class P)
BS 476: Part 6 – Fire propagation Index (I<12)
BS 476: Part 7 - Surface spread of flame (Class 1)

The material should comply to Class'O' fire rating as per BS 476 part 6&7.

The product shall be able to work effectively at ambient temperature range of -100ºC to 150 ºC

B. AHU / DUCT ACOUSTIC LINING (Insulation Thickness & Density as per BoQ)

Insulation material for Duct Acoustic Lining shall be open cell antimicrobial nitrile rubber with self-adhesive. The theral conductivity of the material for air-conditioning application shall not exceed 0.047 W/m.K at 20 deg C. Thickness of the material shall be as specified for individual application as per schedule of quantity.

Ducts so identified and marked on drawings and included in Schedule of Quantities shall be provided with acoustic lining of thermal insulation material for a distance of minimum 5 meters as follows:

The inside surface for the ducts shall be covered with nitrile rubber with self-adhesive, and provided with 22 gauge GI Channels 25 x 25 mm screwed back to back and fixed on the inside of duct, spaced not more than 60 cm center to form a frame work of 60 x 60 cms square. Cut panels 60 x 60 cms of resin bonded fiber glass shall be fitted in the squares.

SECTION H -8.0: PIPING / DUCT /EQUIPMENT INSULATION:

Material

- Insulation material shall be Closed Cell Elastomeric Nitrile Rubber.
- Density of Material shall be between 50+/-10% Kg/m^3
- Thermal conductivity of elastomeric nitrile rubber shall not exceed 0.035 $W/mP^{0P}K$ at an average temperature of $0P^{0P}C$.
- The insulation shall have fire performance such that it passes Class 1 as per BS476 Part 7 for surface spread of flame as per BS 476 and also pass Fire Propagation requirements as per BS476 Part 6 to meet the Class 'O' Fire category as per 1991 Building Regulations (England & Wales) and the Building Standards (Scotland) Regulations 1990.
- Water vapour permeability shall not exceed 0.017 Perm inch (2.48 x 10-14 Kg/m.s.Pa), i.e. Moisture Diffusion Resistance Factor or 'μ' value should be minimum 7000.
- Complete pipe insulation shall have 200 g/m^2 factory laminated, treated woven Glass Cloth coating for mechanical and UV protection.

Thickness of the insulation shall be as specified for the individual application.

Pipe Insulation

All chilled water, refrigerant and condensate drain pipes shall be insulated in the manner specified herein. An air gap of 25 mm shall be present between adjacent insulation surfaces carrying chilled water or refrigerant. Before applying insulation, all pipes shall be brushed and cleaned. All Pipe surfaces shall be free from dirt, dust, mortar, grease, oil, etc. Nitrile Rubber insulation shall be applied as follows:

- Insulating material in tube form shall be sleeved on the pipes.
- On existing piping, pre slit, self-adhesive tube with factory laminated woven glass cloth coating shall be placed. Remove the release paper and make a seam joint. Cover the joint with integral glass cloth flap. Butt joints shall be sealed with adhesive and shall be covered with same glass cloth (slit opened tube of the insulating material (slit with a very sharp knife in a straight line) shall be placed over the pipe, and adhesive shall be applied as suggested by the manufacturer.
- Adhesive must be allowed to tack dry and then press surface firmly together, starting from butt ends and working towards centre.
- Wherever flat sheets shall be used, Factory cut sheets shall be used (it shall be cut out in correct dimension.) All longitudinal and transverse joints shall be sealed as per manufacturer recommendations.
- The insulation shall be continuous over the entire run of piping, fittings and valves.
- All valves, fittings, joints, strainers, etc. in chilled water piping shall be insulated to the same thickness as specified for the main run of piping and application shall be same as above. Valves bonnet, yokes and spindles shall be insulated in such a manner as not to cause damage to insulation when the valve is used or serviced.

The detailed application specifications are as mentioned separately. The manufacturer's trained installer should only be used for installation.

Recommended Adhesive

In all cases, the manufacturer's recommended Adhesive (SR-998) should be used for the specified purpose.

Pump Insulation

Chilled water pump shall be insulated to the same thickness as the pipe to which they are connected and application shall be same as above. Care shall be taken to apply insulation in a manner as to allow the dismantling of pumps without damaging the insulation.

Shell Insulation

The chiller shells shall be factory insulated in accordance with the manufacturer's standards.

Cold Water & Expansion Tank Insulation

Cold water tank, and chilled water expansion tank shall be insulated as per manufacturer's standard.

Parameters for Selection of Thickness

a) Design Basis: Condensation Control
b) Region: CoAstal Area
c) Application: Outdoor & Indoor
d) Design Conditions: 30 Deg. C & 82 % RH

i) Thickness of Insulation

a) Chilled Water Pipe Line Temperature 7.0 Deg. C

Indoor Application (Conditioned / Semi-Conditioned Space)

Up To 50 mm Pipe Size - 25 mm Thick Insulation

Above 50 mm & Up To 150 mm Pipe Size - 32 mm Thick Insulation

Above 150 mm Pipe Size - 38 mm Thick Insulation

Chilled Water Tank - 32 mm Thick Insulation

Outdoor Application / Non-Conditioned Space

Up To 50 mm Pipe Size - 32 mm Thick Insulation

Above 50 mm & Up To 150 mm Pipe Size - 38 mm Thick Insulation

Above 150 mm & Up To 600 mm Pipe Size - 44 mm Thick Insulation

Chilled Water Tank - 44 mm Thick Insulation

ii) Drain Water Pipe Line Temperature 15.0 Deg. C

Up To 50 mm Pipe Size - 19 mm Thick Insulation

iii) Refrigerant Pipe Line Temperature 3.0 Deg. C

Up To 50 mm Pipe Size - 25 mm Thick Insulation

Above 50 mm & Up To 100 mm Pipe Size - 32 mm Thick Insulation

D) DUCT INSULATION:

1.PRE-INSULATED DUCT WORK: PRE-INSULATED ALUMINIUM POLYISOCYANURATE / POLYURETHANE FOAM DUCTWORK

Thickness of Panels	**Air Conditioned Areas**		**Plant Rooms**		**Exposed To Weather**	
	20mm		**30mm**		**30mm**	
Thickness of aluminium	80/80	Microns	80/200	Microns	80/200	Microns
Density of the foam	45	Kg/m3	48	Kg/m3	48	Kg/m3
Finishing of aluminium	Embossed	Embossed	Embossed	Embossed	Embossed	Embossed

The following preferred ductwork system to be installed:
Pre-insulated aluminium ductwork made of Polyisocyanurate sandwich panels, comprising an expanded Polyisocyanurate rigid foam board faced on both sides by aluminium foil.
Physical characteristics of the panels shall be as follows:
Both sides of the aluminium foils shall be lacquered with a 3g/m2 weatherproof and ultraviolet rays protection polyester lacquer.
All the panels shall have to be embossed with the name of the manufacturer and production date.
Thermal insulation characteristics shall be as follows:
Insulating material: Close cell rigid expanded polyurethane foam, CFC free, density 45 to 48 Kg/m3, material physiologically and chemically inert and insoluble, vermin proof,fungus proof, non metabolisable.
Thermal conductivity: 0.022 W/mK or better.
Water absorption shall be less than 0.5% by 24 hours immersion test.
Water vapour diffusion: M= infinity resistance.
The aluminium foil covering the panel to be maintained intact after installation to ensure vapour barrier continuity.
Proposed material should have minimum 5 years installation reference in the region.
The panel manufacturer should be of European/Foreign origin.
All the panels to be used should be labelled by authorised international fire laboratories.
The panel manufacturer shall comply with Fire Mideast Product Listing (MPL) and Factory Production Control Certificate (FPC), by authorised international laboratories.
The panel shall be tested and comply with the following standards:

a. NFPA 101 Life Safety Code Class 'A'
b. ASTM E84 Class "1"
c. NFPA 255
d. UL 723
e. Toxicity Index shall not exceed 5.7 according to NES 713
f. Class 'O' according to BS 476 Part 6 & 7

Temperature Range:
No relevant reduction of insulation, chemical or physical characteristics of the panels to be measurable, when conveying air in the temperature range of –35oC to +110oC.
Installation shall be supervised & certified by the manufacturer's representative.
5-years warranty shall be offered for the insulation material characteristics.
Joint System:
The joints between the ducts shall be using tiger connectors or male – female connection system for small sizes up to 500mm and for bigger sizes more than 500mm aluminium /polymer invisible flanges and slide-in-channel to be used and to be connected by special cover corners, having a holding pin, which goes inside the flange and the insulation, to avoid any field connection and to give the system more strength.
Ductwork shall be installed, using supports, as described in DW144 & according to manufacturer's requirements. Maximum distance between supports shall not exceed:

- 4000mm for ducts with section not exceeding 1200 x 1000mm
- 2000mm for ducts with section exceeding 1200 x 1000mm.

SECTION H-9.0: PIPING AND FITTINGS

1. SCOPE

The scope of this section comprises the supply and laying of pipes required for chilled water; condenser water & drain water conforming to these specifications and in accordance with the requirement of the 'Technical Schedule of Equipments' and 'Schedule of Quantities'

2. WATER PIPING

i. MATERIAL

Water piping fittings and valves shall be of the following makes or approved equal make and shall conform to IS standards as indicated below.

a. Pipes

i. UPTO150MM: MS, Class C (Heavy Class) as per IS 1239 (Part I & II) 1990/1992

ii. 200MM & ABOVE: Welded Black Steel Pipe Class 2 (6.35 MM Thickness). As per IS 3589 (LATEST)

All welding shall be done by qualified welders and shall strictly conform to Standard Code of practice for manual metal arc, welding of Mild Steel.

First butt weld of each welder shall be fully radio graphed by HVAC contractor under guidance of MES for testing purposes. Upon approval of welding joints, the concerned welder shall be allowed to carry further welding of pipes. Rest of the welds shall have 100% visual inspection.

All welded joints (except pipe welded end-to-end) shall be made by use of forged one-piece welding flanges, caps, nozzles, elbows, branch outlets and tees of approved make. Cut samples shall be submitted for approval, if directed. All such fittings etc., shall be of a type which maintain full wall-thickness at all points, simple radius and fillets, and proper bevels or shoulders at ends. All jobs welding shall be done by the electric arc welding process in accordance with the following: -

All joints shall have 45-degree bevel type, pipe mill-beveled or machine-beveled by the contractor.

All scale and oxides shall be removed with hammer, chisel or file and bevel left smooth and clean.

Pipe lengths shall line up straight with abutting pipe ends concentric.

Both conductors from the welding machine shall be extended to locations at which welding work is being done. The leads from welding machine to location of welding work shall be held together with tape or other approved means as to prevent induced current in structural steel, in piping or in other metals within the building. The ground lead shall be connected to length of pipe through joints in pipe, structural steel of building or steel pipe supports.

b. GATE & GLOBE VALVES

Make: As approved shall be heavy duty non rising spindles as per IS 780, 778 and flanges as per is 1536 and factory tested for 10Kg/ sq. cm test pressure

S. No	Size	Construction	Ends
A	15 TO 40 MM	Gun metal body	Screwed
B	50 MM and above	Cast Iron Body & spindle valve, seat wedge etc., of Brass or Gun Metal	Flanged

c. BALANCING VALVES

The balancing valves control and shut off valves with built in pressure drop and flow measuring facility shall be provided in the water outlet pipes of condensers and chillers, AHUs or wherever shown in tender drawings.

i. 15-50 mm Size: Gunmetal ASTM B-6 2 Screwed ends conforming to BS 5154

ii. 65mm and above: Cast iron, flanged ends with stainless steel trim.

The valves shall have PTFE/SS disc with special erosion/corrosion proof sealing. The valves shall have temper proof adjustable and lockage arrangement for required water quantity after commissioning. The valves shall be complete with pressure test cock and drain cocks.

To enable accurate and practical operation, measurement of flow and differential pressure shall be made with a computerized balancing instrument which shall enable the operator to read the flow directly

without the use of diagrams or tables. In addition to measuring flow rate, differential pressure and temperature, computerized balancing instrument shall have a computer programs to provide the following functions:

To balance the HVAC installation and calculate the necessary valve settings, based on system measurements.

To store the results of balancing.

To log measured values from a valve (differential pressure, flow rate or temperature)

To printout saved data in computerized measurement protocol (CMP) consisting of:

- Name and size of Balancing Valve (BV)
- Presetting position of BV
- AP at BV
- Flow at BV
- Design Flow

Flanges shall be of approved make. The supply of flanges shall form part of piping (not separately identified in Schedule of Quantities) and shall also include supply of bolts, washers, nuts and suitable rubber insertion gaskets (minimum 3 mm thick).

d. BUTTERFLY VALVES

Body: Cast Iron

Seat: Resilient lining mounded black nitrile rubber

Disc: SG Iron conforming to IS: 1865 SG 400/12 & BS 2789 GR 420/12 Nylon Coated

The handle shall have arrangement for locking in any position. Valve shall be suitable for 16 Kg/Cm2 working pressure.

e. BALL VALVES

All ball valves and ball valves with Y strainer shall be bronze forged body construction with chrome plated bronze ball and handle of stainless steel constructions. These are separately identified in Schedule of Quantities.

f. NON RETURN VALVES

Non return valves shall be dual plate check valve provided as shown on the Drawings, and identified in Schedule of Quantities conforming to relevant Codes and in accordance with the following Specifications

Size	Construction	Ends
50 to 150 mm	Body cast iron, gun metal plate	Flanged
200 to 450 mm	Body cast iron, plate carbon steel with 13% chrome overlay	Flanged

The spring and hinge/stop pin shall be SS304 and bearing PTFE material. Valves shall be suitable for not less than 10 Kg per sq. cm. gage working pressure.

g. STRAINERS

i. Strainers shall be 'Y' type or Pot Type Strainers as shown on drawings and included in BOQ. 'Y' Strainer shall be fabricated out of MS 'C' class pipe two sizes higher than that of Strainer pipe size. Flanges as per B.S. 10 shall be provided at inlet and outlet connectors. The body shall be pressure tested at 10 kg/cm2 and shall be hot dip galvanized. Permanent magnet shall be provided in the body of the Strainer to arrest MS particles. Filter element shall be of non-magnetic 20 gauge SS sheet with 3 mm perforation. Strainers shall be provided at in let of each Air Handling Unit and Pump as shown in drawings and included in BOQ.

Pot Strainers body shall be fabricated out of MS plate IS 226. Thickness of sheet shall be as per size of the strainer chamfered pipes with flanges shall be provided at inlet / outlet connections of the strainer. The tangential entry of water shall create a centrifugal action and due to velocity shall separate sediments and deposit on the inner surface of Filter Element and at bottom of the Strainer. Butterfly valves shall be provided at inlet/outlet connections as shown in drawing and included in BOQ. The strainer body shall have two separate chambers properly sealed to avoid mixing of filtered and unfiltered water. A powerful magnet shall be provided in the body to arrest MS particles. Filter element of Pot Strainer shall be of non-magnetic 18 gauge SS sheet properly reinforced to avoid damage of the element. A cone with sufficiently to flush out foreign particles. This arrangement shall avoid frequent opening of Pot Strainer for cleaning of filter element. Gage connection shall be provided at inlet and outlet connection. A set of MS flanges with tongue

and groove arrangement and neoprene rubber gasket shall be provided on the top cover and Pot Strainer flange with sufficient bolts and nuts to make the joint watertight. Bearing loaded top cover lifting and swinging arrangement shall be provided. The Pot strainer body shall be properly de-rusted and epoxy coated from inside and outside. Manufacturers Test Certificate shall be provided with each Pot Strainer.

Size of various Pot Strainer, Filter Element and Thickness of MS sheet shall be as detailed below:-

Size (mm)	Pot Dia. (mm)	Pot HT (mm)	Element Dia. (mm)	Element HT (mm)	MS Plate Thickness (mm)
50	300	400	200	240	6
80	350	450	250	250	6
100	450	500	300	280	6
125	500	600	330	340	8
150	540	700	360	390	8
200	610	815	400	470	8
250	800	955	550	510	8
300	1000	1105	750	580	8
350	1190	1300	895	678	12
400	1350	1500	1020	785	12
450	1518	1700	1060	890	12
500	1690	1800	1100	900	12
600	2000	2200	1500	1160	12

The Y-Strainer & Pot Strainer conforming to SSPL 107 & SSPL 106 shall have cast iron body and factory tested at works at 16 Kg/sq.cm pressure. The screen shall be made out of 3 mm perforated stainless steel sheet. It should be easily removable when required to be cleaned. Isolating butterfly valves at either end of the pot strainer shall be provided.

Each pot strainer shall be provided with a Test Certificate.

ii. All chilled water piping and fittings shall be pressure tested, painted and then insulated as described under the section "Insulation".

h. AUTO AIR VENT VALVES

i. Air vent valves shall be provided at all higher points in the piping system for venting and of the following sizes:

Up to 100 mm dia pipes: 25 mm dia.

ii. Air vent valves shall be Gun metal and tested up to pressure of Class I pressure rating.

i. FITTINGS

The dimensions of the fittings shall conform to IS 1239/69 Part II (as per latest amendment) unless otherwise specified in the specification.

All bends in sizes up to and including 150 mm dia shall be readymade of heavy-duty, wrought steel of appropriate class.

All fittings, such as branches, reducers, etc. in all sizes shall be fabricated from pipes of same dia and thickness and length at least twice the diameter of pipe.

The branches may be welded straight to main line.

Blank ends are to be formed with flanged joints and 1 mm thick blank insertion of rubber gasket between flange pair for 150 mm and over in case where a future extension is to be made otherwise blank end discs of 6 mm thickness are to be welded on with additional cross stiffeners.

The tender drawings show schematically the size and location of pipes but this is for contractor's guidance only. Pipe runs may be changed to meet the site conditions.

3. PIPING INSTALLATION

a. All piping work shall be carried out in workman like manner causing minimum disturbance to the existing services.

b. Piping shall be of steel, primer coated with rust preventive paint and finished with approved shade. Pipe supports shall not exceed the following spacing: -

MAXIMUM SPACING OF PIPE SUPPORTS

Pipe Size (MM)	Spacing (Mtr)	Rod Size
25	2	10 mm
30 to 75	2.5	10 mm
100 and above	3.0	12.5 mm

Pipe hangers shall be fixed on walls and ceiling by means of metallic Raw bolts or approved shear fasteners.

c. Piping shall be properly supported on, or suspended from, stands, clamps, and hangers as specified and as required. The contractor shall adequately design all the brackets, saddle, anchors, clamps and hangers and be responsible for their structural sufficiency.

d. Vertical risers shall be parallel to walls and columns. Risers passing from floor to floor shall be supported at each floor by clamps or collars attached to pipe and with a 10 mm thick rubber pad or any resilient material. Where pipes pass through the terrace floor, suitable flashing shall be provided to prevent water leakage. Risers shall also have a duck foot elbow or steel support welded to the pipe at the lowest point. On risers drain valves shall be provided at heels.

e. Pipe sleeve of 50 mm larger than the pipe diameter shall be provided wherever pipes pass through walls and the annular space filled with felt and finished with retaining rings. In case of an insulated pipe the diameter shall be inclusive of insulation.

f. Insulated piping shall be supported in such a manner as not to put undue pressure on the insulation. Metal sheet shall be provided between the insulation and clamp, saddle or roller extending at least 150 mm on both sides of clamp, saddle or roller.

i. PRESSURE GAUGES AND THERMOMETERS

a. One pressure gauge each shall be provided to measure pressure at the inlet and outlet of each cooling coil, shall be not less than 100 mm Dia and shall be complete with shut off (globe) valve. Care shall be taken to protect pressure gauge during pressure testing, range shall not exceed 50% above normal measurement.

b. Thermometer shall be stem type and shall be provided at inlet and outlet of each cooling coil.

4. TESTING

a. All water piping shall be tested to hydrostatic test pressure of at least one and a half times the maximum operating pressure but not less than 10 kg/sq cm for a period of not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified to the satisfaction of the MES

b. Pipes repaired subsequent to above pressure shall be retested in same manner.

c. Piping may be tested in section and such sections shall be securely capped.

d. The Contractor shall ensure that proper noiseless circulation of fluid is achieved through all coils and other heat exchange equipments in the system concerned. If proper circulation is not achieved due to air bound connections, the 'Contractor' shall rectify the defective connections. He shall bear all the expenses for carrying out above rectifications involving tearing up and refinishing of floor walls, etc. as required.

e. The Contractor shall give sufficient notice to all other agencies at site, of his intention to test a section or sections of piping and all testing shall be witnessed and recorded by the Engineer in- charge at site.

f. The contractor shall provide temporary pipe connections to initially by-pass condenser/chiller and circulate water through condenser / chilled water pipe lines for minimum 8 hours. Water should be drained out from the lowest point. The temporary lines shall be removed and blanked with dead flanges. Pot strainers and Y strainers shall be cleaned and fresh water filled in the circuits.

g. After the piping has been installed, tested and run for at least three days of eight hours each, all un-insulated exposed piping in plant room shall be given two finish coats, 3 mills each of approved colour, conforming to relevant BIS Codes. The direction of flow of fluid in the pipes shall be visibly marked with identifying arrows. For painting of insulated and clad pipes refer to insulation section.

h. After testing, all systems shall be chemically cleaned. After cleaning, the pipe work should be rinsed multiples times until the system is neutral. The contractor shall make a report conforming the above to Engineer in charge for records.

i. The Contractor shall provide all materials tools equipment, services and labour required to perform the test and to remove water resulting from cleaning and testing.

5. BALANCING

a. After completion of the installation, all water systems shall be adjusted and balanced to deliver water quantities as specified.

b. Instruments required for the water balancing (computerized balancing instrument) shall be accurately calibrated in an approved manner before taking any measurements. Calibrated orifices and portable flow meters shall be used to balance the water flow. Orifices used for testing and balancing shall be installed with straight length up stream and downstream as recommended by the manufactures and shall be left permanently installed in the system.

c. Automatic control valve and three way valves shall be set for full flow conditions during balance by procedure. Water circuit shall be adjustable by balancing cocks provided for balancing. These shall be permanently marked after balancing is completed so that they can be restored to their correct positions of disturbed.

6. PAINTING

In case of pipes to be insulated after thorough anti grease and rust removal treatment, clean the pipe and then apply two coats of epoxy primer before applying in insulation treatment as specified elsewhere. All uninsulated pipes after de rusting will be provided with two coats of epoxy primer followed by epoxy paint of approved shade.

i. FIRE BREAKS INSULATION

Firebreaks shall be provided in all ducts for internal lining/external thermal insulation after a run of 10 m center to center. There shall be a discontinuity of the insulating material in the form of MS angle of a minimum of 50 mm x 50 mm x 3 mm size. At the interface of the MS angle and insulating material, proper care of tucking in of the insulating material shall be taken so as to prevent erosion.

SECTION H-10.0: VACUUM DEGASSER, AIR & DIRT SEPARATOR & DIRT SEPARATOR

1. Vacuum Degasser

The vacuum degasser shall be of a solid and a robust construction. The Vacuum degasser shall work on the Principle of pressure differential deration. Vacuum degasser shall be installed in a bypass line to CHW header. It shall be able to degas a minimum of 1CMH of water at system working pressure.
The degasser shall be capable of refilling the CHW pipeline with degassed water to compensate the volume of vented gases, unit shall be selected as per system's highest working pressure with following features

- Fully automated degassing and water make-up
- The Degasser shall be able to switch itself off when the pipeline achieves desired Pressure & degassed levels of water.
- Works on pressure differential deaeration principle
- Built in flow meter to measure degassed and make-up water volumes
- Microprocessor based control panel
- BMS compatible
- All Components, i.e. pump, vacuum tube, valves, interconnecting piping and control panel mounted on a compact steel frame, It should be with a Multi-stage Centrifugal pump

The Degasser shall be of Plug & play type & shall be of automatic operation. Vacuum degasser shall consist of

- Vacuum tube with high capacity automatic airvent with an ingress preventer.
- Multistage centrifugal pump.
- Make-up water and system inlet water connections with motorised valves.
- Water outlet connection with motorised valve to enable degasser operation even at low system pressure.
- (Manual preset flow control valves at inlet and outlet are not acceptable.)
- Pressure transmitter to regulate pressure / vacuum in the vacuum tube
- Built in flow meter to measure degassed and make-up water volumes.
- Microprocessor based, BMS compatible, control panel with IP54 protection.
- All Components, i.e. pump, vacuum tube, valves, interconnecting piping and control panel mounted on a compact steel frame.

2. **Dirt Separator**

The Dirt separator shall be of a solid and robust construction (Mild Steel). It shall be able to remove solid particles upto 5 microns from water at Velocity between 2-3m/s. All connections, fittings and heads shall be of carbon steel. The medium used to de-aerate and remove dirt shall be manufactured of Steel Tube & a mesh made of copper wire. This medium should be non-clogging in nature. The flow should not be obstructed by the dirt collected. A Drain valve should be present at the bottom to remove the accumulated dirt without the need of shutting down the operation of the system. The Dirt Separator shall be insulated depending upon its location (outdoor or indoor). The pressure drop on account of the dirt separator shall not exceed 21 kPa at maximum flow of the chilled water system.

3. **Microbubble Air & Dirt Separator**

The Air and Dirt separator shall be of a solid and robust construction (Mild Steel). It shall be able to remove free air and microbubbles as well as remove solid particles upto 5 microns from water at Velocity between 2-3m/s. Removal of Air & dirt shall be through coalescence. The unit shall be able to condition the water to make it highly absorptive at all points in the system. This ensures that microbubbles can no longer exist at any point in the system. All connections, fittings and heads shall be of carbon steel. The medium

used to de-aerate and remove dirt shall be manufactured of Steel Tube & a mesh made of copper wire. This medium should be non-clogging in nature. An automatic air vent of at least 100mm free area to be connected at the top for the release of the air separated from the water. The flow should not be obstructed by the dirt collected. A Drain valve should be present at the bottom to remove the accumulated dirt without the need of shutting down the operation of the system. The Air & Dirt Separator shall be insulated depending upon its location (outdoor or indoor). The pressure drop on account of the air and dirt separator shall not exceed 21 kPa at maximum flow of the chilled water system.

4. Condenser Water conditioning equipment

- Equipment to increase condenser circuit efficiency

Water conditioning equipment shall be non-intrusive type which can be mounted on the periphery of the common condenser header and should help in Dissolves and removes existing lime-scale, prevent new lime-scale accumulation, enhances filtration efficiency, treats bacteria and algae & Inhibits corrosion

The water conditioning equipment shall induce a decaying sine oscillation of ±150 kHz into the water system, essentially making the water in the pipe a part of an electric circuit. The process with charge Hard water which draws the bicarbonate negative (-) ions and calcium positive (+) ions together. The ions should form a microscopic cluster within micro-seconds. The cluster should be stable as long as the signal is present and shall be removed from the system at cooling tower level.

The signal should have the capability to travel at least 2,000 rmt pipeline.

The signal should be capable to travel in the pipe of any material of constructionie. PVC, MS, SS.

It should help to maintain the following parameters under control:

1. Condenser approach should be maintained less than 5Deg F and monitored which will help in direct savings in power at chiller.

2. Stop use of anti-scalant, softener, chemicals etc. Biocide level should be reduced by 75% of the standard to take care of areas where the water has low or no flow

3. This equipment shall remove legionella, e-coli, Klebsiella, pseudomonas.

The equipment should be with CE Marking & ISO Certification

List of approved makes:

Condenser Water conditioning equipment Hydropath/ Merus/ Evapco

SECTION H-11.0: PRESSURISED EXPANSION TANK WITH PRESSURIZATION UNIT

Scope of Work
This section deals with supply, erection, testing and commissioning of pressurized expansion tank for chilled water conforming to general specification and suitable for the duty selected as indicated in BOQ.

Pressurized Expansion Tank with Pressurization Unit

Closed Expansion Tank
The closed expansion tank will be of M.S. construction with interchangeable EPDM-BUTYL rubber membrane. The expansion tank shall be complete with safety relief valve, pressure reducing valve and pressure gauge. The tank will be of pressure rating to suit the system pressure and will be sized to adequately compensate for water expansion due to operating temperature variations. The tank shall be fabricated as per IS 2825-1969 for "non-fired pressure vessels" and the flanges shall be as per IS 6392-1971. For chilled water application, it will be insulated with 50mm thick insulation to the specifications and cladded with 26G-aluminium cladding. The expansion tank shall be supplied along with pressurization unit.

Pressurization Unit
Pressurization unit shall be with 2 nos. (1 working + 1 stand by) horizontal/vertical multi-stage pumps of suitable rating & capacity, as indicated hereunder, factory mounted on a steel frame along with interconnected piping, valves, strainer, pressure gauge, pressure transmitter, flow meter to measure the make-up water quantity, control panel with duty cycling and dry-run protection, electrical relays/contactors and interconnecting wiring:
Protection - IP55
Insulation class - F
Liquid temperature range - 0°C - 50°C
The unit shall be capable of Pressurising the system to the required pressure with suction from a break-tank located at least 1m above pump level. The control unit shall be housed in a metal box, IP 54 protection with BMS compatibility via an RS485 cable interface.

Centrifugal Air Separator: It will be of M.S construction with preferably suitable for grooved connection. The Air separator will be of pressure rating to suit the system pressure & will be sized (as specified in BOQ) to achieve maximum air separation.
The Air Separator will be complete with Automatic Air vent at the top & drain valve in the centre of the bottom. The Air separator will be insulated.

Unless mentioned otherwise, an expansion tank of PVC double layered contain twice the maximum expansion likely to place in the system, shall be provided. The bottom of the tank shall be at least 600mm above the highest point of the system. Tank shall be insulated, if required and be complete with float valve, gauge glass, drain, overflow and make up connections, with gate valves and vent piping as required.

SECTION H-12.0: MOTOR STARTERS CONTROL PANELS

1. **General:**

The motors and switchgears required for various items shall generally be as per specifications given below. All electric motors shall be suitable for 3 phase, 50 cycles 415 volts a.c. supply.

2. **Control Panel:**

2.1 These panels should be floor/wall mounted, sheet steel clad, modular construction, cubicle design, compartmentalised. These panels shall comprise incoming & outgoing feeders (circuit breakers, fuse switch units/switch fuse units, contactor starters with overload relays, single phasing preventer, etc. as indicated in the drawings.

2.2 The panels shall be provided wherever necessary with necessary interlocks designed to prevent incorrect operation and to ensure safety of operating personnel and equipment.

2.3 All feeders are to be operated from the front, and they shall be interlocked suitably. Padlocking arrangement and interlock defeating device shall also be provided. Each module shall have a separate door and partition plate. The feeder incomer switches shall be interlocking with the door so that the door can only by opened when the switch is in `off' position. The doors and covers shall be provided with thick gaskets to make it dust tight. All the door covers shall be provided with synthetic rubber gaskets to make it dust tight. Feeder name tags shall be provided.

2.4 **Air Circuit Breaker and Fuse Switch Units**

The circuit breaker shall be an air break fully draw-out type equipped with arc chutes and their face barriers of proper design. The continuous current rating of the circuit breakers shall be as given in the detailed technical specifications. The circuit breakers shall have a breaking capacity of 31 mva at 415 volts, 50 hz ac & they shall be able to withstand full fault current for one second.

2.5 The circuit breaker shall be provided with a manually operated spring closing mechanism. The operating mechanism shall be trip-free throughout the breaker travel. The breaker shall be equipped with inside `on' & `off' position indicator mechanism and so located that the position of the circuit breaker i.e. whether closed or open, is indicated on the front door of the compartment. The `on' & `off' trip indicating lights shall also be provided for each breaker feeder.

2.6 The moving portion of the circuit breaker shall be so interlocked that it is not possible to isolate it and draw out from the service position or to plug it in from the isolated position when the circuit breaker is closed. The interlock being provided shall be such as to prevent operation of a circuit breaker unless it is fully plugged in or fully isolated and is locked correctly in either of the two positions.

2.7 The circuit breaker compartment doors shall be so interlocked as to prevent access to the breaker while in the plugged-in position. However, special means shall be provided for undoing this interlocked in an emergency.

2.8 The draw-out feature shall clearly provided three distinct positions of the circuit breaker, viz., `service', `test' & isolated. Inadvertent withdrawal of a circuit breaker removable unit too for beyond its supports shall be prevented by a suitably interlock, the design shall provide for the testing of the breaker in the test positions i.e. when the breaker's moving unit is in fully disconnected position and the secondary circuit remains connected or energised. The secondary connections between the fixed and removable units shall be provided with means of spring loaded sliding type contacts to make the breaker fully draw out type.

2.9 The circuit breaker unit shall be provided with a complete range of releases including the overload releases and release for short circuit protection.

2.10 The circuit breaker shall be provided with necessary auxiliary contacts with 2 No. spare contacts. All contacts shall be wires upto the terminal board.

2.11 The fuse switch unit shall be of load break heavy duty, industrial design and of double break pattern with quick make and quick break mechanism, however, the design shall be such that it shall ensure positive opening even if quick break action is lost due to spring stretchening or breaking.

2.12 The `on' and `off' position of the switch handle shall be distinctly indicated and inter locks shall be provided to ensure that switch cover cannot be opened unless the switch is in the `off' position.

2.13 The fuse switch units shall be provided with non-deteriorating type of hrc cartride fuse link and having rupturing capacity not less than 31 mva at 415 volts.

2.14 All alive parts inside switch shall be properly shrouded and interphase barriers shall be provided. Design of the switch handles shall be such that they do not protrude out of the panel in the manner so as to prevent free passage of operating personnel. Design with normal conventional position of switch handle up in `on' position & down in `off' position shall be preferred.

2.15 **415 Volts Bus Bars**

2.15.1 The 415 volts main bus-bar shall have a continuous current rating as indicated in the specification or equivalent standard rating of at least 50 percent of that of the phase bus bars. The bar and its connections shall be so arranged and supported as to withstand without any damage or deformation the specific short circuit current. The bus bars shall be braced and supported on reinforced fibre glass support and shall be of electrolytic grade type E 91e of is:5082. These bus bars shall withstand 43.12 ka for one second during short circuit conditions. The bus bars shall be colour coded with pvc tapes or insulating painting for identification purposes. The bus bars shall be sleeved with special type heat shrinkable pvc sleeving.

2.15.2 Bus supports shall be resistant low absorption type moulded insulation of high impact strength and high creep age surface.

2.15.3 All bus work shall be braced to withstand without damage a short circuit current of 43.12 ka symmetrical for one second.

2.16 **Instruments and Meters**

2.16.1 Current transformer shall comply with the requirements of IS:2705. They shall have ratio outputs and accuracies as specified or required, as shown in single line diagram.

2.16.2 All indicating instruments shall be of industrial pattern and should be provided as shown in the single line diagram.

2.16.3 All instruments shall be switchboard-type flush mounted with proper scale dimensions so as to be clearly visible to the operators standing on the floor. The instruments shall be provided with front of board zero adjuster shall be not preferably be mounted at heights lower than one meter and higher than two meters above the floor level.

2.16.4 The operating handles, meters, instruments etc. shall be mounted at the front of the switchboard. Approved means shall be provided for locking the control switch/operating handles in the open position. For fuse switch gear section of the switch board, meters where specifications shall be mounted in such a manner that it is possible to readily identify the meters for individual units and the arrangements do not create hindrance to maintenance of individual units without having to shut down the bus.

2.16.5 All wires carried within the switch gear enclosure shall be pvc insulated and shall be neatly arranged to be readily accessible and to facilitate easy replacement. Only pvc copper cables shall be used for all power and control interconnections. The cables of 660 volts shall be used. Trained copper cables lugs shall be used. All small wires shall be colour coded and provided with numbered ferrules for easy identification of circuits. As for as possible, each essential circuit shall be connected within the respective switch gear unit. Control wiring terminal shall preferably be near the panel.

3. **Cable Termination:**

3.1 The cables entries and terminals shall be provided in the switchboard to suit the number, type and size of aluminium conductor cables as given in the line diagram. Cable entries shall be so designed as to avoid damage to cables and there shall be sufficient space to avoid short bending of cables. The positions of the cable lugs and terminals shall be such that the cable could be neatly drawn and connected through one-meter deep trench below the switch gear and the jointing carried out in a convenient and satisfactory manner. The cable entry, design panel, cable boxes and terminals and their locations will have to be approved by the engineer/owner. However, the access for cabling shall preferably be from the back of the switch board. The panels shall be provided with control transformers of suitable va rating along with control bus and hr fuses from control supply to contractors.

3.2 The cables socket shall be of copper and of crimping type. Cables risers shall be adequately supported to withstand the effects of rated short circuit current without damage.

3.3 Cable glands of sizes as required shall be provided at all cable entry paints in the bottom plate. The glands shall form part of switch board.

4. **Indication:**

Each incoming and outgoing feeder units shall be provided with `on' `off' indicating lamps of standard conventional colour coding.

5. **Subsidiary Panels:**

Subsidiary panels shall be provided wherever required such as ahu room, air washer room. The construction of these panels should be similar to the main panel and shall have all related accessories.

6. **Contactor Starters:**

6.1 **Star Delta Starter**

The star delta starter shall be air break automatic contactor starter provided with main contractor, star contactor, delta contactor, timer and automatic change over from start to delta, bimetallic over load relay,

operating coil, start/stop push button, single phasing preventer, auxiliary make and break contacts, indicating lamps etc. The contactor shall quick make, quick break, and double break consisting of robust silver contacts. The coil voltage shall be 415 volts ac at 50 hz. The starter shall be provided with trip indication light and an overload reset push button for overload relay.

6.2 **DOL Contactor Starter**

The contactor shall be air break type coil operated, DOL contractor starter, provided with cable entries, ambient temperature compensated bimetallic overload relay, single phasing preventer, solenoid coil, start and stop push buttons, 8 auxiliary make and break contacts, indicating lamps, etc. The contactors shall be quick make quick-make and quick-break, double-break type, consisting of robust silver contacts. The coil voltage shall be 440 volts at 50 c/s. The starter shall be provided with a trip indication light and overload reset bush button for the overload relay.

7. **Squirrel Cage Induction Motors:**

7.1 The motor shall be of well tried out and design and of reputed make. The motors provided on the equipment shall conform to IS:325 in general. The motors shall be squirrel cage induction motors rated for operation at 415 volts, 3 phase, 50 hz a.c. supply. The motor for various equipment shall have the following enclosure level.

(a) Cooling tower & exhaust blower - IP:55 (tefc)
(b) Compressor and A.H.U. motor-IP:55 (tefc).
(c) Pumps IP:55(/tefc/spdp).

7.2 The horsepower and speed of the motor shall match that of driven equipment and the motor shall be suitable for star delta starting or direct on line starting with class `3' insulation. The motors of 7.5 HP and above 7.5 HP shall be suitable for star delta starting, and below 7.5 HP suitable for DOL starting. The compressor motor shall be provided with an automatic star-delta starter

The console shall contain on/off push buttons and indication lamps for all the items as per the BOQ. Indicating light for strip heaters, if any, shall be provided on the switchboard, in the respective unit room.

The requirements given for the main panel are for one unit only. The actual number of switches and lights shall correspond to the number of units being installed. All controls and alarms shall be suitable for 230 volts on the panel.

The alarms shall be with reset buttons.

All control circuits shall be functionally tested.

The red indicating lamps should switch on only in case of a fault. Thus, the red light should come on in case of tripping of the starter on overload or single phasing.

A common alarm shall be connected to all red indicating lamps through individual relays.

Lamp testing arrangements shall be provided in the console.

All the air conditioning equipment shall be interlocked in sequence for safe and trouble-free operations of the plant. The following should be the sequence of operations

8.1 Air handling units
8.2 Chilled / condenser water pumps
8.3 Water chilling units.

During switch-off operations, the sequence shall be reversed.

8.4 For winter heating, the following should be the sequence of operations
8.5 Air handling unit
8.6 Hot water pumps.
8.7 Hot Water Generator/Boiler

During switch of operations, the sequence shall be reversed.

SECTION H-13.0: ELECTRIC WIRING

1. **General:**

The electric wiring of motors for compressors, pumps, air handling units etc. As well as controls, heaters etc. and earthing of all equipment shall be carried out as per specifications given hereunder

2. **Power Cabling for Motors, Heaters, etc:**

2.1 Unless otherwise specified, the power cables shall be PVC insulated, and PVC sheathed aluminium conductor, armoured cables to 1100 V grade conforming to IS 1554. The power cables shall be of 2 core for single phase, 4 core for sizes up to and including 25 sq.mm, 3-1/2 core for sizes higher than 25 sq.mm for 3 phase. Where high voltage equipment are to be fed, the cables shall be rated for continuous operation at the voltages to suit the same.

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

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

2.4 Cable laying work shall be carried out in accordance with IS 1255/1967, Indian Standard code of practice. The scope of work for the Air-conditioning Contractor shall include making trenches in the ground and refilling as required, but excludes any masonry trenches for the cable work.

3.0 CONTROL WIRING

3.1 Control wiring in the plant rooms and AHU rooms shall be done using control wire as per IS 1554 PVC insulated and PVC sheathed, 2.5 sq.mm copper conductor, 1100 V grade, cables drawn in ISI marked steel or PVC conduits. The control cables interconnecting the plant room and the AHU rooms shall be of multi-core armoured type only, and suitable for laying directly in the ground.

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

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

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

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

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

3.7 In cold storage involving temperatures below zero deg. C, Polythene cables shall be used instead of PVC cables.

4.0 **Laying**

4.1 The cables shall be laid, as per drawings or along a short and convenient route between switch board and the equipment, either in trenches, on walls or on trays.

Hangers, supported from the slab. Cable routing shall be checked on the site to avoid interference with structure, equipment, etc. Where more than one cable is running close to each other, proper spacing should be provided between them

4.2 The radius of bends of the cable should not be less than 12 times the radius of cable to prevent undue stress and damage at the bends, the cables should be supported and fixed on M.S. supports, when running in trenches, wall or ceiling suspended hangers when laid underground the cables should be covered with sand and protected with cement concrete covering. suitable G.I. pipe shall be used wherever cable is laid across road, crossing of other services and when passing through R.C.C.

4.3 Wooden bushes shall be provided at the ends of pipes through which cables are taken.

5. **Earthing:**

5.1 **Pipe Earth Electrode**

G.I. pipe shall be of medium class 40 mm dia 4.5 m.long in length. galvanising of the pipe shall conform to relevant is. G.I. pipe electrode shall be cut tapered at the bottom and provided with holes of 12 mm dia drilled

not less than 7.5 cm from each other upto 2m of length from bottom. The electrode shall be buried in the ground vertically with its top not less than 20 cms below ground level.

5.2 **Plate Earth Electrode**

For plate electrode, minimum dimensions of the electrode shall be as under:

i. G.I. plate electrode : 60cm x 60cm x 6mm thick.

ii. Copper plate electrode: 60cm x 60cm x 3mm thick.

The electrode shall be buried in the ground with its faces vertical and top not less than 3 m below ground level.

In case of plate earth electrode, a watering pipe of 20 mm dia of medium class gi pipe shall be provided and attached to the electrode. A funnel with mesh shall be provided on top of this pipe for watering the earth. In case of pipe electrode, a 40mm x 20mm reducer shall be used for fixing the funnel. The watering funnel attachment shall be housed in a masonry enclosure of not less than 30cm x 30cm x 30cm. A cast iron/ms frame with cover having a locking arrangement shall be suitable embedded in the masonry enclosure.

5.3 **Loop Earthing**

Loop earthing shall be provided for all mountings of main board and other metal clad switches and db's with G.I. strip of size specified but not less than 14 swg copper or 12 swg gi or 4 sq mm aluminium wite. The earthing lead from electrode owners shall be suitably protected from mechanical injury by a 15 mm dia gipipe in case of wire and 40 mm dia medium class G.I. pipe in case of strip. Metallic covers or supports of all medium pressure or ht apparatus or conductors shall in all cases be connected to not less than two separate and distinct earths.

5.3.1 All equipment connected with electric supply shall also be provided with double earthing continuity conductors. The size of G.I. earthing conductors shall be:

Earthing should be carried out as per is-3043

Size of phase wire sq.mm aluminium tape/wire (swg)	Size of G.I. conductor
185	25 mm x 4 mm (strip)
150	25 mm x 4 mm (strip)
120	20 mm x 3 mm (strip)

Size of phase wire sq.mm	Size of G.I. conductor aluminium tape/wire (swg)
95	20 mm x 3 mm (strip)
70	4 swg
50	4 swg
35	6 swg
25-6	6 swg
4	8 swg

6. **Miscellaneous:**

6.1 The final connections to the equipment shall be through flexible connections where the equipment is likely to be moved back and forth, such as on slide rails.

6.2 An isolator switch shall be provided at any motor which is separated from the main switch panel by a wall or partition or other barrier or is more than 15 metres away from the main panel.

6.3 Two separate and distinct earthing conduits shall be connected from the equipment upto the main switch board panel.

6.4 The entire installation shall be tested as per electricity rules and I.S. 732-1973/is-3043 with amendments 1,2&3 prior to the commissioning of the plant and a suitable test report furnished by competent local authorities. The test report will be obtained by contractor himself at his own expenses.

6.5 All exposed hangers etc. shall be given 2 coats of suitable paint of approved colour, when all work has been completed.

SECTION H-14.0: TESTING, ADJUSTING AND BALANCING

The AC Contractor shall have a dedicated experienced, specialized, approved, testing and commissioning (T&C) team /agency responsible for coordination with other trades, preparation of T&C plan method statement & T&C procedures, organizing & scheduling the T&C activities along with the progress of works, supervision any re-testing, coordination with third parties for commissioning & certification, organizing & performing testing for satisfaction of all Statutory Bodies, T&C record documentation & handover

4. **General**

a. Testing, adjusting and balancing of heating, ventilating and air-conditioning systems at site.
b. Testing, adjusting and balancing of HVAC Hydronic system at site.
c. Testing, adjusting and balancing of exhaust system at site.

Comply with current editions of all applicable practices, codes, methods, of standards prepared by technical societies and Associations, including:

ASHRAE : 2007 HVAC Application.
SMACNA : Manual for the Balancing and Adjustment of Air Distribution System.

d. AC Contractor shall submit a Test, Adjust, Balance procedure/method statements/charts for approval to Client.

5. **Performance**

a. Verify design conformity.
b. Establish fluid flow rates, volumes and operating pressures.
c. Take electrical power readings for each motor.
d. Establish operating sound and vibration levels.
e. Adjust and balance to design parameters.
f. Record and report results as per the formats specified.

6. **Definitions**

a. Test: To determine quantitative performance of equipment.
b. Adjust: To regulate for specified fluid flow rates and air patterns at terminal equipment (e.g. reduce fan speed, throttling, etc.)
c. Balance: To proportion within distribution system (sub mains, Branches and terminals) in accordance with design quantities.

7. **Testing, Adjusting and Balancing (TAB) Procedures**

The following procedures shall be directly followed in TAB of the total system. Before commencement of each one of the TAB procedures explained hereunder, the AC Contractor shall intimate the Client about his readiness to conduct the TAB procedures in the format given in these specifications.

8. **Description of System and Requirements**

Adjust and balance the following system to provide most energy-efficient operation compatible with selected operating conditions.
a. All supply, return and outside air systems.
b. All exhaust air systems.
c. All chilled water systems.
d. All cooling tower (condenser) water systems.
e. Emergency purge systems.

9. **Air Systems**

I. Air Handlers Performance

The TAB procedure shall establish the right selection and performance of the AHUs with the following results:
a. Air-IN DB and WB temperature.
b. Air-OUT DB and WB temperature.
c. Dew point air leaving.
d. Sensible heat flow.
e. Latent heat flow.
f. Sensible heat factor.
g. Fan air volume.
h. Fan air outlet velocity.

i. Fan static pressure.
j. Fan power consumption.
k. Fan speed.

II. Air distribution

Both supply and return air distribution for each AHU and for areas served by the AHU shall be determined and adjusted as necessary to provide design air quantities. It shall cover balancing of air through main and branch ducts.

III. The Preparatory Work

To conduct the above test, the following preparatory works are required to be carried out, including the availability of approved construction shop drawings and submittals:

a. All outside air intake, return air and exhaust air dampers are in proper position.
b. All system volume dampers and fire dampers are in full open position.
c. All access doors are installed & are air-tight.
d. Grilles are installed & dampers are fully open.
e. Provision and accessibility of usage of TAB instruments for traverse measurements are available.
f. All windows, doors are in position.
g. Duct system is of proper construction and is equipped with turning vanes, and joints are sealed.
h. Test holes and plugs for ducting.

10. **Hydronic System Balancing**

I. The Hydronic system shall involve the checking and balancing of all water pumps, piping network (main & branches), the heat exchange equipment like cooling and heating coils, condensers and chillers and cooling towers in order to provide design water flows.

II. The essential preparation work must be done by the HVAC Contractor prior to actual testing, adjusting and balancing of the HVAC system and ensure the following:

- Availability of coordinated drawings and approved submittals and system sketch with design water flows specified thereon.

- Hydronic system is free of leaks, is hydrostatically tested and is thoroughly cleaned, flushed and refilled.

- Hydronic system is vented.

III. The AC Contractor shall confirm completion of the basic procedures and prepare checklists for readiness of system balance.

a. Check pumps operation for proper rotation and motor current drawn, etc.
b. Confirm that provisions for TAB measurements (Temperature, pressure and flow measurements) have been made.
c. Open all shut-off valves and automatic control valves to provide full flow through coils. Set all balancing valves in the preset position, if these values are known. If not, shut all riser balancing valves except the one intended to be balanced first.

Balancing work for both Chilled Water System and Condenser Water System shall be carried out in a professional manner, and test reports in the specified format shall be prepared and presented to the Client / Consultant for endorsement.

11. **Readiness for Commencement of Tab**

Before starting any of the tests, the readiness to do so should be recorded as per the prescribed checklist.

12. **Tab Instruments**

I. Air Measuring Instruments

a. For measuring DB and WB temperature, RH and dew point, microprocessor based TSI USA make VelociCalc Plus Meter, Model 8386, or equivalent shall be used. This instrument shall be capable of calculating the sensible, latent total heat flows, sensible heat factor and give printouts at site and have data logging/downloading facility.
b. For measuring Air velocity, DB temperature and Air volume, TSI USA make VelociCalc meter model 8386/ 8345 or equivalent shall be used. It shall be able to provide instant print out of recorded Air volume readings.
c. Pitot tube.
d. Electronic Rotary Vane Anemometer TSI make or equivalent.

e. Accubalance Flow Measuring Hood TSI make or equivalent.

[All above instruments shall have a valid certification from a reputed testing institution.]

II. Hydronic Measuring Instruments

a. For measurement of water flow across balancing valves, instruments as provided by the manufacturer of the valves specific to the type of valves shall be need. This shall include but not be limited to differential pressure manometers. Temperature shall be measured using electric thermometers from thermowells provided at strategic location by the HVAC Contractor. The water balancing shall be carried out being computer simulation program provided / certified by the balancing valve manufacturer.

III. Rotation Measuring Instrument

a. Electronic Digital Tachometer.

IV. Temperature & RH Measuring Instrument

a. TSI Veloci Calc model 8386 / VelociCalc model 8345 or equivalent.

V. Electrical Measuring Devices

a. Clamp on Volt ammeter.

b. Continuity Meter.

VI. Vibration and Noise Levels

Vibration and alignment field measurements shall be taken for each circulating water pump, water chilling unit, air handling unit and fan driven by a motor over 10 HP. Readings shall include shaft alignment, equipment vibration, bearing housing vibration, and other test as directed by the PMC.Sound level readings shall be taken at ten (10) locations in the building as selected by the Contractor / Client. The readings shall be taken on an Octave Band analyzer in a manner acceptable to him. The AC Contractor shall submit test equipment data and reporting forms for review. In order to reduce the ambient noise level the readings shall be taken at night. All test shall be performed in the presence of Client / Consultant or his authorized representative.

SECTION H-15.0: IDENTIFICATION OF SERVICES

General

This section comprises of identification of services for each piece of equipment

Valve Labels and Charts

Each valve shall be provided with a label indicating the service being controlled, together with a reference number corresponding with that shown on the Valve Charts and "as fitted" drawings. The labels shall be made from 3 ply (black / white/ black) Traffolyte material showing white letters and figures on a black background. Labels to be tied to each valve with chromium-plated linked chain. The labels shall be suitable for a minimum of 40 characters with font size of 24 minimum. Labelling scheme of each equipment to be submitted for approval from Client / Consultant.

A wall-mounted, glass-covered plan to the endorsement of the Client / Consultant shall be provided and displayed in each plant room showing the plant layout with pipe work, valve diagram and valve schedule indicating size, service, duty, etc.

All AC equipments shall be provided with permanently mounted identification labels and unique tagging numbers. The shop drawings shall also include these tagging numbers for easy identification on site. It should be coordinated with BMS also to ensure consistent equipment tagging among drawings, BMS display and site installation.

Identification of Services

Pipe work and duct work shall be identified by colour bands 150 mm. wide or colour triangles of at least 150 mm. / side. The bands of triangles shall be applied at termination points, junctions, entries and exits of plant rooms, walls, in ceiling spaces, ducts and control points to readily identify the service, but spacing shall not exceed 4.0 metres.

Pipe Work Services

For pipe work services and its insulation, the colours of the bands shall comply with BS.1710: 1971.Basic colours for pipeline identification:

Pipe Line Contents	BS. 4800 Colour Reference	Colour
Water	12 D 45	Green
Steam	10 A 03	Grey
Oils	06 C 39	Brown
Gas	08 C 35	Yellow / Brown
Pipe Line Contents	BS. 4800 Colour Reference	Colour
Air	20 E 51	Blue
Drainage	00 E 53	Black
Electrical	06 E 51	Orange

Colour code indicator bands shall be applied as colour bands over the basic identification colour in the various combinations as listed below :-

Pipe Line Contents	Colour Bands to BS. 4800
Water Services :	
Cooling	00 E 55
Fresh / drinking	18 E 53
Boiler feed	04 D 45/00 E 55 / 04 D 45
Condensate	04 D 45/14 E 53 / 04 D 45
Chilled	00 D 55/14 E 53 / 00 D 45
Central Heating Services :	
Below 100 Deg. C	18 E 55/04 D 45/18 E 53
Above 100 Deg. C	04 D 45/18 E 53 /04 D 45
Cold Water Storage	
Tanks:	00 E 55/18 E 53/00 E 55
Hot Water Supply	00 E 55/04 D 45/00 E 55
Hydraulic Power	04 C 33
Sea / River Untreated	Basic Colour only
Fire Extinguishing	04 E 53
Steam Services :	Basic Colour only
Air : Compressed	Basic Colour only

Pipe Line Contents	Colour Bands to BS. 4800
Vacuum	White
Town Gas : Manufactured	14 E 53
Natural	10 E 53
Oils :	
Diesel	00 E 55
Lubricating	14 E 53
Hydraulic Power	04 C 53
Transformer	04 D 45
Drainage and other fluids :	Basic Colour only
Electrical Services :	Basic Colour only

In addition to the colour bands specified above all pipe work shall be legibly marked with black or white letters to indicate the type of service and the direction of flow, identified as follows:
High Temperature Hot Water HTHW
Medium Temperature Hot Water MTHW
Low Temperature Hot Water LTHW
Chilled Water CHW
Condenser Water CONDW
Steam ST
Condensate CN
Pipe shall have the letters F and R added to indicate flow and return respectively as well as directional arrows.
Duct Work Services: For Duct work services and its insulation the colours of the triangles shall comply with BS.1710: 1971. The size of the symbol will depend on the size of the duct and the viewing distance but the minimum size should not be less than 150 mm. length per side. One apex of the triangle shall point in the direction of airflow.

Services	Colour	BS.4800 Colour Reference
Conditioned Air	Red and Blue	04 E 53 / 18 E 53
Ward Air	Yellow	10 E 53
Outdoor air	Green	14 E 53
Exhaust / Extract / Recirculated Air	Grey	AA 0 09
Foul Air	Brown	06 C 39
Dual Duct System Hot Supply Air	Red	04 E 53
Cold Supply Air	Blue	18 E 53

In addition to the colour triangles specified above all duct work shall be legibly marked with black or white letters to indicate the type of service, identified as follows:
Supply Air S
Return Air R
Outdoor Air O
Exhaust Air E
Smoke Extract Duct M
Spill Air A
The colour banding and triangles shall be manufactured from self-adhesive cellulose tape, laminated with a layer of transparent ethyl cellulose tape.

SECTION H-16.0: LIST OF ABBREVIATIONS

Followings List of Abbreviations shall have been used in preparing the Tender Specifications, Bill of Quantities & Drawings.

AABC :	AMERICAN AIR BALANCING COUNCIL
ACH :	AIR CHANGE PER HOUR
AC :	AIR CONDITIONING
ACMV :	AIR CONDUCTING AND MECHANICAL VENTILATION
AHU :	AIR HANDLING UNIT
ANSI :	AMERICAN NATIONAL STANDARD INSTITUTE
ARI :	AMERICAN REFRIGERATION INSTITUTE
ASHRAE:	AMERICAN SOCIETY OF HEATING, REFRIGERATION AND AIRCONDITIONING ENGINEER
ASME :	AMERICAN SOCIETY OF MECHANICAL ENGINEERS
ASTA :	ASSOCCIATION OF SHORT - CIRCUIT TESTING AUTHORITIES
ASTM :	AMERICAN SOCIETY OF TESTING AND MATERIALS
ATG :	AIR TRANSFER GRILLE
AWS :	AMERICAN WELDING SOCIETY
BAS :	BUILDING AUTOMATION SYSTEM
BIS :	BUREAU OF INDIAN STANDARD
BMS :	BUILDING MANAGEMENT SYSTEM
BTU :	BRITISH THERMAL UNIT
CDW :	CONDENSER WATER
CFM :	CUBIC FEET PER MINUTE
CHW :	CHILLED WATER
CMS :	CENTRAL MONITORING SYSTEM
CRCA :	COLD ROLLED COLD ANNEALED
CSA :	CANADIAN STANDARD ASSOC.CIATION
CT :	COOLING TOWER
CTI :	COOLING TOWER INSTITUTE
DB :	DISTRIBUTION BOARD
DDC :	DIRECT DIGITAL CONTROLLER
DOL :	DIRECT ON LINE
DFA :	DELHI FIRE AUTHORITY
DIA :	DIAMETER
DIDW :	DOUBLE INLET DOUBLE WIDTH
DX :	DIRECT EXPANSION
EA :	EXHAUST AIR
EEPROM:	ELECTRICAL ERASABLE PROGRAM
ELCB :	EARTH LEKAGE CIRCUIT BREAKER
ETL :	ELETRICAL TESTING LABORATORIES
EPA :	ENVIRONMENTAL PROTECTION ACT
FCU :	FAN COIL UNIT
F/A :	FLOOR ABOVE
F/B :	FLOOR BLOW
FCC :	FIRE COMMAND CENTRE
FD :	FIRE DAMPER
FFL :	FINISHED FLOOR LEVEL
FPM :	FEET PER MINUTE
FPS :	FOOT PER SECOND
FRP :	FIBERGLASS REINFORCED PLASTIC
GI :	GALVANISED IRON
GPM :	GALLON PER MINUTE
GSS :	GALVANIZED STEEL SHEET
H/L :	HIGH LEVEL
HDG :	HOT DIP GALVANIZED
HDPE :	HIGH DENSITY POLY ETHANE

HFC : HYDRO FLURO CARBON
HP : HORSE POWER
HVAC : HEATING, VENTILATION & AIR CONDITIONING
IAQ : INDOOR AIR QUALITY
IEC : INTERNATIONAL ELECTROCHEMICAL COMMISSION
IKW : INDICATED KILO WATT
IPD : INITIAL PRESSURE DROP
ISO : INTERNATIONAL STANDARD ORGANIZATION
KW : KILO WATT
L : LITRE
LCD : LIQUID CRYSTAL DISPLAY
L/L : LOW LEVEL
L/S : LITRE PER SECOND
LSZH : LOW SMOKE ZERO HALOGEN
LT : LOW TENSION
M : METER
MAX. : MAXIMUM
MCB : MINIATURE CIRCUIT BREAKER
MCC : MOTOR CONTROL CENTRE
MFD : MOTORIZED FIRE DAMPER
MIN : MINIMUM
MM : MILLIMETER
NBC : NATIONAL BUILDING CODE
NC : NOISE CRITERIA
NEC : NATIONAL ELECTRIC CODE
NFPA : NATIONAL FIRE PROTECTION ASSOC.CIATION
NPLV : NET PART LOAD VALUE
NIST : NATIONAL INSTITUTE OF STANDARDS & TECHNOLOGY
NEMA : NATIONAL ELECTRICAL MANUFACTURERS ASSOC.CIATION
NPSH : NET POSITIVE SUCTION HEAD
NTS : NOT TO SCALE
OA : OUTDOOR AIR
PHE : PUBLIC HEALTH ENGINEERING
PLC : PROGRAMMABLE LOGIC CONTROLLER
P.C. : PERSONAL COMPUTER
PSIG : POUNDS PER SQUARE INCH GAUGE
PUF : POLYURETHANE FOAM
RA : RETURN AIR
RAD : RETURN AIR DUCT
RCC : REINFORCED CEMENT CONCRETE
RH : RELATIVE HUMIDITY
RPM : REVOLUTIONS PER MINUTE
SA : SUPPLY AIR
SAD : SUPPLY AIR DUCT
SMACNA: SHEET METAL & AIR CONDITIONING CONTRACTORS NATIONAL ASSOC.CIATION INC
STD : STANDARD
T/A : TO ABOVE
TAB : TESTING, ADJUSTING AND BALANCING
T/B : TO BELOW
TCC : TERMINAL CONTROL CENTRE
TFA : TREATED FRESH AIR

TOA : TREATED OUTDOOR AIR
TP : THREE PHASE
TR : TONS OF REFRIGERATION
TVOC : TOTAL VOLATILE ORGANIC COMPOUNDS

VAV	:	VARIABLE AIR VOLUME
VFD	:	VARIABLE FREQUENCY DRIVES
VIP	:	VIBRATION ISOLATING PAD
VSPS	:	VARIABLE SPEED PUMPING SYSTEM
XLPE	:	CROSS -LINKED POLYETHYLENE
SISW	:	SINGLE INLET SINGLE WIDTH
UL	:	UNDERWRITERS LABORATORIES INC.
WG	:	WATER GAUGE

SECTION H-17.0: NOISE & VIBRATION CONTROL

Scope of Work

This section deals with design, supply, installation, testing and commissioning of noise and vibration control equipment and accessories.

Standards

The testing of all noise control equipment and the methods used in measuring the noise rating of air conditioning plant and equipment shall be in accordance with the relevant sections of the following British Standards, unless otherwise stated:

BS 4718: 1971	Methods of Test of Silencers for Air Distribution Systems
BS 2750:	Laboratory and Field Measurement of Airborne Sound
Parts 1-9:1980	Insulation of Various Building Elements Recommendations for Field Laboratory Measurement of Airborne and Impact Sound Transmission in Buildings
BS 3638: 1987	Methods of Measurement of Sound Adsorption in a Reverberation Room
BS 4773:	Acoustic Testing.
Part 2: 1976	
BS 4856:	Acoustic performance without additional ducting of forced
Part 2: 1976	Fan convection equipment.
Part 5: 1976	Acoustic performance with additional ducting of forced fan convection equipment
BS 4857:	Acoustic Testing and Rating of High Pressure Terminal
Par 2:1978 (1983)	Reheat Units.
BS 4954:	Acoustic Testing and Rating of Induction Units.
Par 2:1978 (1987)	
BS 5643:	1984 Glossary of Refrigeration, Heating, Ventilating and Air Conditioning Terms

General

The air conditioning contractor must take all necessary precautions to have minimum noise generation and its transmission generated by moving plant and equipment to achieve acceptable limits for occupied areas. In addition to the noise level criteria particular attention must be given to the following details at time of ordering plant and equipment and their installation:

All moving plant / equipment shall be statically and dynamically balanced at manufacturers works and certificates issued.

The isolation of moving plant, machinery and apparatus including lines equipment from the building structure.

Where duct work and pipe work services pass through walls, floors and ceilings, or wherever supported shall be surrounded with a resilient acoustic absorbing material to prevent contact with the structure and minimize the outbreak of noise from plant rooms.

The reduction of noise breakout from plant rooms and the selection of externally mounted equipment and plant to meet ambient noise level requirements of the Specifications.

Electrical conduits and connections to all moving plant and equipment shall be carried out in flexible conduit and cables to prevent the transmission of vibration to the structure and nullify the provisions of anti-vibration mountings.

All duct connections to fans shall incorporate flexible connections, except in cases where these are fitted integral within air handling units.

All resilient acoustic absorbing materials shall be non-flammable, vermin and rot proof and shall not tend to break up or compress sufficiently to transmit vibration or noise from the equipment to the structure.

Where practicable, attenuators shall be built into walls and floors to prevent the flanking of noise the duct work systems and their penetrations sealed in the manner previously described. Where this is not feasible, the exposed surface of the duct work between the attenuators and the wall subjected to noise infiltration shall be acoustically clad as specified.

Ambient noise from cooling tower also shall be assessed to determine the suitable attenuators that can reduce the noise so as not affecting the adjoining public area.

Sound Attenuators

Attenuators shall be provided in ducts in accordance with acceptable noise level criteria & if specified in BOQ. Attenuators shall be constructed from high quality pre-galvanized steel sheet casings with lock formed joints along the casing length. Angle iron cross jointing flanges shall be fitted to silencer casings, drilled as

required and finished with red oxide primer paint. Acoustic splitters shall be formed by chancel section pre-galvanised sheet steel framework retaining acoustic fill of a density to attain the required performance. Splitters shall have round Nos.,e ends to give smooth entry and exit conditions to minimise air pressure drops. The acoustic fill shall be protected from the air flow by 22 swg minimum perforated galvanized sheet steel. All attenuators shall be selected against a maximum allowable air pressure drop of 100 Pa. It will be the responsibility of the AC Contractor at the time of placing orders for fan equipment to obtain from the manufacturers, certified sound power levels to enable the selected duct silencers to be checked against the original design information, prior to orders being placed.

Anti-vibration Mountings.

All items of rotating and reciprocating plant and equipment shall be isolated from the structure by the use of anti-vibration materials, mountings or spring loaded supports fixed to either concrete bases, inertia blocks or support steels. Centrifugal fans and motors within air handling units shall be isolated from the frame of the air handling unit by suitable anti-vibration mountings. Fan discharge air connections shall be fitted with approved flexible connections. Axial flow fans shall be mounted on steel legs as diaphragm plates supported on neoprene in shear anti-vibration mountings, or suspended using spring loaded hangers to suite the application. Centrifugal pumps shall be mounted on inertia bases consisting of reinforced concrete sub-base, anti-vibration mountings and concrete filled steel upper plinth. The AC Contractor shall be responsible for providing the steel upper plinth and mountings. Pipe work connections to circulating pumps, chillers, cooler coils and other heat exchanger equipment shall be made with flexible connections as per piping Specifications. The construction of the anti-vibration mountings shall generally comply with the following:

-Enclosed Spring Mounting (Caged or Restrained Springs) Each mounting shall consist of cast or fabricated telescopic top and bottom housing enclosing one or more helical steel springs as the principle isolation elements, and shall incorporate a built- in leveling device. The springs shall have an outside diameter of not less than 75% of the operating height, and be selected to have at least 50% overload capacity before becoming coil bound. The bottom plate of each mounting shall have bonded to it a neoprene pad designed to attenuate any high frequency energy transmitted by the springs. Mountings incorporating snobbery of restraining devices shall be designed so that the snubbing damping or restraining mechanism, is capable of being adjusted to have no significant effect during the normal running of the isolated machine. The manufacturers shall provide restrained isolator on chillers subject to approval.

Open Spring Mountings

Each mounting shall consist of one or more helical steel springs as the principal isolation elements, and shall incorporate a built-in leveling device. The spring shall be fixed or otherwise securely located to cast or fabricated top and bottom plates, and shall have an outside diameter of not less than 75% of the operating height, and shall be selected to have at least 50% overload capacity before becoming coil-bound. The bottom plate shall have bonded to it a neoprene pad designed to attenuate any high frequency energy transmitted by the springs.

Neoprene-in-Shear Mountings

Each mounting shall consist of a steel top plate and base plate completely embedded in oil resistant neoprene. Each mounting shall be capable of being fitted with a leveling device, and bolt holes in the base plate and tapped holes in the top plate so that they may be bolted to the floor and equipment where required.

Inertia Bases for Pumps

The inertia base shall be an all welded mild steel channel frame the minimum depth of which shall be 1/12 of the longest span between isolator but not less than 150 mm. filled with concrete the density of which shall be 2300 kg/m3.

The inertia base shall be sufficiently large to provide support for all parts of the equipment, including any component, which overhands the equipment base, such as suction, and discharge elbows on centrifugal pumps.

The frame shall include pre-located equipment anchor bolts fixed into position and housed in a steel sleeve allowing minor bolt location adjustment.

Isolator support brackets shall be welded into the corners of the base and suitably re-enforced for the load of the equipment and base.

Additional reinforcing roads shall be provided at 200 mm. centres to ensure the concrete and frame is adequately stiffened against distortion.

SECTION H-18.0: SAFETY CODES

1.SCOPE

The scope of this sub-section is the minimum safety requirements to be observed during manufacture and erection of the HVAC system as specified herein in addition to the safety norms generally followed:

2.I.S. STANDARDS

The safety code for mechanical refrigeration IS: 660 and safety code for air conditioning IS: 659 shall be observed.

3.SAFETY REQUIREMENTS

Some of the important safety requirements are as under but not limited to the same:

a. There shall be maintained in a readily accessible place, first aid appliances including adequate supply of sterilized dressings and cotton wool.

b. The injured person shall be taken to a public hospital without loss of time.

c. Suitable and strong scaffolds shall be provided for workmen for all works that cannot be safely done from ground.

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

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

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

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

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

i. Those engaged in welding works shall be provided with protective eye shields and glove.

j. No paint containing lead or lead products to be used except in the form of paste or readymade paint.

k. Suitable facemasks shall be supplied for use of workers when the paint is applied in the form of spray or surface having lead paint dry rubbed and scraped.

l. Overalls shall be supplied by the Contractor to the painter and adequate facilities shall be provided to enable the working painter to wash during cessation of the work.

m. The ropes used in hoisting or lowering material or as a means of suspension, shall be of adequate quality and adequate strength and free from defects.

n. All site personnel shall wear safety helmets whenever they are in the construction/ erection areas.

SECTION H-19.0: LIST OF BUREAU OFINDIAN STANDARD CODES

LIST OF RELEVENT INDIAN STANDARDS
I.S. 3615 Glossary of Terms Used in Refrigeration & Air Conditioning.
I.S. 325 Three phase Induction Motors
I.S. 1822 Motor Starters of voltage Not Exceeding 1000 volts
I.S. 3624 Bourden Tube Pressure and Vacuum Gauges
I.S. 2372 Timber for cooling towers
I.S. 7403 Code of practice for selection of standard worm and helical gear boxes
I.S. 1620 Horizontal centrifugal pumps for clear, cold, fresh water
I.S. 996 Single phase small A.C. and Universal motors
I.S. 1239 Mild steel tubes, tubulars and other wrought steel fittings
I.S. 3589 Electrically welded steel pipes for water, gas and sewage,
I.S. 6392 Steel pipe flanges
I.S. 778 Gun metal gate, globe and check valves for general purpose
I.S. 2592 Recommendation for methods of measurement of fluid flow by means of orifice plates and nozzles
I.S. 277 Galvanised steel sheets
I.S. 737 Wrought aluminium and aluminium alloy sheet and strip for general engineering purposes.
I.S. 655 Metal air ducts
I.S. 732 Code of practice for electrical wiring and fittings for buildings
I.S. 2516 A.C.circuit breakrs
I.S. 900 Code of practice for installation and maintenance of induction motors
I.S. 1248 Direct acting electrical indicating instruments
I.S. 2516 A.C. circuit breakers for voltages not exceeding 1000 volts
I.S. 4047 Heavy duty air break switches and composite units of air break switches and fuses for voltage not exceeding 1000 volts.
I.S. 2208 HRC cartridge fuse links upto 650 volts
I.S. 1554 PVC insulated (heavy duty) electric cables for working voltage upto and
(PART I), including 1100 volts
I.S. 8183 Specification for bonded glass wool/ mineral wool
I.S. 4671 Specification for expanded polystyrene for thermal insulation purposes.
I.S. 11561 Code of practice for testing of cooling towers.
I.S. 7896 Data for outside design conditions for air conditioning for summer months.
I.S. 8148 Packages air conditioners
I.S. 2370 Sectional cold rooms (walk-in type)
I.S. 5111 Testing of refrigerant compressors
I.S. 10594 Thermostatic Expansion Valve
IS 12615 Energy efficient induction motors
Energy Conservation Building Code 2007
National Building Code of India 2016

Approved make of Materials

If any make stated below does not comply with the technical specifications and or IS Standards, then such a make shall not be used in the work.

S. No	Items	Approved Makes
1	Air Cooled Chiller	Carrier/Trane/York/Daikin/ LG/ SAMSUNG
2	Pumps	Grundfos/Armstrong/WILO
3	Secondary CHW with VFD	Grundfos/Armstrong/WILO
4	Cooling Tower	Paharpur/Mihir//Marley/Bell/Batlimore
5	AHUs (all types) with Cooling coils	VTS/System Air/Flakwood
6	VFD for AHUs	Danfoss/ Siemens/ABB/Allen Bradley/Fuji electric/ VTS/Honeywell
7	Fan coil units	Carrier/ETA/Zeco/Edgetech/VTS/MIDEA
8	Centrifugal fans for AHUs/fresh Air /exhaust fan/ kitchen scrubber	Kruger/Nicotra/Comefri/Wolter/Greenheck
9	Propeller fan	Alsthom/Khaitan/Crompton/GE/Wolter
10	Grills/Diffusers	Carryair/Ravistar/Airmaster/Air flow/Brightflow
11	Fire Dampers UL Listed	Ravistar/Air flow/Carryair/Greenheck/ Bright flow
12	Fire Damper Motors /Actuator	Belimo/Siemens/Honeywell
13	GI sheet for metal duct	Jindal/SAIL / Tata
14	Factory fabricated duct	Zeco/Techno/ Rolastar/ Technofeb
15	Hessian (fire treated)	Navair/pyroguard
16	MS/GI pipe	Jindal Hissar/Tata / Prakash Surya
17	Pre-insulated chilled water pipe	Zeco/seven star / Parma
18	Thermometer	Taylor/H Guru/Fiebig
19	Flow switch	Rapidcool/Siemens/Johnson controls / Honeywell
20	Auto Airvent	Rapid cool/Anergy
21	Filters (pre / fine / Hepa)	AAF/Purolator/Thermadyne/Spectrum
22	Flexible pipe connection	Resistoflex/Kanwal
23	Gun Metal Valve	Audco/Leader/Zolloto
24	Butterfly/Non return/Check Valve	Audco/Advance/Castle/SKS/Cim/SANT
25	Motorised butterfly valve	Bellino/Honeywell/Siemens/Nibco
26	Ball/Gate/Globe Valve	CIM/Rapidcool/Leader/Castle/Emerald/Sant
27	Ball valve with Y-strainer	CIM/Rapidcool/Leader/Castle/Emerald/Sant
28	Pot/Y-Strainer	CIM/Rapidcool/Leader/Castle/Emerald/Sant
29	Suction Guide	Anergy/ Armstrong/Xylem
30	Pressure Gauge	H Guru/Fiebig/Emerald/Taylor
31	2/3 way modulating control valve for AHU	Honeywell/Siemens/Danfoss/Belimo
32	Room thermostat/humidistat	Honeywell/Siemens/Danfoss/Belimo
33	Dial thermometer (capillary Type	Penn/H Guru/Feiig/Emerald
34	Pre-moulded PUF section for insulation	LLyod/Malanpur/Beardsel/Supreme
35	Closed cell nitrile rubber with aluminium foil	Armaflex /Vidoflex /Supreme / Aerocell
36	PUF pipe supports	Malanpur / Lloyd / Beardsel
37	Aluminium tape	Johnson / Birla 3M
38	Vibration isolator	Resistoflex / Dunlop
39	V Belt	Dunlop / Fenner
40	Expansion tank (pressurized) And Air Separator	ITT/Wessels/Grunfoss/Anergy

41	Paints	ICI/Asian/Nerolac/Berger
42	Ultraviolet germicidal Irradiation system	Ruks /Ensavior Technologies Pvt Ltd
43	Aluminium sheets	Hindalco/Balco/Nalco
44	Mineral wool insulation	Lloyd insulation/UP Twiga/Kimmco
45	Closed cell fire retardant XLPE(for duct insulation)	Trocellen/K-Flex/ Supreme
46	Tarfelt/CPRX compound	Shalimar tar product/Asian
47	Dash fasteners	Fisher/HILTI
48	Welding Rods	Advani/L&T
49	Copper refrigerant piping	Diamond/star/Rajco / Maxflow
50	Electrical Panels	EAP/ADLEC/ADVANCE/TRICOLITE or CPERI Certified Electrical Panel Manufacturer
51	Electric Motors	ABB / Siemens / Kirloskar / Grundfos / Crompton / NGEF
52	MCCB	Schneider Electric (NSx Series) / Siemens (VL Series) / L&T (D-Sine) / Legrand (DPX^3) / ABB (TMax) / C&S (Winbreak-1/2)
53	ACB	Siemens (3WL–ETU45B) / L&T (U-Power-OMEGA) / ABB (Emax)PR122 / C&S (Win Master2 4.1 / Legrand (DMX^3 MP4) Schneider (Masterpact NW6.0 A)
54	MCB	Schneider Electric ACTI-9 (N) / Legrand (DX3) / Hager/ L&T (Exora) / ABB (S200M) / Siemens (Betaguard) / C&S (Wintrip2) / Indoasian (Optipro)
55	MCB DB	Legrand (EKINOX-3) / L&T (EXORA) / Hager / Schneider (ACTI-9) / ABB (Elegance) / C&S(Winclass) / Indoasian (Optipro)
56	Power/control cables	Finolex / Universal / Polycab / Nicco / RPG Cables / KEI / Havells / RRKabel / Bonton / Grandlay
57	Starters/contactors/OL Relays/push buttons/ Rotary switches/ changeover switch/ fuse and fittings/ 1phase preventor/ indicating Lamps/	Schneider Electric / L&T / BCH / Siemens / Legrand / ABB / C&S / Hager
58	Voltmeter/Ammeter	AE / Rishab / L&T / C&S / Conzerve
59	CT/PT	Automatic Electric / Matrix / Precise / L&T / Kappa
60	Cable tray	Pilco / Slotco / MEM / BEC / Steelways / Legrand
61	Cable lugs	Comet / Dowells / Hax Brass (Copper Alloy India) / Jainson / Action
62	Authorised BMS Contractor	Siemens/Schneider/ Johnson Control/Carrier/Trane or their approved vendor for the turnkey BMS job.
63	BMS Software	Siemens /Schneider /Honeywell-HBS /Johnson Control
64	Workstation	IBM/HP/Dell
65	Printer	Canon/HP/Samsung
66	Router & DDC's	Siemens/Schneider/Honeywell-HBS/Johnson Control
67	Portable Operator Terminal	Siemens/Schneider/Honeywell-HBS
68	Immersion temp. Sensors	Siemens/Schneider/Honeywell /Johnson Control
69	Outside Air temp. & RH sensors	Siemens/Schneider/Honeywell/Dwyer/Johnson Control
70	Air Differential Pressure switches	Siemens/Schneider/Honeywell/Beck /Johnson Control
71	Outside Air temp. Sensors	Siemens/Schneider/Honeywell /Johnson Control
72	Wall mount Temperature & RH Sensor	Siemens/Schneider/Honeywell/Dwyer/Johnson Control
73	Water Differential Pressure switches	Siemens/Kele/Beck/Johnson Control

74	Water Differential Pressure Transmitter	Huba/Siemens/Honeywell /Johnson Control
75	Air Differential Pressure Transmitter	Siemens/Schneider/Honeywell /Johnson Control
76	Electromagnetic Type Flow Meter	Khrone Marshall/Landis & Gyr
77	Cabling & conduting	
78	Signal & Communication Cable	Fusion Polymer/Lapp/Beldon
79	MS Conduit	BEC / NIC / AKG / RMCON
80	UV-Oxidation System	Ruks/Trimed/OTTPL//Oraipl
81	Bus Ducting	Tricolite Electrical Industries / Control & Switchgears Pvt. Ltd. /Sterling & Wilson / Milestone /Adlec Control System Pvt. Ltd. /Advance Panels & Switchgear Pvt. Ltd. /Indo Asian / Pristine / ASPL (Associated Switch Gears Pvt. Ltd.) /Engineers & Engineers (Electricals) Pvt. Ltd.
82	Tube Axial Fans	Kruger / Nocotra / Comefree / Flakwood / Wolter / Greenheck
83	Pressure independent Balancing valve	Danfoss /Flowcon /TA /Belimo / Honeywell /Johnson Control
84	Heat Recovery Wheels	Desiicant Rotors(DRI) / Novelair Technology / Eventus (Osterberg)/ Flakwood / Bryair
85	Heat Exchanger	Heat X / Mark / Alfa lavel
86	HVAC Controls	Danfoss / Honeywell / Johnson Controls / Siemens / Penn / Carrier ALC

NOTE: Make of any other equipment not mentioned above shall be got approved by the Consultant/the Institute before execution. Any other equivalent make in place of the above makes can be provided if the same meets the standards and is acceptable to the Consultant/the Institute. Any make mentioned above that does not meet the technical specification/BOQ specifications will not be considered for the project execution.

SECTION-I

FINANCIAL BID

NIT No: **IGIDR/Tender/2025/ED/20** Date: **24.09.2025**

Project: Supply, Installation, Testing and Commissioning of Central Cooling System (Revamping the old Centrally AC system) at IGIDR, Mumbai.	
	GENERAL NOTES:
1	The rate for each item of work included in the Schedule of Quantities shall, unless expressly stated otherwise, include cost of :
a	All materials, fixing materials, accessories, appliances, tools, plants, equipment, transport, labour and incidentals required in preparation for and in the full and entire execution, testing, balancing, commissioning and completion of work called for in the item and as per Specifications and Drawings.
b	Wastage on materials and labour.
c	Loading, transporting, unloading, handling/double handling, hoisting to all levels, setting, fitting and fixing in position, protecting, disposal of debris and all other labour necessary in and for the full and entire execution and for the job in accordance with the contract documents, good practice, and recognized principles.
d.	Liabilities, obligations and risks arising out of Conditions of Contract.
e	The unit rate for all equipment or materials in Indian Rupees shall include cost of equipment and materials, including all taxes and duties, and also including forwarding, freight, insurance and transport into Contractor's store at site, storage, installation, testing, balancing, commissioning and other works required. UNIT RATE SHOULD INCLUDE ALL TAX INCLUDING GST IS INCLUDED IN THE PRICE QUOTED.
2	The contractor shall perform Nitrogen test and vacuum test on refrigerant piping. Start and stop timing & pressure maintained shall be checked, and the readings recorded shall be countersigned by A consultant/client's representative.
3	Cable glands shall be compression type, heavy-duty chromium-plated.
4	All cable terminations to have lugs/ thimbles.
5	INSTRUCTION / MAINTENANCE MANUAL
	The Contractor shall prepare and produce instruction, operation and maintenance manuals in English for the use, operation and maintenance of the supplied equipment and installations and submit to the Client / Consultant in (3) copies at the time of handing over. The manual shall generally consist of the following:
i	Description of the project.
ii	Operating instructions.
iii	Maintenance instructions including procedures for preventive maintenance.
iv	Manufacturers catalogues.
v	Troubleshooting charts.
vi	Schematic & control wiring diagrams.
vii	Commissioning Certificate.
viii	Also for BMS System, Training, Operation, Installation manual and Troubleshooting manual and Training should be imparted to the field person.
ix	All necessary licenses should be provided for the BMS free of cost.
6	For Make List If any make stated below does not comply with the technical specifications and or IS Standards, then such a make shall not be used in the work.
7	MAINTENANCE OF PLANT AND TRAINING OF PERSONNEL
	The Contractor shall arrange to provide, at no extra cost, necessary personnel and material to carry out all routine maintenance of the HVAC equipment as required regularly.

Project: Supply, Installation, Testing and Commissioning of Central Cooling System (Revamping the old Centrally AC system) at IGIDR, Mumbai.					
S.No.	**DESCRIPTION**	**QTY**	**Unit**	**RATE**	**AMOUNT**
1	Air Cooled Chiller: Supply, installation, testing & commissioning of AHRI certified Air-cooled Inverter Scroll Chiller / Heat Pumps Unit.				
	Each Chiller / Heat Pumps should be complete with fully Inverter type Scroll compressors, Shell & Tube type Evaporator, Air-cooled condenser with protective coating , Control panel etc. The Chiller / Heat Pumps shall be charged with R410a Refrigerant. Each Chiller(Heat Pumps) should have 4 compressor and 4 independent refrigerants circuit. The drive motor suitable for 380 - 415V +/-5%, 3 phase, 50 cycles/sec . The Chiller / Heat Pumps should be factory insulated as per manufacturers standard. The Chiller / Heat Pumps shall have unit mounted microprocessor based starter and it should not have starting current more than 12 Amps per Chiller / Heat Pumps. Micro-processor based controls with colorful touch screen alpha-numeric display in english for all operating parameters such as chilled water inlet, chilled water outlet, operating pressures etc. Flange connection shall be part of the Chiller / Heat Pumps Chiller / Heat Pumps should be able to unload up to 20 % of the total load. Condenser should have energy efficient Electronically Commutated condenser fans. Chiller / Heat Pumps supplier should be the manufacturer of compressors used in Chiller / Heat Pumps.				
	Cooling capacity at designed conditions indicated below :				
	Actual capacity at design Condition: 39 TR (Variation in Capacity is ± 7.5%.)				
	Chilled water entry temperature: 12 Deg C				
	Chilled water leaving temperature: 7 Deg C				
	Ambient Air Entry temperature: 38 Deg C				
	IKW/TR of Chiller / Heat Pumps at above design condition should not be less than 1.35 kW/TR and IPLV of 0.68 kW/TR (Including compressor and Fan motor).				
	Chiller / Heat Pumps should be equipped with electronic expansion valve for the precise control.				
	Evaporator should be shell & tube type heat exchanger, and the material should be carbon steel and copper tube.				
	The unit was designed with a compact structure and robust assembly. The condenser fan is completed with high-efficiency wing style axial fan and direct driven motor for low sound level.				
	The unit compressor should have factory fitted sound insulation box and noise level should be less than 70 dBA at 1 mtr.				

Project: Supply , Installation, Testing and Commissioning of Central Cooling System (Revamping the old Centrally AC system) at IGIDR, Mumbai.					
S.No.	**DESCRIPTION**	**QTY**	**Unit**	**RATE**	**AMOUNT**
	The Condenser should be of Aluminium Fin and copper tubes. Condenser fins should have factory applied heavy anti-corrosion treatment applied, same shall be equivalent to industrial equipment in the ocean. This special coating should be able to protect the condenser fins from high salinity, humidity and pollution. Supplied should submit a valid test certificate for qualification of at least 10000 Hours of salt spray test as per Test method B of ISO 21207 and ASTM B117 / ISO 9227 and same shall be verified by a prestigious global agency like TUV				
	The Chiller / Heat Pumps unit should have inbult feature for BMS communication with Modbus protocol using RS485 port.				
	Supplier should submit the valid AHRI test certificate for the verification of capacity along with the Chiller / Heat Pumps model selection from the AHRI certified model selection program. Capacity claimed need to be verified by Consultant as required by the customer at AHRI certificate test bed.				
a	The price quoted shall include pre shipping inspection / testing at the works of the manufacturer, Freight, Insurance, Port clearance, loading / unloading, Installation, testing and commissioning as per specifications including the civil structure as required.				
b	Factory Testing: Chiller will be run tested at 100% load at prevailing conditions before dispatch. Cost of Testing and Other expenditures of Travel to Test Lab of OEM should be included in the Cost. No other extra claim for Witness Test should be considered by Customer.				
c	RCC/Cement concrete foundation for the pump unit. (In case pumps are inline, foundation shall be as per Manufacturers recommendation). Also SKID option can be provided based on site condition.				
1.1	39 Tr	4	Nos.		
	Approved Make: (Make of Chiller: Carrier/York/Trane/Daikin/LG)				

Project: Supply, Installation, Testing and Commissioning of Central Cooling System (Revamping the old Centrally AC system) at IGIDR, Mumbai.					
S.No.	**DESCRIPTION**	**QTY**	**Unit**	**RATE**	**AMOUNT**

2	**Air Handling Unit**: Supply, installation, testing and commissioning of factory built/site assembled Eurovent Certified/BIS Certified/Equivalent. Air handling units in Double skin type (Casing shall be of Non-Skeleton construction) with 40 ± 5 MM thick panels or Higher. AHU Construction should meet Mechanical performance of AHU casing as tested in Eurovent accredited laboratory as per EN1886 and meet the following characteristics: Mechanical Strength: D1, Thermal Bridging: TB2, Thermal Transmittance: T2,Air lekage:L1 and Filter by pass: F9 or Higher Characteristics. The said mechanical performance should be meet by each AHU as mentioned below. AHU construction should consist of G.I casing of thickness 0.6 mm outside layer and 0.6 mm inside layer with 275 GSM or equivalent zinc coating and polyurethane foam(PUF) insulation having density of 42 kg/m3, complete with Backward curved aerofoil blade Plug type direct driven fan of Aerofoil design blade along with VFD suitable for static pressure as detailed below or direct driven fan as certified by OEM, chilled water cooling coil with aluminum finned copper tubes. Filter section having pre (EU4, more than 90% efficiency for 10 Microns), fine (Bag filter EU7 3 Microns) and the filter section is equivalent to **MERV 13**, UV lamps(UL Certified), IE3 motor suitable for 415 +10% volts,50 Hz, 3 phase AC supply, drain connections with stainless steel drain pan and necessary vibration isolation arrangement to avoid any vibration etc. complete as per specifications and drawings. The static pressure should be verified as per actual site conditions. VFD should be capable to control the speed of the fan and compatible with BMS integration for Fan speed control. External Static considered is 25-30 mm. All accessory should be considered for the proper functioning. Cooling coils should be 6 row. The VFD shall be suitable for at least One PIDs. The scope shall include the Starter Panel ,controller, field devices and wiring. Starter Panel should be built in AHU VFD should be at least IP-20, suitable for input Voltage of 380 Vac to 480 Vac + 10% to -15% with input frequency of 50Hz +/- 5%. Overload shall be 120% for 60 Sec & VFD Shall be rated at 50 Deg C. Pressure and temperature sensor should be included. VFD should be with weatherproof enclosure. Coil capacity should be approved by consultant. Sound level should not exceed 65 dbA at 1m. Water pressure drop in coil shall not exceed 7 PSIG. Mixing Box to be provided as required/mentioned. RCC/Cement concrete foundation for the AHU unit.(RCC Blocks).				
2.1	5 Tr, 1800 CFM (Mixing Box)	2	Nos		
2.2	7 Tr, 2200 CFM (Mixing Box)	1	Nos		
2.3	11 Tr, 4000 CFM (Mixing Box)	1	Nos		
2.4	12 Tr, 5000 CFM	1	Nos		
2.5	24 Tr, 8000 CFM	1	Nos		
2.6	72 Tr, 20000 CFM	1	Nos		
	Approved Makes: Make of Pump: VTS/System Air/Flaktwoods Make of VFD: VTS/OEM approved/ABB/FUJI/Honeywell/Seimens.				

Project: Supply , Installation, Testing and Commissioning of Central Cooling System (Revamping the old Centrally AC system) at IGIDR, Mumbai.					
S.No.	**DESCRIPTION**	**QTY**	**Unit**	**RATE**	**AMOUNT**
3	**Chiller Water Circulating Centrifugal Pumps**:- Primary Circulating Supply, installation, testing and commissioning of Vertical in line axial Split Coupled PN 16 centrifugal pumps complete with CED coating, externally flushed outside type balanced Mechanical Seal and non-overloading motor, as per specifications and drawings suitable HP, TEFC permanent magnet motor with Efficiency IE5, class 'F' insulation operating on 415 + 10% volts, 3 phase, 50 cycles AC supply for each pump. Pump should be provided with motor mounted IP55 integrated VFD for sensor less/wireless control (2 nos of wireless DPTs should be considered for wireless control across the load). To maintain the redundancy of VSPS (Variable Speed Pumping System), separate Controller must be provided with IP54 protection. Controller should be capable of controlling the two way modulating valve at by-pass line to ensure the minimum flow to the chillers in case of load variation is below the minmum flow required by the Chillers. Controller must have BMS compatibility via Modbus/BACNET connectivity. The controller should stage/destage the variable pumps basis the best efficiency points (BEP) for the optimum efficiency of variable speed pumping system (VSPS). Pump mounted VFD must display dynamic frequency, amps, volts, flow and head of operating pump. Suction Guide and Triple Duty Valves to be provided by the pump manufacturer for the unit responsibility. Efficiency should more than 80%. Each pump shall comprise of following as required as per specifications.				
	Electrical by pass starter for pump set.				
	25 mm thick polyvinyl nitrile rubber insulation duly cladded between aluminum sheets of 0.5mm thickness and properly clamped to pump.				
	3 Nos. - 150 mm dia type pressure gauges				
	Mounting frame with anti-vibration pads (In case pumps are inline, anti-vibration system shall be as per Manufacturers recommendation)				
	RCC/Cement concrete foundation for the pump unit. (In case pumps are inline, foundation shall be as per Manufacturers recommendation). Also SKID option can be provided based on site condition.				
	Pump capacity are as under:				
	For Capacity pump set not less than 400 LPM of water at 30 mtr head each including the triple duct valve and End Suction guide.				
	All Variable Pumps must be provided with a cloud-based service that enables Active Performance Management. It must proactively tracks and manages pump performance and provides early diagnostic messaging, web accessible trends and analysis along with automated reports helping end customer to make performance-based decisions and take immediate action to deliver the best possible HVAC pump performance. The cloud based subscription should deliver real-time alerts, such as:				

	1) Alarms & warnings on excessive vibration 2)Pump in hand 3)Dead head 4)VFD & Motor Overheating. The connectivity kit supplied by pump supplied should have ability to connect and provide real time data for 8 pumps in a single plant room.				
i	Flow: 400 LPM, Head: 30 meter.	4	Nos.		
ii	Variable Flow Control Panel with accessories	1	Nos.		
	Approved Makes: Make of Pump: Armstrong/Grundfoss/WILO. Make of VFD: Danfoss/ABB/FUJI/Honeywell/Seimens.				
4	EXPANSION TANK AND PRESSURIZATION UNIT.				
4.1	**EXPANSION TANK and Pressurization Unit**: Supply, Installation, Testing and commissioning of INSULATED PRESSURISED CLOSED WATER EXPANSION TANK suitable for total volume of Water Solution, circuit along with necessary accessories such as along with necessary accessories such as 2 Nos pumps (1working +1standby) with Pressure Transmitter and interconnecting Pipe & Isolating Valve complete with piping connections, safety relief valve, drain valve, pressure gauge, automatic air purging arrangement, etc.with Pressure Transmitter and interconnecting Pipe & Isolating Valve complete with piping connections, safety relief valve, drain valve, pressure gauge, automatic air purging arrangement, etc. The tank shall be pre-charged. Expansion tank Shall be with replaceable heavy duty butyl rubber bladder. The tank connection's should be as per OEM recommendations and 20 mm drain and charging valve connection to facilitate the on site charging of nitrogen in the tank. The tank shall be fitted with lifting rings and a floor mounting skirt for vertical installation. The tank must be constructed in accordance with IS-STANDARD 2825-1969 (with lates Revision) and Rated at PN 16 and ASME Stamped. The complete system shall be sourced from single manufacturer and supplied and installed with all accessories and safety fixtures required for proper functioning of the complete hydronic system. The tank shall be duly painted in approved colour shall be complete with pressure switches and power distribution and control panel IP55 Control Panel, Pressure Transmitter, interconnecting piping & wiring. (Tank capacity 500 Ltrs). Hot Glycol - Water closed vessel pressurized expansion tank as described above shall be duly Insulated with 50 mm thick PUF/Nitrile Rubber insulating material or Equivalent U value Insulating Material and cladded with aluminium Sheet (20G). All necessary pipe connections should be made by the contractor to connected equipment.				
4.1.1	Expansion Tank of 500 Lts	1	Nos.		
4.1.2	PRESSURIZATION UNIT: Pump Set (Ref. Point 4.1) with Control Panel and accessories.	1	Nos.		
	Approved Makes: Armstrong, Xylem, Grundfoss, Wilo, Anergy Instruments Pvt ltd				

Project: Supply , Installation, Testing and Commissioning of Central Cooling System (Revamping the old Centrally AC system) at IGIDR, Mumbai.					
S.No.	**DESCRIPTION**	**QTY**	**Unit**	**RATE**	**AMOUNT**
5	**Duct Cleaning**: Cleaning of inside surface of HVAC supply Air ducts with specialized latest robotic technology equipment and vacuumization machines, a robotic camera to be used for inspection and cleaning of duct. The contractor shall give copy of the video footage in CD before and after cleaning of ducts. (Duct cleaning work has to carried out by NADCA certified agency). Scope should include the opening and closing of duct area required for cleaning.				
5.1	Estimated Area 500 sq.mts.	1	Lot		
	Approved Makes: Rapid Cool/CPWD APPROVED MAKES				
6	Supply, Installation, Testing and Commissioning of Ceiling Suspended Fan Coil Unit(Cassette Type/ Hi Wall/ Fan Coil Unit- Ceiling) complete with G.I. casing with bottom return Air Plenum (5mm PE insulation) or as per site requirement, Filter box with 8mm Nylon Filter, 3 Row Deep cooling coil with copper tube diameter is 9.52 mm and thickness 0.33 mm with hydrophilic Aluminum fins. An air vent in the coil must be provided. Complete coil must be designed for standard working pressure is 1.6 MPa (16bar) and the test pressure is 3.3MPa (33bar). Unit to be provided with SS drain pan with 7mm PE insulation and +200 mm extended. Direct driven fan (three speed) motor, operated on 230 volts, single phase, 50Hz, AC supply. Unit to be provided with electronic Thermostat having LCD and touch button. It has to based on microprocessor operations which can realize intelligent control of room temperature. It shall also have RS485 Modbus communication function for BMS control, ESP for the Fan Coil Unit be 80 Pa Minimum, Else Specified. The Capacity calculation sheet for Heating application of unit should be in Line with ASHRAE/ Euro vent Standard for Fan Coil and to be approved by Consultant. The Cut outs to be made in ceiling as per the Machine for the Servicing purpose/Trape Door should be included in the price. SCOPE should also include the dismantling the present unit and installing new unit with repair of the false ceiling/ new false ceiling installed. Minimum Capacity should be as follows:				
	Unit to be provided with electronic Thermostat having LCD and touch button. It has to based on microprocessor operations which can realize intelligent control of room temperature. It shall also have RS485 Modbus communication function or Bacnet for BMS control.				
	Scope should include the Unit to be installed with 2 way Self Balancing Valve/3 Way, Isolating Valve i.e Ball Valve and Strainer, 2 way Self Balancing Valve (Pressure Independent)/3 Way should be capable of RS485 Modbus communication function for BMS control. Auto Air vent should be part of the UNIT assembly. The desired U trap should be given as per the site Requirement.				
6.1	2 Tr Casette	7	Nos		

	Approved Makes: FCU: Daikin, Midea, Trane, York, Carrier, Sinko				
	Approved Makes: 2 Valve: Danfoss, Siemens, Honeywell, Belimo, Ballorex, JCI				
	Approved Makes: Remote/Thermostat: Danfoss, Siemens, Honeywell, Belimo/ Ballorex/ JCI/OEM approved				
7	Supplying, fixing, testing and commissioning of following nominal sizes of chilled water piping inside the building (with necessary clamps, vibration isolators and fittings such as bends, tees etc.) dully insulated with following closed cell elastomeric nitrile rubber of minimum 45Kg/cum density, thermal conductivity of 0.037 W/MK or better at 20 Degree Mean temperature class "O" insulation applied by suitable rubber based adhesive complete including repairing of damage to building etc as per specification and as required complete in all respect. The Pipe should be workable in the temp. range of -50 Degree Celsius to 120 Degree Celsius. Note: The Pipes size 150mm & below shall be M.S. 'C' class as per IS: 1239 and pipes size above 150mm shall be welded black steel pipe heavy class as per IS: 3589, from minimum 6.35mm thick M.S. Sheet for pipes up to 350 mm dia. And from minimum 7mm thick MS sheet for pipes of 400 mm dia and above.				
7.1	Inside Building				
7.1.1	150 mm with 32 mm Nitrile Rubber and 26 Gauge GI Cladding	50	mts		
7.1.2	100 mm with 32 mm Nitrile Rubber and 26 Gauge GI Cladding	40	mts		
7.1.3	80 mm with 32 mm Nitrile Rubber and 26 Gauge GI Cladding	50	mts		
7.1.4	65 mm with 32 mm Nitrile Rubber and 26 Gauge GI Cladding	120	mts		
7.1.5	50 mm with 32 mm Nitrile Rubber and 26 Gauge GI Cladding	50	mts		
7.1.6	40 mm with 32 mm Nitrile Rubber and 26 Gauge GI Cladding	20	mts		
7.1.7	32 mm with 19 mm Nitrile Rubber and 26 Gauge GI Cladding	20	mts		
7.1.8	25 mm with 19 mm Nitrile Rubber and 26 Gauge GI Cladding	20	mts		
7.1.9	20 mm with 19 mm Nitrile Rubber and 26 Gauge GI Cladding	20	mts		
	Approved Makes: Zeco/Seven Star/Lloyd/Parma Pipe/CPWD approved Supplier				
8	Supply, Installation, Testing and commissioning of PVC (minimum 15kg/sqcm pressure rated) drain water piping complete with fittings (elbows, tees, reducers, sockets, u trap, etc.) supports, jointing insulated with XLPE class O tubular insulation and any other item required to make the system complete. Nominal diameters of pipe in mms as indicated below:				
i	25 mm dia pipe, Insulation thickness - 19 mm	100	mts		

ii	32 mm dia pipe, Insulation thickness - 19 mm	50	mts		
iii	40 mm dia pipe, Insulation thickness - 19 mm	50	mts		
9	**Cabel Tray**				
9.1	Supplying and installing following size of perforated painted with powder coating M.S. cable trays with perforation not more than 17.5%, in convenient sections, joined with connectors, suspended from the ceiling/Ground/wall with M.S. suspenders including bolts & nuts, painting suspenders etc. as required				
i	150 * 50*1.6	1,500	mts		
10	**Duct and Grills**				
10.1	Supply, Installation, Testing Balancing & Commissioning of G.S.S rectangular/round ducting including plenum as required as per IS 655 - 2006 complete with gaskets, elbows, splitters, vanes, supports adjustable dampers, etc. as per approved drawings.(Factory Fabricated/Site assembled)The price shall include necessary scaffolding required for working at required height. Scope should also include the Duct extension in Auditorium area as reuired.				
	Hot dipped Galvanised with 120GSM Zinc coating				
i	Thickness: 0.63 mm Sheet	100	Sq.m		
ii	Thickness: 0.8 mm Sheet	100	Sq.m		
iii	Thickness: 1 mm Sheet	50	Sq.m		
10.2	Supplying, Fixing, testing and commissioning of Motorized dampers (Fire Dampers) for Fresh Air in supply air duct/ main branch and return air path as and where required of required sizes i/c control wiring, the damper shall be motorized and spring return so as to close the damper in the event of power failure automatically and open the same in case of power being restored. The spring return action shall be inbuilt mechanism and not externally mounted. The damper shall also be closed in the event of fire signal complete as required and as per specifications.	10	sq.m		
10.3	Supply and fixing of 25 mm thickness duly laminated aluminum foil (minimum 60 micron) of mat finish closed cell Nitrile rubber(Class O) insulation on the existing duct after applying suitable adhesive for Nitrile Rubber. The joint shall be sealed with 50 mm wide and 3 mm thick self adhesive nitrile rubber tape insulation complete as per specification and as required.	250	sq.m		
10.4	Supply and fixing of acoustic lining of supply air duct and plenum with 25 mm thick resin bonded glass wool having density of 32 kg/m³, with 25 mm X 25 mm GI section of 1.25 mm thick, at 600 mm centre to centre covered with Reinforced Plastic tissue paper and 0.5 mm thick perforated aluminum sheet fixed to inside surface of ducts with cadmium plated nuts, bolts, stick pins, CPRX compound etc. complete as required and as per specifications. Acoustic lining of supply air duct and plenum with 25 mm thick resin	10	sq.m		

	bonded glass wool having density of 32 kg/m³.				
10.5	Supplying & fixing of powder coated extruded aluminium Supply Air Grills with aluminium volume control dampers as per specifications.	10	sqm		
10.6	Supply and fixing of Flexible connection Duct.	10	sq.m		
10.7	Supplying & fixing of powder coated extruded aluminium Return Air Grills with lovers and without aluminium volume control dampers as per specifications.	10	sqm		
10.8	Supplying , fixing ,tseting and commsioning of Supply Air Diffuser powder coated extruded with aluminium volume control dampers with anti smudge ring and removal core as per specifications.	5	sqm		
10.9	Supplying , fixing ,tseting and commsioning of Return Air Diffuser powder coated extruded without aluminium volume control dampers with anti smudge ring and removal core as per specifications.	5	sqm		
11	**Valves - Manual**				
	Supplying, fixing, testing and commissioning of following diameter valves(PN-16 Rating) (Complete with Flanges integral or welded, fittings, Nuts, Bolts & Gaskets (PN-16 Rating), strainers (Complete with flanges integral or welded, fittings, Nuts, Bolts & Gaskets (PN-16 Rating), gauges etc for condenser water circulation as per specifications. Insulation thickness of valves should be equal to the Insulation of Nitrile Rubber and GI Cladding of Pipe Section as specified.				
11.1	Butterfly Valve (Insulated Valves) with CI body SS disc nitrile sheet & O ring, Complete with fittings, Nuts, Bolts & Gaskets.				
11.1.1	150 mm	2	Nos.		
11.1.2	65 mm	8	Nos.		
	Approved Makes:Audco/C&R/Adverse				
11.2	Y - STRAINER (Insulated Valves) of Ductile CI Body flanged ends with stainless steel strainer for hot water circulation including Insulation thickness of valves should be equal to the Insulation of Nitrile Rubber and GI Cladding of Pipe Section as specified.				
11.2.1	65 mm	4	Nos.		
	Approved Makes:Audco/C&R/Adverse/Anergy				
11.3	NON - RETURN VALVE (Insulated Valves) with duel plate of CI body SS plates vulcanized NBR seal flanged end & PN 16 pressure rating for hot water circulation including Insulation thickness of valves should be equal to the				

	Insulation of Nitrile Rubber and GI Cladding of Pipe Section as sepcified.				
11.3.1	65 mm	4	Nos.		
	Approved Makes:Audco/C&R/Adverse/Anergy /CPWD approved supplier				
11.4	Automatic Air Purge Valves for hot water circulation header as specified and required by Engineer In Charge.				
11.4.1	Automtic Air Purge Valve	10	Nos.		
	Approved Makes:Audco/C&R/Adverse/Anergy/CPWD approved supplier				
11.5	**Air Separator**				
11.5.1	150 mm	1	Nos.		
11.6	SITC of water pressure gauge (100 mm Ø) bourdon type with brass ball valve of 3/8" Ø and SS tubing, socket. Range (0-50) / (0-100) as required by Engineer In Charge.	25	Nos.		
11.7	SITC of Mercury in glass industrial thermometer in SS-304 casing with 0.5 C least count, range 0-50 C. Brass oil filled thermometer of 1/2" size as required by Engineer In Charge.	25	Nos.		
12	**Valves - Motorized and Self Balancing**				
13	Supply, Installation, Testing and Commissioning of following sizes electronic, selfbalancing,pressure independent type dynamic balancing valve with integrated 2 way modualating control valves in a single body. The actuator shall be capable of accepting upto 10V DC and upto 20mA electric signal and shall provide similar transduced feedback output to control system. Maximum close off pressure shall not be less than 6 Bar for upto 50 mm valves and not be less than 7 Bar for 65 mm & above. Valves should have pressure rating of 25 Bar minimum.				
14	65 mm	4	Nos		

S.No.	DESCRIPTION	QTY	Unit	RATE	AMOUNT
15	**Electrical distribution Panel**				

	Supplying, installation, testing & commissioning of cubical type wall/floor mounted Distribution Panel suitable for **OUTDOOR application** from CPRI approved Manufacturer, for 415V, 3 Phase, 4Wire 50 Hz AC supply system fabricated in compartmentalized design from CRCA sheet steel of 2mm thick for frame work and covers, 3 mm thick for gland plates i/c cleaning & finishing complete with 7 tank process for powder coating in approved shade, having Suitable Amp capacity extensible type Copper bus bars of high conductivity, SMC bus bar supports, with short circuit withstand capacity of 50kA with entire panel shall have a common earth bus of suitable size at the rear with 2 Nos earth stud, solid connections from main bus bar to switch gears with required size of Copper bus bars and control wiring with 1.5 sq.mm. PVC insulated FRLS copper conductor, Single Core cable, cable alleys, cable gland plates. providing & fixing following switch gears:-				
	Each MCCB shall be with the following.				
i	Extended Rotary Operating Handle, Phase Spreader links and Phase barriers				
ii	1 Set - Digital Ammeter with in built ASS, metering C.T.s "CAST RESIN" type, 15VA, and accuracy class-1of 800/5A for measuring current in each phase				
iii	1 Set - Digital Voltmeter with in-built VSS, with 2Amp. Backup MCB				
iv	1 Set - 3 Nos. Phase indication LED lamps with 2Amp backup MCB, Breaker 'ON/OFF' indicating light with 2A MCB, test terminal block set, circuits as per standard practice, auxiliary contacts for positive interlocking of the breakers as required. - 2 Set				
v	1 No. Suitable energy meter				
vi	Each Panel will have Junction box with holes punched for connecting it to existing panel through Cable.				
A	**Electrical distribution Panel**				
	Each MCCB shall be with the following.				
i	Extended Rotary Operating Handle, Phase Spreader links and Phase barriers				
ii	1 Set - Digital Ammeter with in-built ASS, metering C.T.s "CAST RESIN" type, 15VA, and accuracy class-1of 800/5A for measuring current in each phase				
iii	1 Set - Digital Voltmeter with in-built VSS, with 2Amp. Back up MCB				
iv	1 Set - 3 Nos. Phase indication LED lamps with 2Amp back up MCB, Breaker 'ON/OFF' indicating light with 2A MCB, test terminal block set, circuits as per standard practice, auxiliary contacts for positive interlocking of the breakers as required. - 2 Set				
v	Location of the Electrical panel should be as required by Engineer - In - Charge.				
	`				
15.1	**Panel - Main (Location: PLANT ROOM)**				

	Incomer				
	Bus Bar:-				
I	TPN Copper extensible type main bus bars of minimum of 500 A capacity (As per capacity of corresponding incoming / Bus couplers), and auxiliary bus bars of suitable capacity with heat shrunk coloured sleeves and i/c SMC bus bars supports at required intervals, complete for cross section, size supports & their spacing etc., for withstanding fault level of 50kA.				
	Outgoings				
	Supplying and fixing the following outgoing complete connections, interconnections, etc., as required.				
II	1 No. - 500 Amps Four Pole, 50 KA, MCCB/MCB with Thermal Magnetic release with O/C, S/C & E/F protection release.	1	Set		
III	**Outgoings**				
	Supplying and fixing the following outgoing complete connections, interconnections, etc. as required				
a)	4 Nos- 65 A 50 KA TPN MCB with Microprocessor release 4# Chiller 39 TR				
b)	4 Nos. - 20 A 35 KA TPN MCB with and single phase preventer (For pump)				
c)	2 Nos. - 20 A 35 KA TPN MCB with single phase preventer				
d)	2 Nos. - 10 A 35 KA TPN MCB with single phase preventer				
	L.T. CABLES				
16	Supply & Laying/ fixing of following size XLPE insulated and PVC sheathed Copper conductor armoured cable/unarmoured as required of 1.1 KV grade complete as required. (ISI Marked) (in ground/in pipe/in duct/on surface/on cable tray)				
16.1	4 x 16 sq.mm. (Chiller)	Mtrs.	100		
16.2	4 x 10 sq.mm.(PUMPS,AHU)	Mtrs.	100		
16.3	4 x 6 sq.mm.	Mtrs.	100		
16.4	3 core x 2 sq.mm.	Mtrs.	100		
17	**EARTHING & MISCELLANEOUS ITEM**				
17.1	Earthing complete with galvanised copper earth plate electrode 60cm × 60cm × 6mm thick, buried directly in ground (earth pit not less than 2.25 metres deep below ground level) with top edge of the plate not less'than 1.5 metres below normal ground level, connected to galvanised earth lead wire but using galvanised iron strip 32×6mm as earthing lead	3	Set		
17.2	Supply and fixing rubber matting conforming to IS-15652-2006 complete as required. of size 2m * 1m * 25 mm	3	Nos.		

	GRAND TOTAL with GST A				
18	Dismantling and buying back				
1.1	Dismantling and buying back (including lifting, shifting & transportation) of following items, including legal disposal of the debris.				
i	chiller 3 x 40TR	1	Lot		
ii	Pump 3 Nos	1	Lot		
iii	Piping	1	Lot		
iv	Electrical panel	1	Lot		
v	Stater panel	1	Lot		
vi	Cable	1	Lot		
vii	7 Nos. AHU	1	Lot		
	GRAND TOTAL with GST B				
Project: Supply, Installation, Testing and Commissioning of Central Cooling System (Revamping the old Centrally AC system) at IGIDR, Mumbai.					
S.No.	**DESCRIPTION**	**QTY**	**Unit**	**RATE**	**AMOUNT**
	FINAL GRAND TOTAL with GST - C = (A-B)				
S.No.	**Comprehensive Annual Maintenance Contract:** Annual Comprehensive routine operation and preventive maintenance comprising Central AC system i/c all accessories, consumables like oil, gas, PCBs & other items to keep the system in perfect running condition as required for the following periods after the defect liability period of **one** year after successfully commissioning and handing over.	**QTY**	**Unit**	**RATE**	**AMOUNT**
1	**1st Year** After Defect Liability	1	Nos		
2	**2nd Year** After Defect Liability	1	Nos		
3	**3rd Year** After Defect Liability	1	Nos		
4	**4th Year** After Defect Liability	1	Nos		
	GRAND TOTAL with GST D				

Note:

The above-quoted rates are inclusive of all applicable taxes. The bifurcation of the quoted rate is enclosed in a separate Excel sheet (Basic rate + %GST, GST Amount, and Total amount, etc.) to be attached with the financial bid.

Date: Signature of the bidder with company seal

**To be submitted on the company letterhead with signature and seal on it.*

ANNEXURE – A*

FORMAT OF UNDERTAKING, TO BE FURNISHED ON COMPANY LETTER HEAD WITH REGARD TO BLACKLISTING/NON-DEBARMENT, BY ORGANISATION UNDERTAKING REGARDING BLACKLISTING / NON–DEBARMENT

To,

The Registrar

Indira Gandhi Institute of Development Research

Film City Road, Santosh Nagar,

Goregaon (East),

Mumbai – 400 065.

We hereby confirm and declare that we, M/s ----------, is not blacklisted/ De-registered/ debarred by any Government department/ Public Sector Undertaking/ Private Sector/ or any other agency for which we have executed/undertaken the works/ Services during the last 5 years.

For M/s _____

Authorized Signatory

Date:

**To be submitted on the company letterhead with the signature and stamp on it.*

Annexure-I

Sr. No.	Item	Information to be filled by Bidder
1	Name of the bidder	
2	Address	
3	Telephone Number: Office /Residence: Mobile Number: Fax No. E-Mail address-	
4	Name of the Contact Person Mobile Number	
5	Details of Registration (number & date)	
6	Month and Year in which the Partnership firm/company was formed/ incorporated.	
7	Type of organisation (Partnership firm, Pvt Ltd., Public Ltd., etc.)	
8	Enclose a copy of the Partnership Deed or Memorandum of Association if applicable	
9	Average Annual Turnover of the Last Three Financial Years (attached audited balance sheets and profit & loss statements or CA certificate)	FY 2022-23: FY 2023-24: FY 2024-25:
10	Bank Account Details	A/C No. Bank Name: IFSC:

**To be submitted on the company letterhead with signature and stamp on it.*

Annexure-II

Bid Security Declaration Format

(*On company letterhead)

Date: Tender No._____

To
INDIRA GANDHI INSTITUTE OF DEVELOPMENT RESEARCH
GOREGAON, MUMBAI – 400 065

I/We undersigned, declare that:

1) I/We understand that, according to your conditions, bids must be supported by a Bid Securing Declaration.

2) I/We accept that I/We may be disqualified/debarred from bidding against INDIRA GANDHI INSTITUTE OF DEVELOPMENT RESEARCH tenders for a period of one year from the date of notification if I/We are in a breach of any obligation under the bid conditions, because I/We
a) have withdrawn/modified/amended, impairs or derogates from the tender, my/our bid during the period of bid validity specified in the form of Bid; or
b) having been notified of the acceptance of our Bid by the purchaser during the period of bid validity (i) fail or refuse to execute the contract, if required, or (ii) fail or refuse to furnish the Performance Security within the timeline, in accordance with the instructions to Bidders & as per tender terms & conditions.

3) I/We understand this Bid Security Declaration shall cease to be valid on the Thirty-First day from following,
a) If I am/we are not the successful Bidder, the receipt of your notification of the name of the successful Bidder; or
b) the expiration of the validity of my/our Bid or any extension thereof.

Signed:
Name:
Capacity:
(insert signature of person whose name and capacity are shown) In the capacity of (insert legal capacity of person signing the Bid Security Declaration)

Annexure-III

Certificate/ Undertaking

This is to certify that we have visited the site for work of **Supply, Installation, Testing and Commissioning of Central Cooling System (Revamping the old Centrally AC system), at INDIRA GANDHI INSTITUTE OF DEVELOPMENT RESEARCH, GOREGAON, MUMBAI – 400 065** on …..... and assessed the actual situation & nature of the site. We have also assessed the amount of work involved at the site for tendered work before submitting our offer. We will be able to complete the above work within the stipulated time as per site conditions.

We further undertake that no extra cost will be claimed by us later on for any difficulties/ modifications involved during the execution of tendered works. We understand that work is to be executed in an already operational/ functional institute.

Authorized Signatory

Name & Address of the company with seal

Annexure-IV

DETAILS OF TECHNICAL PERSONNEL TO BE EMPLOYED FOR THE WORK

S.No	Designation	Total No.	No. available for this work	Name	Qualifications	Professional experience & details of work carried out	How these Would be Involved in This work	Remarks
1	2	3	4	5	6	7	8	9
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

* CV should be attached for each personnel, which should specify relevant experience.