Name of work

Supply, installation, testing and commissioning of Variable Frequency Drive (VFDs) and associated sensors for existing AHUs at various locations within IIT Kanpur.

BID DOCUMENT

Superintending Engineer, IWD

Office of Superintending Engineer, IWD
Indian Institute of Technology, Kanpur

Indian Institute of Technology Kanpur

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It is certified that this document contains 116 pages

Superintending Engineer

1. Notice Inviting e-Tenders

The Superintending Engineer, IWD, IIT Kanpur on behalf of Board of Governors of IIT Kanpur invites online percentage rate tender from eligible air conditioning contractor satisfying criteria mentioned in the document for the following air conditioning work in two bid system.

NIT No: 07/AC/SE/2026/45 dated 18.05.2026

1	Name of work	:	**Supply, installation, testing and commissioning of Variable Frequency Drive (VFDs) and associated sensors for existing AHUs at various locations within IIT Kanpur.**
2	Estimated cost (inclusive of GST)	:	**Rs. 23,44,284/-** **(I/c GST)**
3	Earnest Money Deposit (Rs.)	:	**Rs. 46,886/-** **(The Director, IIT Kanpur)**
4	Duration of contract	:	**Two (2) months**
5	**Last Time & date of submission of bids (Up to)**	:	As per CPP portal data (https://eprocure.gov.in/eprocure/app)
6	**Opening of bids**	:	As per CPP portal data (https://eprocure.gov.in/eprocure/app)
7	**Time allowed for submission of requisite documents by lowest bidder**	:	Within **One week** of opening of financial bids

The bid forms and other details may be downloaded from Central Public Procurement Portal (http://eprocure.gov.in/eprocure/app). Aspiring bidders who have not enrolled / registered in e- procurement should enroll / register themselves before participating through web site http://eprocure.gov.in/eprocure/app. The portal enrolment is free of cost. Bidders are advised to go through instructions provided at "Instructions for online bid submission."

Bidders can access tender documents on the website (for searching in the NIC site), kindly go to quotation search option and type 'IIT'. Thereafter, click on "GO" button to view all IIT quotations. Select the appropriate quotation / tender and fill them with all relevant information and submit the completed Quotation / Tender document online on the website http://eprocure.gov.in/eprocure/app. as per the schedule given in the next page.

Note: No manual bids will be accepted. All bids (both Technical & Financial) should be submitted in the e-procurement portal.

Applicants are advised to keep visiting the above-mentioned websites from time to time (till the deadline for bid submission) for any updates in respect of the tender documents, if any. Failure to do so shall not absolve the applicant of his liabilities to submit the applications complete in all respect including updates thereof, if any. An incomplete application may be liable for rejection.

Superintending Engineer, IWD

INDIAN INSTITUTE OF TECHNOLOGY KANPUR
INSTITUTE WORKS DEPARTMENT
Air-conditioning Division
NOTICE INVITING E-TENDER

The Superintending Engineer, IWD, I.I.T., Kanpur on behalf of Board of Governors of IIT Kanpur invites online percentage rate tender from eligible air conditioning contractors for the following air-conditioning & refrigeration work in two bid system:-

Sl. No	Name of work	Estimated cost put to tender (In Rs.)	Earnest Money (In Rs.)	Period of Completion (in Month)
1	**Supply, installation, testing and commissioning of Variable Frequency Drive (VFDs) and associated sensors for existing AHUs at various locations within IIT Kanpur.**	23,44,284/- (I/c GST)	46,886/-	02 Months

Last date & time of submission of bid 3.30 PM on …….. The bid forms and other details are available on website https://eprocure.gov.in/eprocure/app, https://iitk.ac.in/iwd/tenderhall.htm. But the bids can only be submitted online through, https://eprocure.gov.in/eprocure/app. Any corrigendum regarding this Tender will be published only on above mentioned website.

NIT No. 07/AC/SE/2026/45 Dated: 18.05.2026

Superintending Engineer

2. Information and Instructions for Bidders for E-Tendering

The Superintending Engineer, IWD, IIT Kanpur on behalf of Board of Governors of IIT Kanpur invites online percentage rate tender from eligible Air conditioning contractor satisfying criteria mentioned in the document for the following Air conditioning work in two bid system.

1	Name of organization	:	Indian Institute of Technology, Kanpur
2	NIT No.	:	07/AC/SE/2026/45
3	Location	:	Indian Institute of Technology, Kanpur
4	Tender / Quotation type (open / limited /EOI / Auction / Single	:	Open
5	Tender / Quotation category (services / works	:	Works
6	Type of Contract (work / supply / auction/ service / buy / empanelment / sell	:	Works
7	Form of contract (CPWD-7/8)	:	CPWD-7
8	Work Category (civil / electrical / Air Conditioning / fleet / management / computer system	:	Air conditioning Work
9	Is multi-currency allowed?	:	No
10	Date of publishing / issue / start	:	As per CPP portal
11	Document download start date	:	As per CPP portal
12	Document download end date	:	As per CPP portal
13	Date & time of pre-bid meeting	:	As per CPP portal
14	Venue of pre-bid meeting	:	As per CPP portal
15	Last date & time of uploading of bids	:	As per CPP portal
16	Date & time of opening of technical bids	:	As per CPP portal
17	Bid Validity Days	:	90 days after opening of technical bid
18	Earnest Money Deposit (EMD)	:	**Rs. 46886/- scanned copy as a proof of EMD deposition to be uploaded with e-Tendering website by the bidder within the**

			period of bid submission. The hardcopy of earnest deposit receipt (EMD) shall be submitted in the office of Superintending Engineer
20	No. of Bids / Covers (1 / 2 / 3 / 4)	:	2
21	Address for communication	:	Office of Superintending Engineer, IWD, IIT Kanpur-208016 Contact no. 0512-259-7725
22	Email address	:	seiwd@iitk.ac.in; vktiwari@iitk.ac.in

The intending bidder must read the terms and conditions of CPWD-6 carefully. He should only submit his bid if he considers himself eligible and he is in possession of all the documents required.

1. Information and instructions for bidders posted on website shall form part of bid document.
2. The bid document consisting of drawings, specifications, schedule of quantities of items to be executed, schedule of stages for payment as applicable and the set of terms & conditions of the contract to be complied with and other necessary documents can be seen and downloaded free of cost from www.eprocure.gov.in
3. But the bid can only be submitted proof of submission of EMD.
4. Those contractors not registered on the website mentioned above, are required to get registered beforehand. Only e-bids shall be accepted in CPPP portal through e-tendering processes.
5. The intending bidder must have valid Class-III digital signature to submit the bid.
6. On opening date, the contractor can login and see the bid opening process. After opening of bids, he will receive the competitor bid sheets.
7. Contractor can upload documents in the form of JPG format and PDF format.
8. Contractor must ensure to quote rate of each item. The column meant for quoting rate in figures appears in pink colour and the moment rate is entered, it turns sky blue.

   In addition to this, while selecting any of the cells a warning appears that if any cell is left blank the same shall be treated as "0". Therefore, if any cell is left blank and no rate is quoted by the bidder, rate of such item shall be treated as "0" (ZERO).

However, if a tenderer quotes nil rates against each item in item rate, the tender shall be treated as invalid and will not be considered as lowest tenderer.

9. The "Eligibility/technical Bid" shall be opened first on due date and time as per the evaluation scheme. The "Financial Bid" of bidders qualifying the technical bid shall be opened on a later date as to be announced in CPP portal.

10. The bidders are advised to visit the site before submission of bids to have more clarity about the site conditions and availability of space for execution of the work.

11. All modifications/addendums/corrigendum's issued regarding this bidding process shall be uploaded on website only.

12. The department reserves the right to reject any or all bids without assigning any reason thereof and may restrict the list of qualified bidders to any number deemed suitable by it, if too many bids are received satisfying the minimum laid down criteria.

13. The rates for all items of work, shall unless clearly specified otherwise, include cost of all operations and all inputs of labour, material, T&P, scaffolding, wastages, watch and ward, other inputs, all incidental charges, all other taxes (inclusive of GST), cess, duties, levies etc. required for execution of the work.

14. If claimed, the enlistment of the contractors should be valid on the last date of submission of bids. In case the last date of submission of bid is extended, the enlistment of contractor should be valid on the original date of submission of bids.

15. The description of the work is as follows: **" Supply, installation, testing and commissioning of Variable Frequency Drive (VFDs) and associated sensors for existing AHUs at various locations within IIT Kanpur.."** The work is estimated to cost **Rs. 2344284/-**. However, this estimate given is mere approximation for guide.

16. Agreement shall be drawn with the successful bidders on prescribed Form No. CPWD 7 which is available as a Govt. of India Publication and also available on website www.cpwd.gov.in. Bidders shall quote his rates as per various terms and conditions of the said form which will form part of the agreement.

17. The site for the work will be handed over as per the special terms and conditions of the document.

18. An approval programme of completion submitted by the contractor after award of work based on the milestone given in the tender.

19. The bid document consisting of NIT, the schedule of quantities of various

types of items to be executed and the set of terms and conditions of the contract to be complied with and other necessary documents can be seen and downloaded from website www.eprocure.gov.in free of cost.

20. After submission of the bid the contractor can re-submit revised bid any number of times but before last time and date of submission of bid as notified.

21. While submitting the revised bid, contractor can revise the rate of one or more item(s) any number of times (he/she need not re-enter rate of all the items) but before last time and date of submission of bid as notified.

22. Earnest Money Deposit receipt scanned copy shall be uploaded to the e-Tendering website within period of submission.

23. Earnest money can be paid in the form of Treasury Challan or Demand Draft or Pay order or Banker's cheque or Deposit at call receipt or Fixed Deposit Receipt drawn in favor of Director IIT Kanpur along with Bank Guarantee of any Scheduled Bank where applicable.

    A part of earnest money is acceptable in the form of bank guarantee also in such case 50% of earnest money or Rs. 20 lacs, whichever is less, will have to be deposited in shape prescribed above and balance in shape of Bank Guarantee of any scheduled bank.

24. Copy of documents as specified in the bid shall be scanned and uploaded to the e-tendering website within the period of bid submission.

25. The bid submitted shall be opened at as per the details provided in the CPP portal at IWD office. The date of opening of Financial Bid shall be informed through web site after the opening of financial bid

26. The bid submitted shall become invalid if:

    (i) The bidder is found ineligible.

    (ii) If the bidder does not deposit original EMD to the office of Superintending Engineer, AC Division, IWD, IIT Kanpur within the due date of submission.

    (iii) The bidder does not upload scanned copies of all the documents stipulated in the bid document.

    (iv) If a tenderer quotes nil rates against each item in item rate tender (if applicable), the tender shall be treated as invalid and will not be considered as lowest tenderer.

27. The contractor whose bid is accepted will be required to furnish performance guarantee of 5% of tendered value within the period specified in Schedule F. This guarantee shall be in the form of Fixed Deposit Receipts or Guarantee Bonds of any Scheduled Bank or the State Bank of India in accordance with the prescribed form.

28. In case the contractor fails to deposit the said performance guarantee within the period as indicated in Schedule 'F' including the extended period if any, the contractor shall be suspended for two years and shall not be eligible to bid for IITK tenders from the date of issue of suspension order.

29. The contractor whose bid is accepted will also be required to furnish either copy of applicable licenses/ registrations or proof of applying for obtaining licenses, registration with EPFO, ESIC and BOCW Welfare Board including Provident Fund Code No. If applicable and also ensure the compliance of afore said provisions by the sub-contractors, if any engaged by the contractor for the said work and program chart (Time and Progress) within the period specified in Schedule 'F'.

30. Intending Bidders are advised to inspect and examine the sites and its surroundings and satisfy themselves before submitting their bids as to the nature of the ground and sub-soil (so far as is practicable), the form and nature of the site, the means of access to the site, making proper arrangements to the site for smooth operation, the accommodation they may require and in general shall themselves obtain all necessary information as to risks, contingencies and other circumstances which may influence or affect their bid. Bidder shall be deemed to have full knowledge of the sites whether he inspects it or not and no extra charge consequent on any misunderstanding or otherwise shall be allowed. The bidder shall be responsible for arranging and maintaining at his own cost all materials, tools & plants, water, electricity access, facilities for workers and all other services required for executing the work unless otherwise specifically provided for in the contract documents. Submission of a bid by a bidder implies that he has read this notice and all other contract documents and has made himself aware of the scope and specifications of the work to be done and of conditions and rates at which stores, tools and plant, etc. will be issued to him by the Institute and local conditions and other factors having a bearing on the execution of the work.

31. Intending Bidders are advised to get familiarized with the specifications /rules related (i.e.**"Supply, installation, testing and commissioning of Variable Frequency Drive (VFDs) and associated sensors for existing AHUs at various locations within IIT Kanpur..."**.to the work as approved by the competent authority and various policies related to C&D waste and other environmental guidelines of the institute pertaining to the. Bidder shall be deemed to have full knowledge of such rules and regulations whether he has read it or not and no extra charge consequent on any misunderstanding or otherwise shall be allowed. In case of reduction of scope of work or no work is possible to carry out on account of such issues, no cost shall be payable to them. Submission of a bid by the bidder implies that he has read this notice and

all other documents and has made himself aware of the Institute Regulations and other factors having a bearing on the execution of the work.

32. The competent authority on behalf of the Board of Governors does not bind itself to accept the lowest or any other bid and reserves to itself the authority to reject any or all the bids received without assigning any reason. Bids in which any of the prescribed conditions is not fulfilled or any condition including that of conditional rebate is put forth by the bidders shall be summarily rejected.

33. Canvassing whether directly or indirectly, in connection with bids is strictly prohibited and the bids submitted by the bidders who resort to canvassing will be liable to rejection.

34. The competent authority on behalf of the Board of Governors reserves to himself the right of accepting the whole or any part of the bid and the bidders shall be bound to perform the same at the rate quoted.

35. The contractor shall not be permitted to bid for works in the Institute Works Department responsible for award and execution of contracts, in which his near relative is posted as Divisional Accountant or as an officer in any capacity between the grades of Superintending Engineer and Junior Engineer (both inclusive) in IWD. He shall also intimate the names of persons who are working with him in any capacity or are subsequently employed by him and who are near relatives to any gazetted officer in the Office of IWD/ Institute Works Department. Any breach of this condition by the contractor would render him liable to be removed from the approved list of contractors of this Department.

36. No Engineer of Gazetted Rank or other Gazetted Officer employed in Engineering or Administrative duties in an Engineering Department of the Government of India is allowed to work as a contractor for a period of one year after his retirement from Government services without the prior permission of the Government of India in writing. This contract is liable to be canceled if either the contractor or any of his employees is found any time to be such a person who had not obtained the permission of the Government of India as aforesaid before submission of the bid or engagement in the contractor's services.

37. The bids for the work shall remain open for acceptance for a period of Ninety (90) days from the date of opening of bids. If any bidder withdraws his bid before the said period or issue of letter of acceptance, whichever is earlier, or makes any modifications in the terms and conditions of the bid which are not acceptable to the department, then the Institute shall, without prejudice to any other right or remedy, be at liberty to suspend the bidder for one year.

38. This notice inviting Bid shall form a part of the contract document. The

successful bidders/contractor, on acceptance of his bid by the Accepting Authority shall within 7 days from the stipulated date of start of the work, will sign the contract.

39. The Notice Inviting Bid, all the documents including additional conditions, specifications and drawings, if any, forming part of the bid as uploaded at the time of invitation of bid and the rates quoted online at the time of submission of bid and acceptance thereof together with any correspondence leading thereto

40. Standard C.P.W.D. Form 7 or other Standard C.P.W.D. Form as applicable.

41. The bid document will include the following components:

    (a) CPWD-7 and CPWD-6 including Schedule A to F for all the components of the work, Standard General Conditions of Contract for CPWD 2023 as amended/modified up to last date of submission of the bid.

    (b) General / specific conditions, specifications applicable to all components of the work.

42. The eligible bidders shall quote percentage rates after considering all the components ofthe work.

43. After acceptance of the bid by competent authority, the Executive Engineer, IWD shall issue letter of award on behalf of the Board of Governors to the contractor. After the work is awarded, the contractor will have to enter into one agreement with Superintending Engineer, IWD. One such signed set of agreement shall be handed over to Engineer-In-Charge as applicable.

44. Entire work under the scope of bid shall be executed under one agreement.

45. The requirement of technical staff given in various specialized works is as per requirements given in clause 32, page no. 48 of NIT document. The actual deployment of these technical staff will be as per execution of work and direction of the Superintending Engineer, IITK. In case of non-deployment, a penalty of Rs. 25,000/- per month shall be levied from the contractor.

46. The bill for work components shall be facilitated by Engineer-in-Charge to the contractor.

47. The work shall be treated as complete when all the components of the work are complete.

48. It will be obligatory on the part of bidder to sign the contract document for all components before the first payment is released.

49. In case of reduction in scope of work claim on account of reduction in value of work, loss of expected profit, consequential overheads etc. shall not be entertained.

50. A team of officers from Indian Institute of Technology Kanpur may visit the office/ site of work of bidders for establishing their credibility and verification of submitted documents.

51. The mentioned work is urgent as requested by client/Institute and to be completed strictly in given time schedule as per special terms and conditions. The contractor has to deploy the labour and supervisory staff in shifts to meet the targeted completion date. The work may be executed in extended shifts or two shifts. The rates quoted by the contractor will be deemed to be inclusive of any extra expenditures on account of this reason. Nothing shall be paid on this account.

52. Any trenching and digging for laying sewer lines/water lines/cables etc. shall be commenced by the contractor only when all men, machinery's and materials have been arranged and closing of the trench(s) thereafter shall be ensured within the least possible time. All the excavation and digging of the trenches shall be done manually as numbers of service line are passing inside the campus except in certain cases as approved by IITK. **No Hydraulic Excavator shall be allowed for earth digging work** except in certain cases as approved by IITK.

53. Payment shall be regulated as under:

- 75% of the payment against receipt of materials at site on prorata basis listed in BOQ. Delivered material shall be verified by Engineer In-Charge along with delivery challan & test certificates.
- 15% of the payment against completion of installation work and along with satisfactory performance report by Engineer In-charge.
- 10% of the payment against completion of testing and commissioning and satisfactory performance report by Engineer In-charge.

54. The competent authority on behalf of the Board of Governors reserves the right to terminate the contract if,

a) Any violation of labour law has been observed.

b) Any of the construction workers engaged in the works under this contract is found also engaged in Service Contracts of the Institute at the same time.

55. The competent authority on behalf of the Board of Governors reserves the right to disqualify an agency for

(a) Non-compliance of Institute orders

(b) Violation of Institute policies as established by the Competent Authority in the best interests of the Institute.

2.1 Instructions for Online BID Submission

This tender document has been published on the Central Public Procurement Portal (URL: http://eprocure.gov.in/eprocure/app). The bidders are required to submit softcopies of their bids electronically on the CPP portal, using valid Digital Signature Certificates (DSC). The instructions given below are meant to assist the bidders in registering on the CPP portal, prepare their bids in accordance with the requirements and submitting their bids online on the CPP portal.

More information useful for submitting online bids on the CPP portal may be obtained at http://eprocure.gov.in/eprocure/app

2.2.1 Registration

1. Bidders are required to enroll on the e-procurement module of the Central Public Procurement portal (URL:http://eprocure.gov.in/eprocure/app) by clicking on the link, "click here to enroll". Enrolment on the CPP portal is free of charge.
2. As part of the enrolment process, the bidders will be required to choose a unique username and assign a password for the accounts.
3. Bidders are advised to register their valid e-mail address and mobile number as part of the registration process. These would be used for any communication from the CPPP portal.
4. Upon enrolment, the bidders will be required to register their valid Digital Signature Certificate (class 2 or class 3 certificates with signing key usage) issued by any certifying authority recognized by CCA India (e.g. Sify / TCS / nCode/ eMudhra etc.) with their profile.
5. Only one valid DSC should be registered by a bidder. Please note that bidders are responsible to ensure that they do not lend their DSCs to others which may lead to misuse.
6. Bidder then logs in to the site through the secured log-in by entering their user ID Password and the password of the DSC / eToken.

2.2.2 Searching for tender documents

1. There are various search options built in the CPP portal to facilitate bidders to search active tenders by several parameters. These parameters could include tender ID, organization name, location, date, value, etc. There is also an option of advanced search for tenders, wherein the bidders may combine a number of search parameters such as organization name, form of contract, location, date, other keywords etc. to search for a tender published on the CPP portal
2. Once the bidders have selected the tenders they are interested in, they

may download the required documents / tender schedules. The tenders can be moved to the respective "My Tenders" folder. This would enable the CPP portal to intimate the bidders through SMS / e-mail in case there is any corrigendum issued to the tender document.

3. The bidder should make a note of the unique Tender ID assigned to each other; in case they want to obtain any clarification/help from the Helpdesk.

2.2.3 Preparation of bids

1. Bidder should take into account any corrigendum published on the tender document before submitting their bids.
2. Please go through the tender advertisement and the tender document carefully to under- stand the documents required to be submitted as part of the bids. Please note the number of covers in which the bid documents have to be submitted. Any deviations from these may lead to rejection of the bids.
3. Bidder, in advance, should get ready the bid documents to be submitted as indicated in the tender document / schedule and generally, they can be in PDF / XLS / RAR / DWF formats. Bid documents may be scanned with 100 dpi with black &white option.
4. To avoid the time and effort required in uploading the same set of standard documents which are required to be submitted as a part of every bid, a provision of uploading such standard documents (e.g., PAN card copy, annual reports, auditor's certificates, etc.) has been provided to the bidders. Bidders can use "My Space" area available to them to upload such documents. These documents may be directly submitted from the "My Space" area while submitting a bid, and need not be uploaded again and again. This will lead to a reduction in the time required for bid submission process.

2.2.4 Submission of bids

1. Bidder should log into the site well in advance for bid submission so that he / she upload the bid in time i.e. on or before the bid submission time. Bidder will be responsible for any delay due to other issues.
2. The bidder has to digitally sign and upload the required bid documents one by one as indicated in the tender document.
3. A standard BOQ Format has been provided with the tender document to be filled by all the bidders. Bidders are requested to note that they should necessarily submit their financial bids in the format provided and no other format is acceptable. Bidders are required to download the BOQ file, open it and complete the white colored [unprotected] cells with their respective financial quotes and other details (such as

name of the bidder). No other cells should be changed. Once the details have been completed, the bidder should save it online, without changing the filename. If the BOQ file is found to be modified by the bidder, the bid will be rejected.

4. The server time (which is displayed on the bidders' dashboard) will be considered as the standard time for referencing the deadlines for submission of the bids by the bidders, opening of bids etc. The bidders should follow this time during bid submission.
5. All the documents being submitted by the bidders would be encrypted using PKI encryption techniques to ensure the secrecy of the data. The data entered cannot be viewed by unauthorized persons until the time of bid opening. The confidentiality of the bids is maintained using the secured Socket Layer 128-bit encryption technology. Data storage encryption of sensitive fields is done.
6. The uploaded tender documents become readable only after the tender opening by the authorized bid openers.
7. Upon the successful and timely submission of bids, the portal will give a successful bid submission message & a bid summary will be displayed with the bid no. and the date &time of submission of the bid with all other relevant details.
8. Add scanned PDF of all relevant documents in a single PDF file of compliance sheet.

2.2.5 Assistance to bidders

1. Any queries relating to tender document and the terms and conditions contained therein should be addressed to the tender inviting authority for a tender or the relevant contact person indicated in the tender.
2. Any queries relating to the process of online bid submission or queries relating to CPP portal in general may be directed to the 24 x 7 CPP Portal Help Desk.

2.2.6 General instruction to bidders

1. The tenders will be received online through portal https://eprocure.gov.in/eprocure/app. In the technical bids, the bidders are required to upload all the documents in PDF format.
2. Possession of a valid class II / III Digital Signature Certificate (DSC) in the form of smart card / e-token in the company's name is a prerequisite for registration and participating in the bid submission activities through https://eprocure.gov.in/eprocure/app. Digital Signature Certificates can be obtained from the authorized certifying agencies,

details of which are available in the websitehttps://eprocure.gov.in/eprocure/app under the link "Information about DSC".

Tenderers are advised to follow the instructions provided in the "Instructions to the tenderer" for the e-submission of the bids online through the Central Public Procurement Portal for e-procurement athttps://eprocure.gov.in/eprocure/app.

Superintending Engineer

2.3 List of documents to be scanned and uploaded within the period of bid submission

The following mandatory documents to be submitted with online bid submission:

The Online bids (complete in all respect) must be uploaded online in two Envelops as explained here: -

2.3.1 Envelope - 1: Technical Bid

The following mandatory documents to be provided as **a single PDF** file in the same sequence as listed for an eligible bid:

1. EMD scanned copy shall be submitted along with the technical bid**
2. GST Registration Certificate or GST Undertaking as per 5.1
3. Copy of EPF & ESI Registration
4. Copy of PAN card
5. Affidavit for not being blacklisted/debarred/restrained as per 5.2
6. Performance report of works executed as per 5.3 or Completion certificate issued by competent Authority.
7. Structure and Organization of the Agency as per 5.4
8. Declaration on Details of the Bidder(s) as per 5.5
9. Details of Similar Nature of Works Completed as per 5.6
10. Declaration about Site Inspection as per 5.7
11. Letter of Transmittal as per 5.8
12. Tender Certificate as per 5.9
13. Tender Acceptance Letter as per 5.10
14. CPWD-7 5.11
15. Financial Information as per 5.12
16. Bankers certificate as per 5.13 (minimum 40% of estimated cost put to tender) Or Net Worth Certificate (minimum 10% from certified Chartered Accountant with UDIN) as per 5.14
17. Eligible specialized agencies /Enlistment Order of the Contractor in appropriate class and category issued by CPWD.

**** The bidder must provide an Earnest Money Deposit (EMD) for the amount specified in the tender document. This should be in the form of a bank guarantee (including e-bank Guarantee) or Banker's Cheque or Demand Draft (DD) or Fixed Deposit receipt issued by Scheduled Commercial Bank or Nationalized Bank in favour of "The Director, IIT Kanpur" Payable at Kanpur shall be scanned and uploaded to the e-tendering website by the bidder within the period of bid submission. The hard copy of earnest despite receipt (EMD) shall be submitted in the office of Superintending Engineer, Central Office IWD, IIT Kanpur (except in case of e-bank Guarantee) before the date and time of opening of technical bids as specified in the bid document.**

Due date for EMD hardcopy submission is 29.05.2026 @ 15.30Hrs

2.3.2 Envelope - 2: Financial Bid

Price bid should be submitted in BOQ format

3. Eligibility Criteria

3.1 Eligibility criteria for contractors

Contractors who fulfill the following criteria shall be eligible to apply.

Eligible Bidders
Eligible bidders should satisfy the following criteria for an eligible bid:

3.1.1 **Average annual financial turn over:**

Average annual financial turnover of works should be at least 30% of the estimated cost of work put to tender during the last 3 consecutive financial years by the certified Chartered Accountant. Audited turnover statements to be furnished as proof of the same duly certified by chartered accountant along with Profit & Loss Statements.

3.1.2 Bankers Certificate- 40% of the estimated cost put to tender as per 5.13 Or

Net-Worth certificate of minimum 10% of the estimated cost put to tender issued by certified chartered Accountant with UDIN as per 5.14

3.1.3 **Experience:**

Firms/Contractors must have completed satisfactorily
One similar work of 80% value of the estimated cost put to tender
Or
Two similar work of 60% value of the estimated cost put to tender
Or
Three similar work of 40% value of the estimated cost put to tender
Works completed during last 7 years ending last day of the month previous to the one which application are invited.

And

One completed work of similar nature costing not less than the amount equal to 40% of the estimated cost put to tender (either part of above or a separate one) with Central Government Department/ Central Autonomous Body/ Central Public Sector Undertaking/ State Government Department.

3.1.4 **Definition of similar work:** Similar type of work means " SITC of AHU with VFD and associated works. "

The value of executed works shall be brought to current costing level by enhancing the actual value of work at simple rate of 7% per annum; calculated from the date of completion to the previous day of last date of submission of bids.

3.1.5 Should have valid registration of EPF, ESIC and GST.

3.1.6 **Eligible bidders must also satisfy the following conditions and ensure submission of all documents mentioned in 2.3**

A Legal: Unregistered Partnership Firm and Joint Venture or Consortium are not eligible

B Registration: Bidder should be registered with the Income Tax Department (PAN), Employees Provident Fund (EPF) Organization, Employees State Insurance (ESI) Corporation & GST. Bidders are not eligible in absence of these documents.

4. Bid Evaluation and Award

The following process will be followed for the Technical and Financial Bids Evaluation:

4.1 Technical Bid Evaluation

- Technical bids received complete in all respects covering the entire scope of work, will only be opened
- The technical bid evaluation is done only for bidders who satisfy the minimum criteria by submitting documentary proof supporting eligibility criteria and the bids of agencies who have not submitted these documents are liable to be rejected without notice.
- After evaluation of Pre-Qualification Documents, a list of short-listed agencies will be prepared

4.2 Financial Bid Evaluation

For financial bids, the following points shall be followed:

- After evaluation of Pre-Qualification/technical bid Documents, a list of short-listed agencies will be prepared.
- Thereafter the financial bids of only the qualified and technically acceptable bidders who meet the eligibility criteria shall be opened at the notified time & date through CPPP Portal in the presence of the qualified bidders or their representatives, if present.
- The bid shall remain valid for Ninety (90) days from date of opening of eligibility bids/Technical bid.

NOTE

The institute reserves the right, without being liable for any damages or obligation to inform the bidder, to:

- Amend the scope and value of contract to the bidder.
- Reject any or all the applications without assigning any reason.

Any effort on the part of the bidder or his agent to exercise influence or to pressurize the employer would result in rejection of his bid. Canvassing of any kind is prohibited.

4.3 Selection Criteria

Contract award shall be based on the lowest financial bid (L1) among all technically qualified bidders.

5. Various forms and Formats

5.1 Undertaking regarding obtaining GST registration

Proforma for Undertaking regarding obtaining GST registration Certificate of The State in which work is to be taken up

(Undertaking to be furnished on a 'Non-Judicial' stamp paper worth Rs.100/)

(Scanned copy of this notarized undertaking to be uploaded at the time of submission of bid, if required)

If work is awarded to me, I/we shall obtain GST registration Certificate of the State, in which work is to be taken up within one month from the date of receipt of award letter or before release of any payment by IITK, whichever is earlier, failing which I/We shall be responsible for any delay in payments which will be due towards me/us on a/c of the work executed and/or for any action taken by IITK or GST department in this regard.

Signature of bidder

OR

(An authorized Officer of the firm with stamp)

Signature of Notary with Seal

5.2 Affidavit for not being blacklisted/debarred/restrained

Proforma for AFFIDAVIT for not being blacklisted/debarred/restrained

(AFFIDAVIT to be submitted on a 'Non-Judicial' stamp paper worth Rs.100/)
(Scanned copy of this notarized affidavit to be uploaded at the time of submission of bid)

I/we undertake and confirm that our firm/partnership firm has not been blacklisted and/or debarred/restrained by any Central Govt./ State Govt. Agency/ Autonomous body of the Central or State govt./ PSU etc. Further that, if such information comes to the notice of the Institute, then I/we shall be debarred for bidding in the Institute in future forever. Also, if such information comes to the notice of the Institute on any day before date of start of work, the competent authority shall be free to cancel the agreement and to forfeit the entire amount of Earnest Money Deposit/Performance Guarantee.

Signature of bidder

OR

(An authorized Officer of the firm with stamp)

Signature of Notary with Seal

5.3 Performance report on work executed

Proforma of Performance report on works referred to in Financial Information

(To be printed in Company's Letterhead)

(Scanned copy of the Performance Reports to be uploaded at the time of submission of bid)

1. Name of work/project & location:
2. Agreement no.:
3. Estimated cost:
4. Tendered cost:
5. Date of start:
6. Date of completion:
7. Stipulated date of completion:
8. Actual date of completion:
9. Amount of compensation levied for delayed completion, if any:
10. Amount of reduced rate items, if any:
11. Performance Report:
    (a) Quality of work: Outstanding / Very Good / Good /Poor
    (b) Technical Proficiency: Outstanding / Very Good / Good /Poor
    (c) Resourcefulness: Outstanding / Very Good / Good /Poor
    (d) General Behavior: Outstanding / Very Good / Good /Poor

Signature of Superintending Engineer or Equivalent

Dated:

5.4 Structure and Organization of the Agency

Proforma of providing Structure and Organization of the Bidding Agency
(To be printed in Company's Letterhead)

(Scanned copy of the Structure and Organization Document to be uploaded at the time ofsubmission of bid)

1. Name & address of the bidder:
2. Telephone no./Telex no./Fax no.:
3. Email address for Communication:
4. Legal status of the bidder (attach copies of original document defining the legal status):
   (a) An Individual:
   (b) A proprietary firm:
   (c) A firm in partnership:
   (d) A limited company or Corporation:
5. Particulars of registration with various Government Bodies (attach attested photocopy)

   Organization / Place of registration No.

   1.
   2.
   3.
6. Names and titles of Directors & Officers with designation to be concerned with this work.
7. Designation of individuals authorized to act for the organization
8. Has the bidder, or any constituent partner in case of partnership firm, ever been convictedby the court of law? If so, give details.
9. Any other information considered necessary but not included above.

Signature of bidder

5.5 Declaration on Details of the Bidders

Proforma of Declaration on Details of the Bidders
(To be printed in Company's Letterhead)

(Scanned copy of the Performance Reports to be uploaded at the time of submission of bid)

DECLARATION

I/We,..... hereby declare that all the information and data furnished by our organization with regard to this tender specification are true and complete tothe best of our knowledge. I/we have gone through the specification, conditions and stipulations in details and agree to comply with the requirements and intent of specification.

Particulars of the bidder as per following details:

1.	Name of the firm / organization	:	
2.	Type of the firm / organization: Public Ltd, / Private Ltd./ Registered firm	:	
3	Registered office	:	
4	Address of office	:	
5	Contract people	:	
6	Name & designation	:	
7	Land line & mobile no.	:	
8	Email	:	
9	PAN No.	:	
10	GST No.	:	
11	EPF Registration No.	:	
12	ESI Registration No.	:	
13	EMD/FDR/DD No. & Date	:	
14	Has the applicant ever been required to suspend any project for a period of more than six months continuously after Commencement of work?	:	If so, give the name of the project and reasons of suspension of project
15	Has the applicant ever been convicted bya court of law?	:	YES / NO, If yes give details of the case

16	Details of any litigation in which the applicant is / was involved.	:	
17	All forms submitted as desired in the bid	:	Yes / No
18	Undertaking regarding no subletting of work.	:	

We further declare that our organization has not been blacklisted /delisted or put to any holiday by any Institutional agency **/** Govt. Department **/** Public Sector Undertaking in the last three years.

Signature of Bidder(s) with seal

Dated:

5.6 Details of Similar Nature of Works Completed

Proforma for submission of Details of Eligible Similar Nature of Works Completed* during the Last Seven Years ending previous day of the last date of submission of tenders (Scanned copy of the Performance Reports to be uploaded)

The contractor needs to submit the supporting documents

Sr. No	Name of work / project and location	Owners or sponsoring organization	Const of work in crores of rupees	Date of commencement as per contract	Stipulated date of completion	Actual date of completion	Litigation/ arbitration cases pending /in Progress with details*	Name and address / tele-phone number of officers to whom reference may be made	Whether the work was done on back to back basis Yes/No
1	2	3	4	5	6	7	8	9	10
1									

***** Indicate gross amount claimed and amount awarded by the Arbitrator.

Signature of bidder with seal

Dated:

5.7 Declaration about Site Inspection

Declaration about Site Inspection

(By Bidder)

To

The Executive Engineer,

IWD, IIT,

Kanpur

Subject: Submission of Tender for the work of " Supply, installation, testing and commissioning of Variable Frequency Drive (VFDs) and associated sensors for existing AHUs at various locations within IIT Kanpur.."

Dear Sir/Madam,

It is hereby declared that as per terms and conditions of this tender document, **I/** We the bidder inspected and examined the subject site and its surrounding and satisfy myself / ourselves as to the nature of the ground and sub-soil (so far as is practicable), the forms and nature of the site./ ourselves before submitting the bid, the accommodation which may require and all necessary information as to risks, contingencies and other circumstances which may influence or affect our bid have been obtained. I/We the bidder shall have full knowledge of the site and no extra charge consequent upon any misunderstanding or otherwise shall be claimed in later date. I /We bidder shall be responsible for arranging and maintaining at own cost all materials, tools & plants, water, electricity access, facilities for workers and all other services required for executing the work unless otherwise specifically provided for in the contract documents. Submission of a bid by me/us implies that I **/** We have read this notice and all other contract documents and has made myself /ourselves aware of the scope and specifications of the work to be done and local conditions and other factors having a bearing on the execution of the work.

Sincerely

(Duly authorized signatory of the Bidder)

5.8 Letter of Transmittal

To
The Executive Engineer,
IWD, IIT,
Kanpur - 208016

Name of Work: " Supply, installation, testing and commissioning of Variable Frequency Drive (VFDs) and associated sensors for existing AHUs at various locations within IIT Kanpur"

Dear Sir/Madam

Having examined details given in Notice and bid document for the above work, I/we hereby submit the relevant information.

5.9.1 I/We hereby certify that all the statements made and information supplied in the enclosed forms and accompanying statement are true and correct.

5.9.2 I/we have furnished all information and details necessary for eligibility and have no further pertinent information to supply.

5.9.3 I/We also authorize the Executive Engineer, IWD, Indian Institute of Technology Kanpur or his representative(s) to approach individuals, employers, firms and corporation to verify our competence, work experience, and general reputation.

5.9.4 I/we submit the following certificates in support of our suitability, technical knowledge and capability for having successfully completed the following eligible completed works:

Sl. No.	Name of work	Amount	Certificate issued by
1			
2			

CERTIFICATE

It is certified that the information given in the enclosed eligibility bid are correct. It is also certified that I/We shall be liable to be debarred, disqualified/ cancelation of enlistment in case any information furnished by me/us found to be incorrect.

Signature(s) of Bidder with seal Enclosures: Date:

5.9 Certificate for Tender

(To be given on Company Letter Head)

Dated:

To,
Superintending Engineer
IIT Kanpur-208016

Sub: Certificate of compliance as per Rule 144 (xi) GFR's 2017 Tender Reference

No: .....

Name of Tender / Work:

.....

I have read the clause regarding restrictions on procurement from a bidder of a country which shares a land border with India; I certify that this bidder is not from such a country or, if from such a country, has been registered with the Competent Authority. I hereby certify that this bidder fulfils all requirements in this regard and is eligible to be considered. [Where applicable, evidence of valid registration by the Competent Authority shall be attached.]"

I have read the clause regarding restrictions on procurement from a bidder of a country which shares a land border with India and on sub-contracting to contractors from such countries; I certify that this bidder is not from such a country or, if from such a country, has been registered with the Competent Authority and will not sub-contract any work to a contractor from such countries unless such contractor is registered with the Competent Authority. I hereby certify that this bidder fulfills all the requirements in this regard and is eligible to be considered. [Where applicable, evidence of valid registration by the Competent Authority shall be attached.]"

(Signature of the Bidder, with Official Seal)

5.10 Tender Acceptance Letter

(To be given on Company Letter Head)

Date: .....

To,
Executive Engineer,
IWD, IIT,
Kanpur-208016
Sub: Certificate of compliance as per Rule 144 (xi) GFR's 2017
Tender Reference No:
.....
Name of Tender / Work:
.....
Dear Sir,

1. I/ We have downloaded / obtained the tender document(s) for the above mentioned 'Tender/Work' from the web site(s) namely: .... as per your advertisement, given in the above-mentioned website(s).
2. I / We hereby certify that I / we have read the entire terms and conditions of the tender documents from Page No..... to (including all documents like annexure(s), schedule(s), etc .,), which form part of the contract agreement and I / we shall abide hereby by the terms / conditions / clauses contained therein.
3. The corrigendum(s) issued from time to time by your department/ organisation too have also been taken into consideration, while submitting this acceptance letter.
4. I / We hereby unconditionally accept the tender conditions of above mentioned tender document(s) / corrigendum(s) in its totality / entirety.
5. I / We do hereby declare that our Firm has not been blacklisted/ debarred/ terminated/ banned by any Govt. Department/Public sector undertaking.
6. I / We certify that all information furnished by our Firm is true & correct and in the event that the information is found to be incorrect/untrue or found violated, then your department/ organisation shall without giving any notice or reason therefore or summarily reject the bid or terminate the contract, without prejudice to any other rights or remedy including the forfeiture of the full said earnest money deposit absolutely.

Yours Faithfully,

(Signature of the Bidder, with Official Seal)

5.11 CPWD-7

CPWD-7

PERCENTAGE RATE TENDER & CONTRACT FOR WORKS

Tender for the " **Supply, installation, testing and commissioning of Variable Frequency Drive (VFDs) and associated sensors for existing AHUs at various locations within IIT Kanpur."**

1. To be uploaded as per details uploaded in CPP portal at www.eprocure.gov.in
2. To be opened in the presence of tenderers who may be present at the time of opening in the office of Superintending Engineer, IWD, IIT Kanpur.
3. The pre-qualification/Technical bid shall be opened first on due date and time as mentioned above. The time and date of opening of financial bid of contractors qualifying the technical bid shall be communicated to them at a later date.

TENDER

(To be signed in Company's Letterhead)

I/We have read and examined the notice inviting tender, schedule, A, B, C, D, E & F Specifications applicable, Drawings & Designs, General Rules and Directions, General Conditions of Contract (For construction works) 2023, clauses of contract, Special conditions, Schedule of Rate & other documents and Rules referred to in the conditions of contract and all other contents in the tender document for the work.

I/We hereby tender for the execution of the work specified for the Board of Governors within the time specified in Schedule 'F' viz., schedule of quantities and in accordance in all respect with the specifications, designs, drawing and instructions in writing referred to in Rule-1 of General Rules and Directions and in Clause 11 of the Conditions of contract and with such materials as are provided for, by, and in respect of accordance with, such conditions so far as applicable.

We agree to keep the tender open for Ninety (90) days from the due date of its opening and not to make any modification in its terms and conditions.
I/We have deposited EMD for the prescribed amount in the office of concerned

Executive Engineer as per the bid document.

If I/We, fail to furnish the prescribed performance guarantee within prescribed period, I/We agree that the said Board of Governors or his successors, in office shall without prejudice to any other right or remedy, be at liberty to take action as per GCC 2023. Further, if I/We fail to commence work as specified, I/We agree that Board of Governors or the successors in office shall without prejudice to any other right or remedy available in law, be at liberty to forfeit the said performance guarantee absolutely. The said Performance Guarantee shall be a guarantee to execute all the works referred to in the tender documents upon the terms and conditions contained or referred to those in excess of that limit at the rates to be determined in accordance with the provision contained in Clauses 12.2 and 12.3 of the tender form.

Further, I/We agree that in case of forfeiture of Earnest Money or Performance Guarantee as aforesaid, I/We shall be debarred for participation in the re-tendering process of the work.

I/We undertake and confirm that eligible similar work(s) has/have not been got executed through another contractor on back-to-back basis. Further that, if such a violation comes to the notice of Department, then I/we shall be debarred for tendering in Indian Institute of Technology Kanpur in future forever. Also, if such a violation comes to the notice of Indian Institute of Technology Kanpur before date of start of work, the Superintending Engineer, IWD shall be free to forfeit the entire amount of Performance Guarantee.

I/We hereby declare that I/We shall treat the tender documents drawings and other records connected with the work as secret/confidential documents and shall not communicate information / derived there from to any person other than a person to whom I/We am/are authorized to communicate the same or use the information in any manner prejudicial to the safety & integrity of IIT Kanpur.

Signature(s) of Contractor(s) with seal

Dated:

Address

Occupation

5.12 Financial Information

Proforma for providing Financial Information
(Scanned copy of the completed information sheet to be uploaded at the time of submission of bid)

Financial Analysis: Details to be furnished duly supported by figures in balance sheet/ profit & loss account for the last three financial years duly certified by the Chartered Accountant, as submitted by the applicant to the Income Tax Department (Copies to be attached).

Financial Years	2022-23	2023-24	2024-25
Gross Annual turnover			
Profit/Loss			

Signature of Chartered Accountant with Seal

Signature of bidder

5.13 Banker's Certificate from a scheduled Bank

Proforma of Banker's Certificate from a Scheduled Bank

(To be printed in Bank's Letterhead)

(Scanned copy of the Certificate to be uploaded at the time of submission of bid)

This is to certify that to the best of our knowledge and information that M/s./Sh..... having marginally noted address, a customer of our bank are/is respectable and can be treated

as good for any engagement up to a limit of Rs ..... (Rupees .....). This certificate is issued without any guarantee or responsibility on the bank or any of the officers.

.....

(Signature for the Bank)

NOTE:

1. Bankers certificates should be on letter head of the Bank, addressed to tendering authority.
2. In case of partnership firm, certificate should include names of all partners as recorded with the Bank.

5.14 Net Worth Certificate by certified Chartered Accountant

Proforma of Net Worth Certificate by certified Chartered Accountant

(To be printed in Letterhead of Chartered Accountant)

(Scanned copy of the Certificate to be uploaded at the time of submission of bid)

This is to certify that as per the audited Balance Sheet and Profit & Loss statement of the account during the financial year ....., the net worth of M/s./Sh.....(Name & Registered Address of individual/firm/company) as on 31.3.2025 is Rs. .....(Rupees. .....) after considering all liabilities. It is further certified that the net worth of the company has not eroded by more than 30% in the last three years ending on 31.3.2025.

.....
(Signature of the Chartered Accountant)

.....
(Name of the Chartered Accountant)

.....
(Membership No. of ICAI)

.....
(Date & Seal

6 Proforma of Schedules

Operative schedules shall be supplied separately to each intending tenderer

SCHEDULE "A"	Schedule of Qty	Uploaded separately

SCHEDULE 'B'

Schedule of materials to be issued to the contractor:

S. No.	Description of item	Quantity	Rates in figures & words at which the material will be charged to the contractor	Place of issue
1	2	3	4	5
NIL				

SCHEDULE 'C'

Schedule of Tools and Plants to be hired to the contractor

S. No.	Description	Hire charges per day	Place of issue
1	2	3	4
----------NIL ----------			

SCHEDULE "D"	Extra schedule for specific requirements/document for the work, if any:	As attached in tender form.
SCHEDULE "E"	Schedule of component of other Materials, Labour, POL etc. for price escalation	**N. A.**
SCHEDULE "F"	Reference to General Conditions of contract.	
Name of Work:	**"Supply, installation, testing and commissioning of Variable Frequency Drive (VFDs) and associated sensors for existing AHUs at various locations within IIT Kanpur."**	
Estimated cost of the work:	**Rs. 23,44,284/-**	
Earnest money	**Rs. 46,886/-**	
Performance Guarantee	5% of tendered value PG shall be 5% of the Estimated cost put to tender (ECPT) or contract amount whichever is higher, valid up to stipulated date of completion and Six (6) months	

	beyond that. a) A bid will be treated abnormally low if the quoted amount is lesser than 80% of estimated cost put to tender. b) Requirement of Additional proforma Guarantee (APG): In case of abnormally low bids as defined above, the bidder shall be required Additional Performance Guarantee (APG) in additional to the Standard Performance Guarantee (PG). The amount of Additional Performance Guarantee (APG) shall be equivalent to the difference between the 80% amount of ECPT and quoted amount. (e.g. if ECPT is A and quoted amount is 0.7A then the amount of APG shall be 0.8A-0.7A). The Additional Performance Guarantee (APG) shall be in the prescribed format of Performance Guarantee and has to be submitted within the time frame prescribed for submission of Performance Guarantee. The other terms and conditions of release etc. Of APG shall be same as that of PG.
Security Deposit	2.5% of the tendered value of the work will be deducted from each bill. Same would be released after successful completion of One-year defect liability period and as per special conditions of the contract.

General rules and direction:

Officer inviting tender	**Superintending Engineer, IWD, IIT, Kanpur**

Definitions:

2(v)	Engineer-in-charge	
	For Air conditioning works	**Superintending Engineer, IWD, IIT Kanpur**
2(vi)	Accepting authority	**Dy. Director, IIT Kanpur**
2(vii)	Percentage on cost of materials and labour to cover all overheads and profits	N.A
2(viii)	**Standard Schedule of Rates:**	**Minimum central labour wage rates (central Govt. and Market rates for other**

		items-if applicable)
2(ix)	Department	IWD, IIT Kanpur
2(x)	Standard CPWD contract Form:	GCC 2023, CPWD **form-7** as modified & corrected up to last date of tender (Whether correction vide latest circulars are in corporate or not in this document). The following condition pertains to GST of clause 37 & 38 of General Condition of contract and corresponding Amendments should be read as follows: a- The Quoted rates should be inclusive of GST.
Clause 1	i) Time allowed for submission of Performance Guarantee from the date of issue of letter of acceptance ii) Maximum allowable extension with late fee @0.1% per day of performance guarantee amount beyond the period as provided in i) above	7 Days 7 Days
Clause 1A	Applicable. The Defect liability period shall be One Year from the date of handing over of the assigned works to the user/Institute	
Clause 2	Authority for fixing Compensation under Clause 2	**SE, IWD, IIT, Kanpur.** **Or successor thereof**
Clause 2A	Whether Clause 2A shall be applicable	Yes
Clause 5	i) Number of days from the date of issue of issue of letter of acceptance for reckoning date of start	15 days 3 Months

	ii) Time allowed for execution of work	
i)	Number of days from the date of issue of letter of acceptance for reckoning date of start	**15 days**
ii)	**Mile stone**	Not applicable
Authority to decide	**Extension of time**	**SE, IWD, IIT, Kanpur. Or successor thereof**
Clause 6A	Computerized Measurement of bills	**APPLICABLE**
Clause 7		**APPLICABLE**
Clause 10A	Material to be provided by the contractor	**APPLICABLE**
Clause 10B (ii), (iii)	Whether clause 10-B (ii) and 10-B (iii) shall be applicable.	**NOT APPLICABLE**
Clause 10 C	Component of labour expressed as percentage of value of work	**NOT APPLICABLE**
Clause 10 CA		**NOT APPLICABLE**
Clause 10 CC	Increase/Decrease in Price of materials/wages	**NOT APPLICABLE**
Clause 11		CPWD Specifications of all HVAC items (CPWD 2023 or latest), with correction Slips/amendments/revisions issued up to the last date of receipt of tenders and as per NIT.
Clause 12: Type of work		Original Work/minor maintenance work
Clause 12.2 & 12.3: Deviation limit beyond		

which clause 12.2 & 12.3 shall apply for Building works		Not applicable
Clause 16 Competent Authority for deciding reduced rates: For Civil items and For Electrical items of work		As per table 7
Clause 17 - Defect liability period completion of contract whichever is later		One Year and those listed in Special Conditions of Contract
Clause 18 - List of mandatory machinery, tools & plants to be deployed by the contractor at site		As per the scope of work
Clause 32 - Requirement of Technical Representative(s)		As per table 9

If the Contractor commits default in commencing the execution of the work as aforesaid, the performance guarantee shall be forfeited.

Table 6 Major milestones of the project

Sl. No.	Description of Milestone (Physical)	Time allowed from date of start	Maximum duration of work	Amount to be withheld in case of non achieve of the milestones (% of composite tendered amount)
1.	Not Applicable			

The detailed program chart approved by the engineer-in-charge shall indicate how the resources will be deployed by the contractor to maintain desired progress and for the completion of the work within the specified period. If the submitted program is approved, the milestone shall be redefined accordingly by the Superintending

Engineer, IWD Indian Institute of Technology Kanpur. The amount to be withheld in such a case, for non-achievement of milestone(s), shall remain unaltered i.e., 1% of tendered amount

Table 7 Authority to decide

1.	Extension of time (EOT)	SE, IWD IIT Kanpur
2.	Rescheduling of milestones	**Not applicable**
3.	Shifting of start in case of delay in handing over of site.	SE, IWD, IIT, Kanpur

Table 8: Materials for which all India Wholesale Price Index to be followed Nearest Materials (other than cement, reinforcement bars and the structural steel) for which All India Wholesale Price Indexto be followed)

Sl. No.	Material covered under this clause	Base Price of Materials, covered underclause 10 CA
1.	**Not applicable**	

Table 9: Requirement of Technical staff as per Clause 32

Sl. No.	Qualification	Number	Minimum Experience in years	Designation	Rate at which the recovery shall be made from the contractor in the event of not fulfilling provisionof Clause 32
1.	Graduate / Diploma	1	5	Project / Planning / construction / billing Engineer (Electrical/ Mech.)	Rs. 25000/- (Rupees Twenty Five Thousand only) per month, per person

Note: Assistant Engineers retired from Government services who are holding Diploma will be treated at par with Graduate Engineers. Diploma holder with minimum 10 years relevant experience with a reputed construction co. can be treated at par with Graduate Engineers for the purpose of such deployment subject to the condition that such diploma holders should not exceed 50% of requirement of degree engineer.

The details of appointed engineers/technical staffs have to be verified and approved by Engineer- in-charge

7.0 Scope of work

- **Supply, installation, testing and commissioning of Variable Frequency Drive (VFDs) and associated sensors for existing AHUs at various locations within IIT Kanpur.**

General

SCOPE

The scope of this section comprises the supply, laying, erection, testing, and commissioning of pipes required for this project.

Specification of Air conditioning works

7.1 PIPE MATERIALS

7.1.1 Pipes shall be of the following materials.

(i) Mild steel heavy class (ERWS Black steel) tube conforming to IS: 1239 for sizes up to 150 mm.

(ii) Welded black steel pipe, class 2, conforming to IS: 3589, for sizes greater than 150 mm. These pipes shall be factory rolled MS C class pipe. The thickness of MS pipe shall be minimum 8 mm for pipes of sizes 200 mm and above.

7.1.2 PIPE JOINTS

Seismic considerations shall be taken into account while planning joint details. Joints in black steel pipes shall be of any of the following types.

Screwed joints and union joints screwed to pipes, up to 25 mm size.

Butt welded joints for pipe sizes above 25mm. electric welding shall be used for sizes 100mm and above.

Flanges joints with flanges as per IS: 6392 for all sizes. Flanges may be steel welded neck type or slip on type welded to pipe, or alternatively screwed type. The item of flanges shall be measured and paid separately.

Flexible coupling V grooves joints.

Flexible connections shall be provided at the pumps, and other machine where requires as per following specifications-

a) The Flexible connections shall be flanged type expansion joint. Flanges shall be non-compressible and mechanically strong type and the Neoprene rubber shall be provided in between the flange ends.

b) The connections shall work for a temperature range of minus 10°C to 70°C. c) The length and working pressure of bellows shall be as follows:

Nominal Bore (mm)	Length (mm)	Pressure (Bar)
20-25	125	15
32-200	150	15
250-350	200	10

d) Connections shall be provided with control rods to control the excessive elongation or compression of piping systems.

e) These shall be capable to withstand torsional movement up to 3o without damage.

7.1.3 PRE-INSULATED CHILLED WATER PIPES

All piping system for service reaching a maximum temperature of 70°C installed above ground with Aluminum/GI/ HDPE jacketing and underground with HDPE jacketing.

i) The pipe shall be MS ERW as specified in the Piping Section.

ii) The pipe insulation shall be rigid polyurethane foam with excellent heat-insulating properties, good mechanical properties and good resistance against aging with minimum density of 48 kg/cu m, 90% minimum closed cell content, minimum compressive strength of 2.7kg/cm2, and initial thermal conductivity of 0.026W/mK and the insulation fulfills all technical requirements according to EN 253. The insulation shall completely fill the annular space between the service pipe and jacket and shall be bonded to both, the service pipe & jacket. Polyurethane foam made from Polyol and Isocyanate with 42 kg/ m3 density. Protective Jacket Material shall be as specified and shall be sufficiently sized to allow for desired insulation thickness for optimum performance of the system.

iii) The cladding shall be spirally wounded of G.I. or Aluminium as specified in tender documents for pipes installed on surface.

S.No.	Dia. Of MS Pipe	Minimum Thickness of PUF in (mm)	Minimum Thickness of G.I. Cladding	Minimum Thickness of Al. Cladding
1.	20mm	33	26 gauge	24 gauge
2.	25mm	33	26 gauge	24 gauge
3.	32mm	33	26 gauge	24 gauge
4.	40mm	33	26 gauge	24 gauge
5.	50mm	33	26 gauge	24 gauge

6.	65mm	36	26 gauge	24 gauge
7.	80mm	42	26 gauge	24 gauge
8.	100mm	42	26 gauge	24 gauge
9.	125mm	42	26 gauge	24 gauge
10.	150mm	42	26 gauge	24 gauge
11.	200mm (8 mm thick)	52	26 gauge	24 gauge
12.	250mm (8 mm thick)	62	26 gauge	24 gauge
13.	300mm (8 mm thick)	62	26 gauge	24 gauge

v) Underground systems shall be buried in a trench of not less than 600 mm deeper than the top of the pipe & not less than 450mm wider than the combined OD of all piping systems. A minimum thickness of 600mm of compacted backfill over the top of the pipe is desirable.

vi) Trench bottom shall have a minimum of 150mm of sand, pea gravel or specified backfill material, consolidated to suit operating weight & to act as a cushion for the piping.

vii) For pipes buried in ground outer protective insulation jacket shall be seamless, extruded, black, UV resistant, high-density polyethylene (HDPE). HDPE Jacket shall be of High-density polyethylene (HDPE) with > 944 kg/ m3 density Diameter from 90 to 1000mm with minimum 3 to 28mm wall thickness and compressive strength is 40 PSI as specified.

viii)All straight pipe lengths will have water tight end seal. All fittings will have square cut insulation cutback.

ix) For leak identification purpose 2 wire diagnostic wiring shall also be provided.

x) Fitting can be fabricated at site over the carrier pipe and correct quantity of PUF shall be poured manually.

xi) Field joints insulation shall consist of PUF poured manually in a site-fabricated GI cladding fixed around the joint

xii)For pipes buried in ground minimum thickness of the HDPE jacket and PUF shall be as follows:

S.No.	Dia. Of MS Pipe	Min. PUF Thickness (mm)	Min. Thickness of HDPE Cladding (mm)

1.	20mm	30	2.5
2.	25mm	36	2.5
3.	32mm	36	2.5
4.	40mm	36	2.5
5.	50mm	37	3.0
6.	65mm	39	3.0
7.	80mm	43	3.0
8.	100mm	40	3.2
9.	125mm	39	3.5
10.	150mm	53	4.4
11.	200mm (8 mm thick)	63	5.0
12.	250mm (8 mm thick)	57	6.3
13.	300mm (8 mm thick)	63	7.0

The pre-insulated pipe shall be manufactured at factory. The insulation shall completely fill the annular space between the carrier pipe & jacket and shall be bonded to both, carrier & jacket. The pre-insulated pipes must be manufactured using High pressure PUF injection machines. The outer jacket & the carrier pipe must be held concentric using special chucks. Vent holes must be drilled to ensure expiration of air. The necessary quantity of Polyol & ISO must be mixed at high speed & injected into the void. The quantity of PUF injected for each pipe must be kept as a verifiable record to ensure that the required Density & thickness of insulation is maintained.

7.1.4 VALVES

i) The material of butter fly valves shall be as under: Body- Cast iron Disc- Stainless Steel Seat- Either integral or Nitrile rubber O-ring- Nitrile/ Silicon

ii) Balancing valve shall be of cast iron flanged construction with EPDM/ SG iron with epoxy coated disc with built in pressure drop measuring facility (pressure test cocks) to compute flow rate across the valve. The test cocks shall be long enough to protrude out of pipe insulation.

iii) Non return valves shall be of gun metal construction up to 65 mm, the metal conforming to class 2 of IS: 778. For 75 mm and above, the valve shall be of bronze or gun metal, body being of cast iron. While screwed or flanged ends may be provided up to 65 mm, flanged ends shall be provided for larger sizes.

iv) Air valves shall be of gunmetal body.

STRAINERS

(i) Strainers shall be of 'Y" type or pot type as specified.

(ii) 'Y' strainers shall be provided on the inlet side of each air-handling unit and pump in chilled water and condenser water circuit.

(iii) Pot strainers, where specified, shall be provided in return water headers, for chilled water and condenser water if enough floor area is available in the refrigeration plant room, as an alternate to individual Y type strainers with pumps.

(iv) The strainers shall be designed to the test pressure specified for the gate valves.

(v) Filtration area of Y-strainer shall be minimum four times the connecting pipe size.

(vi) Strainers shall have a removable bronze/ stainless steel minimum 1mm thick screen with 3 mm perforations and permanent magnet.

(vii) Strainers shall be provided with flanges or threaded sockets as required. They shall be designed so as to enable blowing out accumulated dirt and facilitate removal and replacement of screen without disconnection of the main pipe.

(viii) Strainers shall be provided with equal size isolating gate valves on either side so that the strainers may be cleaned without draining the system.

(i) Pot strainer shall be fabricated out of MS sheet and the sizes shall be as under: -

Pipe sizes (mm)	Pot dia (mm)	Pot Height (mm)	Basket dia (mm)	Basket Height (mm)
50	300	400	200	240
80	350	450	250	250
100	450	500	300	280
125	500	600	330	340
150	540	700	360	390
200	610	815	400	470
250	800	955	550	510
300	1000	1105	750	580
350	1190	1300	895	678
400	1350	1500	1020	785
450	1518	1700	1060	890
500	1690	1800	1100	900

INSTRUMENTS

i) Pressure gauge of appropriate range and 150 mm. dial size shall be provided at the following locations.

a)Supply and return of all heat exchange equipments. b)Suction and discharge of all pump sets.

The pressure gauge shall be duly calibrated before installation and shall be complete with shut off cocks.

ii) Direct reading industrial type thermometer of appropriate range shall be provided at the inlet and outlet of all heat exchange equipments. The thermometers shall be installed in separate wells.

iii) Appropriate number of additional sockets shall be provided for the installation of pressure & temperature transducers for BMS.

EXPANSION TANKS

i) Expansion tanks for chilled water and hot water shall be of M.S. construction and of adequate capacity, to contain 200% of the maximum expansion likely to take place in the system. The tank shall be insulated and be complete with float valve, gauge glass, drain, overflow and make up connections, with gate valves and vent piping wherever required.

ii) The piping shall be enlarged at the connection to the expansion tank to permit entrained air to separate and to be vented through the tank. The expansion tank should be located at the pump suction side at the highest point of the system.

iii) Valves, strainers and traps must be omitted from the expansion line since these may be accidentally turned off or become plugged.

iv) Pressurized expansion tank with air separator, can be used where the conventional type expansion tank is not feasible to be provided.

INSTALLATION

i) The installation work shall be carried out in accordance with the detailed drawings prepared by the Air- conditioning Contractor and approved by the Engineer-in-charge.

ii) Air-conditioning contractor shall utilize the structural provisions for Air-conditioning services wherever provided by the Department in the building and make his own arrangements for additional changes.

iii) Expansion loops or joints shall be provided to take care of expansion or contraction of pipes due to temperature changes.

iv) Tee-off connections shall be through equal or reducing tees, otherwise ferrules welded to the main pipe shall be used. Drilling and tapping of the walls of the main pipe shall not be resorted to.

v) Wherever reducers are to be made in horizontal runs, eccentric reducers shall be used if the piping is to drain freely, in other locations, concentric reducers may be used.

vi) Open ends of piping shall be blocked as soon as the pipe is installed to avoid entrance of foreign matter.

vii) All pipes using screwed fittings shall be accurately cut to the required size and threaded in accordance with IS: 554 and burs removed before laying.

viii) Piping installation shall be supported on or suspended from structure adequately. The Air-conditioning contractor shall design all brackets, saddles, clamps, hangers etc. and shall be responsible for their structure integrity.

ix) Pipe supports, preferably floor mounted shall be of steel, adjustable for height and prime-coated with zinc chromate paint and finish-coated gray. Spacing of pipe supports shall not be more than that specified below:

x)

Nominal Pipe size (mm)	Spacing (Meters)
12 and 15	1.25
20 and 25	2.00
32, 40, 50 and 65	2.50
80, 100 and 125	2.50
150 and above	3.00

Extra supports shall be provided at the bends and at heavy fittings like valves to avoid undue stress on the pipes. Pipe hangers shall be fixed on walls and ceiling by means of metallic or rawl plugs or approved shear fasteners.

xi) Insulated piping shall be supported in such a manner as not to put undue pressure on the insulation.

xii) Anti vibration pads, springs or liners of resilient and non-deteriorating, material shall be provided at each support, so as to prevent transmission of vibration through the supports. xii)Pipe sleeves of diameter larger than the pipe by least 50 mm shall be provided wherever pipes pass through walls and the annular spaces shall be filled with felt and finished with retaining rings.

xiii) Vertical risers shall be parallel to walls and column lines and shall be straight and plumb. Risers passing from floor to floor shall be supported at each floor by clamps or collars attached to pipe with a 12 mm thick rubber pad or any other resilient material as approved by the Engineer-in-charge.

xiv) The space in the floor cut outs around the pipe work (after insulation work where applicable) shall be closed using cement concrete (1:2:4 mix) or steel sheet, from the fire safety considerations, taking care to see that a small annular space is left around the pipes to prevent transmission of vibration to the structure.

xv) Riser shall have suitable supports at the lowest point.

xvi) Where pipes are to be buried under ground, the top of the pipes shall be not less than 75 cms. From the ground level. Where this is not practicable, permission of the Engineer-in-charge shall be obtained for burying the pipes at lesser depth. The pipes shall be surrounded on all sides by sand cushion of not less than 15 cms. After the pipes have been laid and top sand cushion provided, the trench shall be refilled with the excavated soil and any extra soil shall be removed from the site of work by the Air conditioning contractors.

xvii) All pipes and their steel supports shall be thoroughly cleaned and given one primer

coat of Zinc chromate before being installed.

xviii) After all the water piping has been installed; pressure tested in accordance with clause 10.10, all exposed piping in the plant room shall be given two finish coats of paint, approved by the Engineer-in

Charge. Similar painting work shall be done over insulated pipe work, valves etc. The direction of flow of fluid in the pipes shall be indicated with identifying arrows.

xix) 3 mm gasket shall be used for flanged joints.

xx) Cut-outs in floor slabs shall be sealed with cement concrete or steel plate after the plumbing work is done, from the fire safety point of view.

PRESSURE TESTING

(i) All piping shall be tested to hydrostatic test pressure of at least one and a half times the maximum operating pressure, but not less than 21 kg./sq.cm. for a period not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified to the satisfaction of the Engineer-in-Charge.

(ii) Piping repaired subsequent to the above pressure test shall be re-tested in the same manner.

(iii) System may be tested in sections and such sections shall be securely capped.

(iv) It shall be made sure that proper noiseless circulation is achieved through all the coils and other heat exchange equipments in the system. 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 the above rectification, including the tearing up and refinishing of floors, walls, etc. as required.

(vi) Pressure gauges may be capped off during pressure testing of the installation.

(vii) The contractor shall provide all materials, tools, equipments, instruments, services and labour required to perform the tests and to remove water resulting from cleaning after testing.

7.1.5 BALANCING

i) After completion of the installation, all water system shall be adjusted and balanced to first minimize throttling losses; then the pump impeller shall be trimmed or pump speed shall be adjusted to meet design flow conditions. Exceptions to above:

a) Where Variable frequency Drives are used as starter &capacity control. b) Impellers need not to be trimmed nor pump speed adjusted for pumps with pump motors of 7.5 kW (10 hp) or less, c) Impellers need not to be trimmed when throttling results in no greater than 5% of the nameplate horsepower draw, or 2.2 kW (3hp), whichever is greater.

ii) Automatic control valves (Pressure Independent Balancing cum Control Valve) and three way diverting valves shall be set for full flow condition during balancing procedure. Water circuit shall be adjusted by balancing cocks provided for balancing. These shall be permanently marked after the balancing is completed so that they can be restored to their correct positions, if disturbed.

MEASUREMENT

Measurements of plumbing work shall be on following basis: -

a) Piping shall be measured along the centre line of installed pipes including all pipe fittings and accessories but excluding valves and other items for which quantities are specifically indicated in the schedule of work. No separate payment shall be made for fittings and accessories.

b) The rates for piping work shall include all wastage allowances, pipe supports, hangers, nuts and check nuts, vibration isolators, suspension where specified or required, and any other item required completing the piping installation. None of these items will be separately measured nor paid for.

c) Piping measurement shall be taken before application of the insulation in the case of insulated pipe work.

7.1.6 INSULATION

The insulation of pipes carrying hot or chilled water shall be carried out as per following (except in case of pre-insulated pipe)

INSULATION WORK

SCOPE

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

MATERIAL-TYPES

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

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

a) Expanded polystyrene (T.F.Quality)

b) Resin bonded glass wool

c) Polyvinyl Nitrile (Closed cell rubber foam)

d) XLPE (Closed cell cross linked polyolefin foam)

Expanded polystyrene (T.F.Quality) shall be used for pipe insulation like inside the A.C. plant room, exposed to outside or burried in ground. In the case of expanded polystyrene (TF quality), Resin bonded glass wool the pipe insulation should be in rigid sections in two halves and preformed to fit snugly on to pipes (upto pipe sizes for which the preformed sections are manufactured by the manufacturer of insulation). For higher pipe sizes insulation slabs shall be used.

Resin bonded glass wool is to be used for piping inside the building due to its fire retardant properties, for considerations of fire safety. Polyvinyl Nitrile (Closed cell rubber foam) available in tube shapes for sliding on to the small dia. pipes can be used if successfully tested for fire retardant properties.

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

i) For suction line, Chilled water pipe and Chiller insulation :

(a) Expanded Polysterene (T.F. Quality)

(b) Polyvinyl Nitrile (Closed cell rubber foam)

MATERIAL SPECIFICATIONS

The insulation material shall satisfy the following

requirements: - For thermal application on pipes.

Material

Minimum Density (Kg/cu.m)

Maximum Thermal conductivity (K.cal/ hr. degree C/m at 10 DegCmean temp.)

Resin bonded glass wool 320.031 Expanded polystyrene (TF) 200.035 Polyvinyl Nitrile

foam550.034 For thermal insulation of ducts:

Material Minimum Density(Kg / cu.m) Resin bonded glass wool 24 Polyvinyl Nitrile foam 40

Fibre Glass Insulation used for duct insulation shall be factory faced with aluminium foil on one side reinforced with kraft paper & fused to the insulation material.

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

For acoustic lining :

Application Thickness Material

MinimumDensity (Kg./Cu.M) Duct 25 mmResin bonded

glass wool32 AHU room 50 mmResin bonded glass wool/

Mineral wool 32/ 48

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

v) Expansion tank Insulation Expanded polystyrene insulation of density not less than 20kg per cu.m. shall be used.

INSULATION THICKNESS

The thickness of insulation shall be as indicated below unless specified otherwise in the tender specifications.

For pipe insulation (for chilled water as well as hot water application Pipe Size (mm)

Glass fibre /Exp. Polystyrene (mm) 150 & below50 Above 150 75

For Duct insulation Application Fibre glass (mm) Thermal for AC area12.5 Thermal for Non AC area25 Acoustic25

For room acoustic lining Resin bonded glass wool50 mm Resin bonded mineral

wool50 mm For pumps : Expanded polystyrene TF quality50 mm

Chiller Insulation Thickness of polyvinyl rubber insulation used for chiller insulation shall not be less than 19mm.

vi) Expansion tank Thickness of expanded polystyrene (TF quality) insulation used shall not be less than 50mm.

APPLICATION OF INSULATION ON PIPES (including suction line insulation)

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

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

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

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

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

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

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

APPLICATION OF INSULATION ON PUMPS

Expanded polystyrene (TF quality) 50mm thickness shall be sandwiched between two aluminium sheets of 0.5mm thickness and properly clamped to pump in two semicircular sections.

APPLICATION OF INSULATION ON EXPANSION TANK

Insulation of expansion tank shall be expanded polysterene (T.F.Quality) of thickness not less than 50mm. It shall be applied as under

i) Surface shall be thoroughly cleaned with wire brush and rendered free from all dust & grease. ii)The two layers of hot bitumen shall be applied. iii)The insulation slabs will then be fixed in one layer and joints shall be sealed with hot bitumen. iv)The insulation slab then shall be covered with 0.63 mm x 19mm G.I. wire mesh netting which shall be fixed to insulation with brass / G.I. nails.

v) The insulation shall then finally be finished with aluminum cladding of thickness not less than 0.5mm.

MEASUREMENT OF INSULATION

a) Pipe insulation shall be measured in units of length along the centre line of the insulated pipe. The linear measurements shall be taken before the application of the insulation. For piping measurements, all valves, orifice plates and strainers shall be considered strictly by linear measurement along the centre line of the pipes, and no special rate shall be applicable for insulation of any accessories, fixtures or fittings whatsoever.

7.1.7 CONTROLS

SCOPE

This chapter covers the requirements of equipment safety controls, refrigerant flow controls, system controls, and variable speed drive (VSD). For chilling units all the controls shall be microprocessor based.

EQUIPMENT SAFETY CONTROLS

Compressor:

Compressor shall be provided with the following safety controls: -

i) High discharge pressure (HP) safety (cut out) to stop the compressor automatically, in case discharge pressure exceeds a pre-set safe value. This safety shall operate when discharge head pressure exceeds the set point. Only manual resetting shall be provided for this safety.

ii) Low suction pressure (LP) safety (cut-out) to stop the compressor automatically, in case suction pressure falls below a pre-set value. This safety shall operate when the suction pressure falls below the set point. Automatic resetting shall be provided for this safety, with adjustable cutin and cut-out pressures. This safety shall be used for pumping down the system for shutting off the refrigeration plant.

iii) Oil pressure (O.P) safety (cut-outs) to stop the compressor, in case lubricating oil pressure falls below a safe set value. A time delay mechanism shall also be provided, so as to permit running of the compressor upto a maximum period of 90 seconds, with the oil pressure differential below the set value and allow it to continue normal operation if the pressure differential builds up to the set value within that time, or otherwise shut-down the compressor. Only manual resetting shall be provided for this safety.

iv) High bearing oil temperature cut-out (for centrifugal compressor only). This shall be provided with a manual reset only.

v) High lubricating oil temperature cut-out (for centrifugal compressor only). This shall be provided with a manual reset only.

vi) Time delay mechanism on the starting gear to limit short cycling regardless of mal-functioning of controls.

The cut-outs (i) to (v) mentioned above shall operate when the respective controlled variable crosses the set point to trip the compressor. Audio visual alarm shall be provided to indicate such operations. A manual reset shall be provided for them.

Safeties mentioned above shall operate when the respective controlled variable crosses the set point to trip the compressor.

Audio visual alarm shall also be provided to indicate such operations.

Condenser

The safety control for a condenser shall comprise a safety pressure relief valve on the shell. This shall operate to relieve the pressure at the set point without prior leakage. For small condensers, a fusible plug may be provided to melt at a predetermined temperature.

Chiller

i) An antifreeze shall be provided with water chiller, set at a few degrees above the freezing point. This shall operate, when the temperature of water in the chiller falls below the set point to trip the compressor motor. The reset provided for the safety shall be manual.

ii) Flooded type of chiller in addition, shall be provided with safety pressure relief valve.

5.1.1 Refrigeration Plant

i) In addition to the safety controls as above for the individual components of a refrigeration plant, the following safety controls shall also be provided for the plant.

a) Compressor motor over current cut-out. b) Condenser water flow switch. c) Chilled water flow switch. d) Condenser air flow switch in the condenser fan discharge (in case of air-cooled condensers). e) Air flow switch in the evaporator fan discharge in case of direct expansion coils

ii) The above controls, on operation, shall trip the compressor motor, and these shall be provided with manual reset arrangement.

iii) The compressor motor shall also be interlocked electrically with, a) Condenser water pump in case of water cooled condenser, and condenser fan with air cooled condensers, (b) Chilled water pumps in case of chilled water system and evaporator fan in case of direct expansion system, and c) Antifreeze thermostat in case of chillers.

iv) Indicating lamps shall also be provided on the control panel for indicating operation of the safeties and interlocks.

REFRIGERANT FLOW CONTROLS

A refrigeration plant shall be provided with controls, necessary for starting, stopping and

modulating the flow of refrigerant in the plant so as to satisfy the load requirements. These comprise solenoid valve, thermostatic/ Electronic type expansion valve, float valve, compressor capacity controls etc. and other special controls if specified in a particular work.

Solenoid Valve

a) For reciprocating and screw type compressors liquid line solenoid valve shall be provided in the liquid line of the system, ahead of the expansion valve, to allow or to stop the flow of liquid refrigerant to an evaporator, or a section of sectionalized evaporator. This shall be operated by snap-acting thermostat and it shall also be provided with a test switch to enable manual energizing.

b) Discharge gas valves shall be provided in the following applications as required: -

i) Hot gas defrosting: Normally this solenoid valve shall remain closed, but it shall open up to feed the evaporator with hot gas for defrosting when required, especially in cold storage applications.

ii) Compressor capacity control for reciprocating compressor and for cylinder unloading during starting.

c) Solenoid valves shall be direct acting in smaller sizes and pilot operated for larger sizes, as required. The size of the valves shall be determined by the desired flow rate of refrigerant through them and the pressure drop across the same (and not by the size of the refrigerant line).

Thermostatic / Electronic type Expansion Valve

Thermostatic/ Electronic type expansion valve shall be provided in DX type refrigeration plant to modulate the flow rate of liquid refrigerant entering the evaporator in response to the extent of superheat of refrigerant gas leaving the evaporator, so that only a metered flow is ensured matching the load.

The number of expansion valve shall be such that the specified accuracy of temperature control of the system can be achieved and that no valve is expected to operate below 35% of its rated capacity. The sizes shall be selected suitably so as to avoid hunting. Adjustable super heat control and external equalizer port shall be provided for each valve. Each expansion valve shall be easily removable for cleaning and adjusting.

Float Valve

Float valve shall be provided in refrigeration plant with flooded type chiller for maintaining

the liquid level in chiller under all conditions of load at a rate commensurate with the rate of vaporisation. This can be provided either on low pressure side or on high pressure side. When provided as low side float valve, this shall be located as a part of the chiller or accumulator.

Compressor Capacity Control

The capacity control arrangement shall be in accordance with reciprocating type compressor,

and centrifugal type compressor & for screw type compressor.

SYSTEM CONTROLS

i) The requirements for maintaining the inside design conditions as specified in the tender specifications for the work shall be met by appropriate system controls and control elements. The system shall satisfy the requirements of both full load and partial load conditions. Details of complete control elements shall be indicated by the tenderer in the tender.

ii) For cooling applications in plants other than package type AC (PTAC) units, control shall be effected by 3 way diverting valve in chilled water coil. For heating using hot water coils, flow control through them shall also be achieved by using 3 way valves.

In the case of PTAC type units, the control of the units is affected through snap acting room thermostat.

iii) The size of 3 way diverting valves shall be selected so as to match the coil wherein the flow is to be regulated. The make and size shall be indicated in the Technical particulars in the tender.

iv) Operation of the modulating motor of 3 way diverting valve shall be controlled by proportional type thermostat.

v) One snap acting humidistat shall be provided for each humidifier.

vi) Where strip heaters are specified, maximum size of each heater bank shall not exceed 9 KW, distributed in three phases of 3 KW per phase.

vii) Every bank of strip heaters shall be controlled by a snap acting thermostat in case of temperature control requirement and by a snap acting humidistat for reheat control to maintain the specified RH condition.

viii) Where more than one bank of heaters is required to be provided for one AHU, thermostat shall be provided in each bank shall suitable for operation in stages.

ix) A safety thermostat (safety stat) shall be provided as high limit safety for each bank of heaters.

x) The heater banks intended for reheating during monsoon shall form part of heaters required for winter heating (where winter heating is specified). Necessary change-over switch shall be provided as part of the system wiring to change their control by thermostats or humidistat as required.

OPERATIONAL CONTROLS AND INTERLOCKS

i) The operation of refrigeration plant shall be either manual or automatic, as specified. The plant shall be started by an ON/OFF switch.

Additionally, in the case of an automatic plant, an auto/manual switch shall also be provided.

ii) The automatic operation shall be effected through the monitoring of return chilled water temperature, or the room conditions, as the case may be. In multi unit installations, one unit shall be arranged to be loaded fully before the next unit is switched on automatically. A similar operation system shall be followed in shutting off of the unit. Change over from one operating unit to another shall be possible through the status switch of the plant to be shut down by change to manual position and thus overriding its anti-cycle timer. It should be possible to introduce the changed unit by running it to speed and changing over the status switch to "auto" position.

iii) Pump down shut down shall be provided through low pressure (LP) safety irrespective of the status switch position, auto/manual.

iv) It should be possible to start the compressor motor only after the cooling tower fan motor (where provided), chilled water (where provided) and condenser water pumps are operated.

v) The compressor motor shall be able to be started or run, only after all the safeties are satisfied.

vi) The blower motor shall be interlocked with strip heaters (where provided) such that power supply to strip heaters will become ON, only after the blower has been started and run to full (designed) speed.

vii) Where only the blower motor and not heaters is connected to standby generating set in any particular application, a timer shall be provided, such that the heaters may get energised, only after a period of time, after the blower is run.

viii) In the event of signal from high limit safety of heaters the power supply to the blower motor and the heater bank shall automatically and instantly be switched off.

ix) The power supply to AHU shall be cut off on receipt of a signal from the Fire Alarm System.

REQUIREMENTS OF CONTROL ELEMENTS

The system control elements comprise controlling elements such as thermostats, humidistat, three way valves, heaters, humidifiers, dehumidifier etc as required for individual applications.

Thermostats

Thermostats shall be electric fixed differential type as indicated below, with sensing element located in the return air stream. All thermostats shall be supplied with the standard mounting boxes as recommended by the manufacturer. The profile, mounting arrangement and exact location of the thermostat shall be such as to suit the site.

i) Proportional control thermostats shall be provided for actuating the three way modulating valve at each air handling unit. Thermostat shall provide manual switching (heat-off-cool-in heating-cooling system).

ii) Snap-acting fixed differential type thermostat for actuating the threeway diverting valve at each fan coil unit.

Thermostat shall have temperature adjustments WARM-NORMALCOOL settings and fan switch. Switching off must break fan circuit.

iii) Snap-acting fixed differential heating thermostat for electric winter heating and reheat applications for putting on/off power supply to electric heating or reheat coils in air handling units.

iv) Safety thermostat shall be provided for electric winter heating and reheat application for cutting off power supply to strip heaters in case air flow across strip heater is not established.

vi) Air-stat shall be provided within air handling unit containing electric heating or reheat coils to prevent heaters from energizing unless the air flow is established.

Humidistat

Humidistat shall be provided with air handling unit for areas, which require humidity control. One humidistat shall activate the reheat coils in case the space humidity rises beyond the preset limit. Another humidistat shall energize the humidifier when the humidity falls below the preset limit. These humidistat shall also de-energize these devices when the desired humidity is reached.

Humidistat shall be snap-acting type having humidifier/dehumidifier control from 20-80 percent relative humidity, with differential of 5 percent. Humidistat shall have nylon element with three bobbins, and removable knob to prevent tempering of set point.

Three-way modulating valves (for AHUs)

These shall be provided in chilled/hot water lines as diverting valves at each air-handling unit and shall be actuated by a space thermostat. Space conditions shall be maintained by continuous proportional modulation of the chilled/hot water through the coil. The valve shall revert to fully bypass position when fan is shut off. Maximum pressure drop across valve shall not exceed 0.85 kg/ sq.cm. Where VSD (to control chilled water flow) is provided, the AHUs shall be provided with 2 way diverting valve.

Three-way diverting valves for FCUs

This shall be provided as 2 position diverting valves in chilled/hot water lines at each fan coil unit and shall be actuated by a space thermostat. Space conditions shall be maintained by allowing all of chilled/hot water to either pass through the coil or bypass the coil and mix with the chilled/hot water return. The valves shall revert to fully bypass position when fan is shut off. Pressure drop across the valve shall not exceed 0.14 kg/ sq.cm. Valve shall have the facility to replace motor actuator without removing the valve body.

Strip heaters shall be of finned type construction with a surface temperature not exceeding 45 deg. C. The same shall be suitable for 230 V, AC supply. The heaters shall be adequately insulated electrically from their mountings unit/ casing.

Dehumidifiers, where provided shall use adsorption type desiccants. The desiccant used shall be non- toxic, non-corrosive having a life of about 5 years with constant employment in regeneration cycle.

7.1.8 VARIABLE SPEED DRIVE (VSD)

Air quantity flow control

The VSD System shall function to supply variable air quantity in the air-conditioned area in response to the load variations including that due to variations in ambient conditions and filter cleanliness conditions, to maintain the inside designed temperature, RH and pressure conditions in conjunction with the humidifier and re-heaters. During the day hours, as per the time interval selected, the VSD System shall regulate the speed of the AHU to maintain the temperature within maximum designed temperature and positive air pressure inside the air-conditioned area. The positive air pressure shall be maintained by keeping a difference of minimum 15% in the airflow between the supply and exhaust air. However, under any circumstances during the day hours, the air flow rate will not fall below the 60% of the rated CFM of the AHU or 15 air changes, whichever is higher. During the rest of the night hours, the Programmable timer shall give a signal to the VSD to run the AHU at a predetermined reduced speed so as to provide only 25% of the normal CFM or the minimum CFM achievable closest to 25% but not below 25% of the normal CFM. Due to the clogging of the air filter if the inside temperature conditions are not achieved even at 100% AHU speed then the VSD will close an N.O. contacts to activate an alarm. The VSD shall have the provision to switch over to the manual mode as and when required. The system shall comprise of dedicated Variable Speed Drives (VSDs) designed for HVAC applications to accept 2 feedback signals (from temperature sensor installed in the AC area and programmable timer controller) and have 2 programmable set points (inside temperature conditions, and 60% of the normal CFM condition as stated above) using HVAC terminology, to regulate the speed of the AHU motors in response to the variations in load and filter cleanliness conditions to maintain temperature and Air flow differential in supply and exhaust conditions. In case, any additional sensor (s) including wiring etc are required to meet the system requirements the cost of that shall be deemed to be included in the cost of the VSD. The VSD control shall have:

a) RFI (Radio frequency interference) Filters for EMC (Electro magnetic compatibility) compliance.

b) Voltage Vector Control technology to generate advanced sinusoidal output voltage, 100% true RMS value of the fundamental voltage at rated speed and nominal torque, cause no motor de-ration and keep motor temperature limits within permissible class B limits.

c) a Numeric Characters for all operating parameters, programming parameters and faults.

d) Built in energy meter.

e) Built in run time counter.

f) Local control panel (key pad)

The system shall also comprise a suitable programmable timer & PLC with required electronic components, to allow 2 feedback signals (Temperature & Minimum CFM) to be passed on to the VSD during the day hours. In the night hours only one signal from the programmable timer shall go to the VSD to run it at pre- determined reduced speed. The room/ space air temperature and air flow shall be sensed by a temperature and air flow transmitters, which shall generate suitable DC signal to provide feedback to the VSD, which in turn shall regulate the speed of the AHU fan to maintain the designed conditions as described above.

VSD shall be designed, with built-in PID controller, control panel (keypads & display), IP 20 enclosure for use on standard centrifugal fans. The VSDs should not cause any de-ration of the connected motors and must ensure that class B temperature levels of the connected motors are never exceeded. The display should be in alpha-numeric characters and programming facility should be in user-friendly HVAC terminology. The VSDs should be able to accept up to 2 feedback signal from temperature & air flow transmitter simultaneously and to program 2 set points in it.

The system shall also have following features incorporated :

a) Heat sink over temperature protection

b) Under voltage protection

c) Over voltage protection

d)Alpha-numeric display

facilities

e)ON indication f)Trip indication

g) Selectable display of various parameters line voltage, frequency, speed, power, torque, motor temperature percentage, VSD temperature percentage, KWH.

h) Raise and lower speed push button in

local mode. i)Frequency range variation

from 0 to 50 Hz.

j) Remote start and stop facility including indications there of with necessary hardware and terminal blocks, including toggle switch etc. to over ride remote start & stop at the time of maintenance/ repairs. k) Off delay facility through timer or PLC with 30 sec to 120

sec. time delay, to be connected to air flow switch.

l) Safeguard facility against single phasing.

m) Tripping of AHU blower motors in response to the fire alarm signal from AFAS.

n) Inter locking of Exhaust and AHU blowers such that power supply gets fed to exhaust blower only when the supply air flow is there.

Chilled water flow control

Variable Speed Drive (VSDs) for controlling the chilled water flow rate in the secondary circuit may be provided when AHUs operation is for 24 hours and where the secondary chilled water system has been provided. Requirement and Specifications of VSD system shall be as follows:

The VSD System shall function to supply variable chilled water flow in the secondary circuit of air- conditioning system in response to the load variations including that due to variations in ambient conditions to maintain the inside designed temperature conditions. However, under any circumstances, the secondary chilled water pump speed shall not fall below the 30% of the nominal speed or any other suitable minimum speed as per the system requirement. The VSD shall have the provision to switch over to the manual mode as and when required and facility for the manual speed variation from VSD itself. The system shall comprise of dedicated Variable Speed Drives (VSDs) designed for HVAC applications to accept two feedback signals (from differential pressure transmitters installed across the two farthest, most significant AHUs of the zone to select either maximum of the two or average of the two (as selected by the user) feedback signals using HVAC terminology, to regulate the speed of the secondary chilled water pump motors in response to the load variations. In case, any additional sensor (s) including wiring etc. if required to meet the system requirements the cost of that shall be deemed to be included in the cost of the VSD. The VSD shall have:

a) RFI (Radio frequency interference) Filters for EMC (Electro magnetic compatibility) compliance.

b) Voltage Vector Control technology to generate advanced sinusoidal output voltage, 100% true RMS value of the fundamental voltage at rated speed and nominal torque, cause no motor de-ration, and keep motor temperature limits within permissible class B limits.

c) The VSDs shall have D.C. link reactors/ harmonic filters integrated to minimise power line harmonics. There shall be reactors in both the positive and negative rails.

d) An automatic energy optimisation feature shall be provided as standard in the frequency converter. This feature shall reduce output voltage, further to quadratic V/f characteristics, when the motor is lightly loaded and minimise the motor losses.

e) The VSD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 160% torque for upto 5 seconds (for high inertic and high friction load).

f) The VSD shall include Automatic Motor Adaptation (AMA) to optimize motor performance, improve start capabilities and compensate for motor cable variances. The AMA shall be carried out at motor stand still with no need for detaching the pump from motor.

g) Unlimited output power circuit switching must be possible without the need for central circuit interlocking and without causing damage to the VSD.

h) Auto-derating of maximum drive current shall be incorporated in VSD to allow continued operation at reduced speed in case of VSD over temperature phase loss or mains imbalance without damaging the VSD.

i) parameters, programming parameters, faults,

j) Built in energy meter. k)in run time counter. l)Local control panel (key pad)

The system shall also comprise a suitable PLC if required, with electronic components.

VSD shall be designed, with built-in PID controller, control panel (keypads & display), IP 20 enclosure for use on standard centrifugal pumps. The VSDs should not cause any de-ration of the connected motors and must ensure that class B temperature levels of the connected motors are never exceeded. The display should be in alphanumeric characters and programming facility should be in user-friendly HVAC terminology. The VSDs shall be able to accept up to two feedback signals from differential Pressure transmitters simultaneously and to program set points in it. The system shall have following features incorporated:-

a)Heat sink over temperature protection b)Under voltage protection c)Over voltage protection d)Protections against input transients, loss of A.C. line phase, short circuit, ground fault, frequency converter over temperature. e)Alpha-numeric display facilities f)ON indication g)Trip indication h)Selectable display of various parameters like output line voltage, output frequency, speed, power, motor temperature percentage, heat sink temperature, VSD temperature percentage, KWH, hours run, differential pressure. i)Raise and lower speed push button in local mode. j)Frequency range variation from 0 to 50 Hz. k)Remote start and stop facility including indications thereof with necessary hardware and terminal blocks, including toggle switch etc. for over ride of remote start & stop of at the time of maintenance/ repairs. l)Safeguard facility against single phasing.

Where both building management system and air quantity flow control / chilled water flow control through VFD are provided for same application, control panel for sequencing of VFD shall not be required.

ECONOMIZER

Air- Side Economizers (Ambient Cooling)

Each individual cooling fan system that has a design supply capacity over 72 CMM (2,500 cfm) and a total mechanical cooling capacity over 22 kW (6.3 tons) shall include either:

a) An air economizer capable of modulating outside-air and return-air dampers to supply 100% of the design supply air quantity as outside-air; or

b) A water economizer capable of providing 100% of the expected system cooling load at outside air temperatures of 10°C (50°F) dry-bulb/7.2°C (45°F) wet-bulb and below

Exceptions to above are:

a) Projects in the hot-dry and warm-humid climate zones are exempt b)Individual ceiling mounted fan systems < 192CMM (6,500 cfm) are exempt

Partial Cooling

circulating cool night-time air to pre-cool the building prior to daily occupancy in the cooling season. The building control system can operate ventilation fans in the economizer mode on a scheduled basis. Care should be taken to prevent excessive fan operation that would offset cooling energy savings. It should also be ensured that night humidity does not preclude the use of this strategy.

Economizers shall be capable of providing partial cooling even when additional mechanical cooling is required to meet the cooling load.

TIMECLOCK CONTROL

All mechanical cooling and heating systems shall be controlled by a timeclock that: i) Can start and stop the system under different schedules for three different daytypes per week.

i) Is capable of retaining programming and time setting during loss of power for a period of at least 10 hours

ii) Includes an accessible manual override that allows temporary operation of the

system for up to 2 hours Exceptions to the above are: i) Cooling systems < 28 kW (8

tons) ii) Heating systems < 7 kW (2 tons)

TEMPERTAURE CONTROL

i) All heating and cooling equipment shall be temperature controlled. Where a unit provides both heating and cooling, controls shall be capable of providing a temperature dead band of 3° C (5° F) within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum Where separate heating and cooling equipment serve the same temperature zone, thermostats shall be interlocked to prevent simultaneous heating and cooling.

DEMAND BASED CONTROL

Conventional HVAC controls employ pressure -or temperature-set point control to isolate (or decouple) one system element from another. In any air conditioning plant, the cooling towers, chillers, distribution pumps, and supply fans are controlled independently with temperature or pressure set points that ensure the surrounding equipment also can operate independently over a wide range of loading requirements. Although a network-capable direct-digital-control (DDC) system may be employed for control, the network typically is used only to collect information for operations. In many systems, additional isolation is provided with primary -secondary pumping, bypasses, decoupling lines, and valves or dampers that have large pressure drops.

This focus on independent equipment selection wastes a lot of energy. In this system, normally the chiller will operate at a fixed chilled water temperature. At low load conditions, the chiller compressor would operate at a higher than needed head to provide colder water than required which the chilled water pump will distribute at a higher pressure than what is required. All these bring inefficiency into the system though the individual controls are provided to control them.

Demand-based control is a method of applying direct-coupled network control. It is based

on the idea that a building HVAC system is a single system the energy efficiency and comfort performance of which are optimize d when the operation of all the components is coordinated to meet actual needs in the spaces served.

Demand based control is intended to fill the vacuum created by development of variable frequency drive for HVAC equipment.

Demand based control ties the operation of all the equipment to end use requirements-actual space requirement in single building HVAC applications but this does not mean that chillers and cooling towers operate directly from the room temperature sensor. Rather in this control, all the components of air conditioning plant are directly coupled and work as a single system.

With variable-speed equipment and network capabilities, the long standing dictum that equipment must be decoupled to operate effectively has been re versed. Direct coupling leads to simpler, more-efficient operation. It is intuitive that coordinating the operation of a chiller plant and chilled-water distribution network is required to achieve the highest overall cooling system efficiency. When cooling needs to adjust in response to space conditions, demand based control coordinates the operation of all elements to provide cooling where it is needed according to predefined efficiency relationship.

Equal marginal performance principle is applied to optimize the pumps operation under all loading conditions. A circuit consisting of cooling towers, chiller pumps, and conditioning fans with VSD could be optimize in this manner. These components could be directly coupled and controlled using demand-based control to operate the circuit as a single system and provide the cooling capacity required. Thus, with demandbased control, equipment is coordinated to operate according to power (kilowatt) set points, which is s impeller, more stable, and much more efficient than the use of temperature or pressure set points is.

7.1.9 ELECTRICAL WORK

SCOPE

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

GENERAL

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

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

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

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

SWITCH BOARDS

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

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

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

iv) All switch fuses/fuse switches dis-connector switches shall be of AC 23 duty as per IS:

4064-1978 as amended upto date. They shall be complete with suitable HRC cartridge type fuses.

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

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

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

viii) Switchboards shall be fabricated as per specifications indicated in subpara above.

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

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

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

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

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

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

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

POWER CABLING

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

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

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

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

CONTROL WIRING

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

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

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

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

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

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

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

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

EARTHING

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

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

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

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

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

Motors upto and including 10 HP rating	2 Nos. 3 mm dia copper wire/ 2 nos. 4mm dia GI wire
12.5 HP to 40 HP	2 Nos. 4 mm diacopper wire/ 2 nos. 6mm dia GI wire
50 HP to 75 HP	2Nos. 6 mm dia copper wire/ 2 nos. 25x3mm GI strip
Above 75 HP	2Nos. 25mm x 3mm copper strip/ 2 nos. 25x6mm GI strip

Switch boards with incoming rating

Upto 100 A	2 Nos. 3 mm dia copper wire/ 2 nos. 4mm dia GI wire
125 A to 200 A rating	2 Nos. 6mm diacopper wire/ 2 nos. 25x3mm GI strip
Above 200 A rating	2Nos. 25mm x 3mm copper strip/ 2 nos. 25x6 mm GI strip

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

POWER FACTOR CAPACITORS

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

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

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

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

REMOTE CONTROL CUM INDICATING PANEL

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

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

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

be provided.

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

MOTOR STARTER

i) The motor starter shall conform to IS: 1822 —Motor starters of voltage not exceeding 1000 volts‖ and shall be air insulated and suitable for 415 volts, + 10%, 50 Hz., 3 phase AC supply. Enclosures shall have protection of IP 42 for Indoor applications and IP 55 for outdoor applications.

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

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

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

v) Each starter shall be provided with the following protections: a)Thermal overload on all the three phases with adjustable settings, b)Under voltage protection, and c)Independent single phasing reventor. (current sensing type) vi)Adequate number of extra NO/ NC contacts for interlocks, indicating lamps etc. shall be provided on the starter/ contactor.

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

MOTOR EFFICIENCY

- All permanently wired poly-phase motors of 0.375 kW or more serving the building and expected to operate more than 1500 hours per year and all permanently wired poly phase motors of 50 kW or more serving the building and expected to operate more than 500 hours per year shall have a minimum acceptable nominal full load motor efficiency not less than IE3 class as per IS 12615 for Energy Efficient motors.
- Motors of horsepower differing from those listed in the table shall have efficiency greater than that of the listed kW motor. See Annexure N.

- Motor horsepower ratings shall not exceed 20% of the calculated maximum load.
- Motor nameplates shall list the nominal full load motor efficiencies and the full load power factor.
- Motor users should insist on proper rewinding practices for rewound motors. If the proper rewinding practices cannot be assured, the damaged motor should be replaced with a new, efficient one rather than suffer the significant efficiency penalty associated with typical rewind practices.
- Certificates shall be obtained and kept on record indicating the motor efficiency. Whenever a motor is rewound, appropriate measures shall be taken so that the core characteristic s of the motor is not lost due to thermal and mechanical stress during removal of damaged parts .After rewinding, a new efficiency test shall be performed and similar records shall be maintained.
- Motors should be installed with soft start energy savers and Variable Speed drives based on the application required.

7.1.10 Double Skin Air Handling Unit

Scope

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

Type

The air handling units shall be double skin construction, draw-thru type comprising of various sections such as filter section, coil section, fan section and monsoon reheat section, factory assembled as elaborated in drawings and schedule of quantities.

Capacity

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

Housing/Casing

The housing/casing of the air-handling unit shall be of double skin construction. The housing shall be so constructed that it can be delivered at site in total/semi knock down conditions depending upon the locations. The casing strength of the assembled Air Handling Unit shall be designed to meet BS EN 1886, Class 2A and the casing air leakage of the assembled Air Handling Unit shall be designed to meet BS EN 1886, Class B.

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

Double skin panels (each not exceeding 750mm wide) shall be made out of 24 gauge pre painted galvanized steel sheet on outside and 24 gauge plain galvanized sheet inside with 48 mm thick injected CFC free PU foam insulation in between. These panels shall be bolted from inside on to the frame work with soft rubber gasket in between to make the joints air tight.

Frame work for each section shall be bolted together with soft rubber gasket in between to make the joints air tight. Suitable doors with pressure die cast aluminium hinges and latches shall be provided for access to various panels for maintenance. The entire housing shall be mounted on steel channel frame work. Each component section of the Air Handling Unit shall have matching cross- sectional dimensions of the same construction showing a neat exterior along the length of the unit and a clean interior appearance to ensure even air flow through each plant item.
Drain pan shall be constructed out of 18 gauge stainless steel with necessary slope to facilitate rapid removal of condensate water. Drain pan shall be factory insulated with minimum 9mm thick closed cell elastomeric insulation as required. Necessary supports will be provided to slide the coil in the drain pan. Outlet shall be provided from the drain pan in a manner that access panel can be opened without disconnecting the drain pipe connection.

Motor and Drive

Fan motors shall be high efficiency IE-02 suitable for operation on 415 + 10% volts, 50 cycles, 3 phase, squirrel cage, totally enclosed fan cooled with IP-55 protection and class F insulation and class B temperature rise. Motors shall be especially designed for quiet operation and motor speed shall not exceed 1440 RPM & 2800 RPM for fans below 3500 Cfm. Drive to fan shall be provided through belt-drive arrangement. Belts shall be of the oil-resistant type. Efficiency of motors shall be 85 % or more. As an option belt guards shall be provided with a painted metal sheet belt guard that totally encloses the drive, the guard shall be rigidly attached to the fan base support structure.The motor shall be suitable for VFD controlling.

Fan

The fan shall be forward curved floor standing double inlet double width type. The wheel and housing shall be fabricated in galvanized steel construction as per manufacturer standard. The fan impeller shall be mounted on a solid shaft supported to housing with angle iron frame/spider and self lubricated sealed eccentric type ball bearings. The impeller and fan shaft shall be statically and dynamically balanced. The fan outlet velocity shall not be more than 1800 FPM. Fan housing with motor shall be mounted on a common steel base mounted inside the air handling housing on anti-vibration spring mounts or rubber mounts. The fan outlet shall be connected to casing with the help of fire retardant canvass.

Cooling /Heating Coils

Chilled/Hot water coils shall have 12.5 mm to 16 mm dia tubes of wall thickness not less than 24 G with aluminium fins firmly bonded to copper tubes assembled in zinc coated steel frame. Face and surface areas shall be such as to ensure rated capacity from each unit and such that air velocity across each coil shall not exceed 500 FPM. The coil shall be pitched in the unit casing for proper drainage. Each coil shall be factory tested at 21Kg/Sqcm air pressure under water. Tubes shall be hydraulically/ mechanically expanded for minimum thermal contact resistance with fins. Fin spacing shall be 11 to 13 fins per inch (4 to 5 fins per cm.)

Filters

Each unit shall be provided with a factory assembled filter section containing cleanable type pre-filters of synthetic media having anodized aluminium channels. The media shall be supported with HDP mesh on one side and aluminium mesh on other side. Filter face velocity shall not exceed 500 FPM. Filters shall fit so as to prevent by-pass. Holding frames shall be provided for installing a number of filter cells in banks. These cells shall be held within the frames by sliding the cells between guiding channels. Filters shall be of 90% efficiency down to 10 micron.

Heater Section

Each Air Handling units shall be provided with heater section for monsoon reheat & winter heating as required. The section shall include all control such as heating thermostat, control wiring etc. The unit shall also incorporate necessary safety features as mentioned under strip heaters. The heater terminals shall be extended in order to check parameters without opening the AHU door/panels. The cpacity of the heater strip to be provided by the manufacturer at the time of drawing approval by Engineer In Charge.
Supply and install (or paint) on the exterior of the unit in a prominent position adjacent to the heater bank a notice, which shall read.

Fire

This unit contains electric heating elements and is fire resistant. In the event of fire, disconnect the power by the main isolating switch.
(Characters to be in white, 15mm high for the word "FIRE" and 5mm high for the rest on a red background)

Accessories

Each air handling unit shall be provided with manual air vent at highest point in the cooling/heating coil and drain plug at the bottom of the coil. Besides, the following accessories may be required at air handling units, the detailed specifications are given in individual sections, and quantities separately described in the schedule of quantities.

Motorized self balancing pressure independent valves located in chilled / hot water lines connecting to the coil. This valve shall be operated by the cooling/ heating thermostat and shall control the flow of chilled/hot water.

Insulated butterfly valves/balancing valves, Y-strainer, unions and condensate drain piping upto sump or floor drain in air handling unit rooms as described in section "Piping".

Dial type thermometer in the thermometer wells and pressure gauge (with cocks) within gauge ports in chilled/ hot water supply and return lines as per the section "Automatic Controls and Instruments".

Performance Data

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

Testing

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

7.1.11 FAN COIL UNITS

General

The fan coil units shall be complete in all respects and shall generally comply with the specifications as given hereunder.

Fan Coil Units

The coil units shall be of seamless copper tube not less than 0.5 mm thick walls and min. 9 MM OD tube dia. The coil shall have continuous aluminium sheet fins with die formed collars for mounting. The finned coil, fan section with motor, drain pans, air filters, filter box, fan speed regulator and other controls.

Cooling Coil

The coil shall be of seamless copper tubes not less than 9 mm O.D. 0.40 mm thick. The coil have continuous aluminium plate fins. The fins shall be spaced by collars forming integral part of the fins. The tubes shall be staggered in the direction of air flow. The coil circuit should be sized for adequate water velocity but not exceeding 1.8 M/s (6 F.P.S) the fins hall be uniformly bonded to the tubes by hydraulic expansion of the tubes.

The coils shall be tested against leaks at a hydraulic pressure of 10 kg/sq.cm. This pressure shall be maintained for a period of 2 hours. No drop should be observed indicating any leaks.

Fan Section

- This shall consist of (2) two light weight aluminium impellers of forward curved type, both statically and dynamically balanced, along with properly designed G.I. sheet casings of 18 gauge.
- The two impellers shall be directly mounted on to a double shaft, single phase multiple winding motor capable of running at (3) three speeds.
- G.I. Plenum of 18 gauge shall connect the fan outlets to the coil.

Drain pans

The drain pan shall be of double skin construction made of 1.6 mm (16 GA.) G.I. Sheet, covering the whole of coil section and extended on one side for accommodating coil connection, valve etc. and complete with a 25 mm drain connection. The drain pan shall be insulated with 25 mm expanded polystyrene and covered with second G.I. tray.

Air Filter

The filter shall be cleanable type 12 mm thick, of wire mesh to be mounted, behind the pan in a filter box made of G.I. Sheet of 18 gauge.

Speed Control

A sturdy switch shall be provided with the unit complete with wiring, for off and with minimum (3) three speed control, of the fan.

Painting

The fan coil units shall be powder coated in suitable colour.

Automatic Controls (Wherever Required)

Each unit shall have a room type thermostat and a 2 way motorised water valve. The valve shall be fixed at a convenient location. The thermostat shall be mounted along with the speed control switch on a common plate. The plate shall clearly indicate the fan positions. The controls should be as per specifications under 'controls'.(price separately)

The water valves on inlet line shall be of gun metal ball type with integral water strainers, having BSP(FPT) inlet and flare type mpt outlet connection. The valve on return line shall be as above, but without the water strainer.

Water Connections

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

7.1.12 FILTERS

General

The various types of Filters to be used in the Different Systems, to achieve the required degree of air purification shall confirm to the following specifications.

Standard Filters

The standard filters shall have an efficiency of 90 % down to 10 Microns.

The frames of the filter shall be of G.I. of suitable rigidity.

The filtering media shall be 5 ply pleated synthetic media, closely packed to give the required efficiency.

Miscellaneous

Suitable packing shall be provided in the frames of all filters, to prevent any leakage of air through the gaps, between the filter joints. All such joints shall be properly sealed against any leakage of unfiltered air.

7.2 INSPECTION, TESTING AND COMMISSIONING

7.2.1 SCOPE

This chapter covers initial inspection and testing of pre insulated pipe, valves, leak detection system at manufacturer's works, initial inspection of other equipments/ materials on receipt at site, final inspection testing & commissioning of all equipment at site & description of testing requirements & procedure.

7.2.2 INITIAL INSPECTION AT MANUFACTURER'S WORKS

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

ii) Pneumatic pressure test at twice the normal pressure for the pre insulated chilled water pipe shall be carried out.

iii) Hydraulic test at 21 Kgf/sq.cm. for the Pre insulated chilled water pipe shall be carried out as per the Indian Standard.

iv) U value of the pre insulated pipe have to be verified at the manufacturing works as per the Factory Testing:

All instruments and personnel for tests shall be provided by the contractor. Contractor shall inform the client about the pre insulated pipe factory testing schedule min. 10 to 15 days before the pipes are ready for factory testing.

Pipes and Valves

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

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

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

Insulation and acoustic lining

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

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

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

FINAL INSPECTION

i) After completion of the entire installation as per specification in all respects, the AC contractor shall demonstrate trouble free running of the AC equipments and installation for a period of minimum 120 hours of running as detailed under para 1.15.

ii) After the trial run as in para 1.15 above, the AC contractor shall offer the plant for the seasonal test, namely test for summer or monsoon season whichever occurs earlier. The test results as per Appendix G shall be furnished.

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

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

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

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

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

b. Wet bulb Temperature : Sling psychrometer conforming to IS:6017.

Scale Error:

For less than 0 deg. C : 0.3 deg C + 0.2

deg. C. For over 0 deg. C : 0.2 deg. C + 0.1

deg. C.

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

d. Water flow meter : Water flow shall be measured using the arrangement installed as per schedule of work. In case the tendering firms do not have testing instruments of the accuracy mentioned above, they should specify the accuracy of the instrument available with them for testing at the tender stage.

TESTING REQUIREMENTS AND PROCEDURES

Balancing of all air and water systems and all tests as called for in the specification shall be carried out by the HVAC contractor in accordance with the specifications and relevant

local codes if any. Performance tests of individual equipment and control shall be carried out as per manufacturer's recommendation. All tests and balancing shall be carried out in the presence of Engineer-in-charge or his authorized representative.

The whole system balancing shall be tested with microprocessor based hi-tech instruments with an accuracy
+ 0.5%. The instrument shall be capable of storing data and then down loading into a P.C. The HVAC contractor shall provide a minimum but not limited to the following instruments:

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

ii) Velo meter to measure air volume and air velocity

iii) Pitot tube

iv) Electronic rotary vane Anemometer

v) Accubalance flow measuring hood

The contractor shall be responsible to provide necessary sockets and connections for fixing of the testing instruments, probes etc.

Air Systems:

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

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

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

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

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

v) Test and adjust each register, grills, diffuser or other terminals equipment to within 5%

of design air quantity. Each opening shall be defined on the test report by size, manufacturer's model, room location, design cfm and actual cfm. Outlets shall be adjusted to minimize objectionable drafts.

vi) Test and record static pressure drop across all filters and major coils.

vii) High velocity duct systems shall be tested for leakage. If excessive or audible leakage is detected, the defect shall be repaired by the contractor. Sufficient static pressure readings shall be taken from the air handling units to the terminal units to establish system static pressure.

Water System:

Systems are to be balanced by opening all valves, closing all by-pass and setting all mixing valves to full coil flow. Water systems shall be cleared of air. Verify that the system has been properly cleaned, flushed and treated before testing. Basically, the following tests and adjustments are required.

i) Test and adjust all pumps to deliver the proper gpm. Record rpm, motor amperage, discharge and suction pressure. Pumps shall operate without objectionable noise or cavitation. Plot actual pump and system performance points on manufacturer's pump curves.

ii) Check all expansion tanks for proper filling pressurization. Verify operation of automatic fill and relief valves.

iii) Check the operation of all automatic valves.

iv) Test and adjust correct water flow through chiller, major items of equipment and main water circuits. The balancing valves, provided on the equipment shall be used for adjustment.

v) Check capacity output of chillers and set water flow rate for proper data.

vi) Check and adjust each coil to provide proper gpm. Record water and air temperature changes and water pressure drop.

vii) Set pressure drops across coil by-pass to match coil full-flow pressure drop.

Unit capacity in Tons Refrigeration shall be computed from the temperature readings, pressure readings and water/ brine flow measurements. Flow measurements shall be preferably through flow meters.

Pumps shall be tested for the discharge head, flow and BHP. Where it is not possible to measure the flow, atleast the discharge head and BHP (on the input side) shall be field tested.

Balancing Tolerance:

Systems shall be balanced within the following tolerances ;

i) Duct leakage Rates (at operating pressures) :

Low pressure ducts	5% of full
flow (0 to 0.5 kPa)	
Medium Pressure Ducts	1% of full
flow (0.5 to 3 kPa)	
High Pressure Ducts	1% of full
flow (Greater than 3 kPa)	

ii) Air flow rates :

Under 70 L/S	10% of flow
Over/ at 70 L/S	5% of flow

iii) Water flow rates :

Chilled Water	2% of flow
Other	5% of flow

iv) Heat flow rates :

Heat exchangers	5% of design

capacity Procedure:

Review all pertinent plans, specifications, shop drawings and other documentation to become fully familiar with the systems and their specified and intended performance.

Furnish equipment and instruct sheet metal trade on proper use for conducting duct leakage tests. Conduct first test as a way of instructing the above trades in the presence of the Department‘s representative.

Test relative barometric pressures in various building area, as deemed necessary by the Department's representative and at least in all areas served by different systems.

Test performance and continuously record on a 24 hour basis, temperature and humidity levels where control equipment is provided for that purpose in certain critical areas.

Before commissioning of the equipment, the entire electrical installation shall be tested in accordance with relevant BIS codes and test report shall be furnished by a qualified and authorised person.

Reports

Provide 3 copies of the complete balancing and testing reports to the department. Report shall be neatly typed and bound suitable for a permanent record. Report forms shall contain complete test data and equipment data as specified and safety measures provided as per para 1.14.3.

Final documentation

The contractor shall leave the system operating in complete balance with water and air quantities as shown on drawings. Set stops on all balancing valves and lock all damper quadrants in proper position. Secure all automatic damper and valve linkages in proper positions to provide correct operating ranges.

Proper damper positions shall be marked on ducts with permanent indication.

Notify the department of any areas marginal or unacceptable system performance. The above tests and procedures are mentioned herein, for general guidance and information only, but not by way of lamination to the provisions of conditions of contract and design/ performance criteria.

Upon commissioning and final handover of the installation, the HVAC contractor shall submit (within 4 weeks) to the engineer-in-charge/ department 6 (six) portfolios of the following indexed and bound together in hard cover ring binder (300 x 450 mm) in addition to the completion drawings as mentioned above.

i) Comprehensive operation and maintenance manual

ii) Test certificates, consolidated control diagram and technical literature on all controls.

iii) Equipment warranties from manufacturers.

iv) Commissioning and testing reports

v) Rating charts for all equipment

vi) Log books as per equipment manufacturers standard format

vii) List of recommended spares and consumables

viii) Any special tools required for the operation or the maintenance of the plant shall be supplied free with the plant.

At the close of the work and before issue of final certificate of completion by the Engineer-in-charge, the contractor shall furnish a written guarantee indemnifying the department against defective materials and workmanship for the Defects liability period. The contractor shall hold himself fully responsible for reinstallation or replace free of cost to the department.

i) Any defective material or equipment supplied by the contractor ii)Any material or equipment supplied by the department which is proved to be damaged or destroyed as a result of defective workmanship by the contractor.

Miscellaneous

- The contractor shall supply the skilled staff and all necessary instruments and carry out any test of any kind on a piece of equipment, apparatus, part of system or on a complete system, if the architect requests such a test for determining specified or guaranteed data, as given in the specification or on the drawings.

- Any damage resulting from the tests shall be repaired and/or damaged material replaced, to the satisfaction of the Engineer In Charge without any extra cost.

- In the event of any repair or any adjustment having to be made, other than normal running adjustment, the tests shall be void and shall be recommenced after the adjustment or repairs have been completed.

- The contractor must inform the Engineer In Charge when such tests are to be made, giving sufficient notice, in order that the architect or his nominated representative may be present.

- The contractor may be required to repeat the test as required, should the Ambient conditions at the time, do not give, in the opinion of the Engineer In Charge, sufficient and suitable indication of the effect and performance of the installation as a whole or of any part, as required.

7.2.3 IDENTIFICATION OF SERVICES

SCOPE

The scope of 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.

A wall mounted, glass covered plan to the approval of the Architect / Engineer shall be provided and desplayed in each plant room showing the plant layout with pipe work, valve diagram and valve schedule indicating size, service, duty, etc.

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 and 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.

7.3 Technical Submittals

The successful tenderer after award of work shall furnish technical submittals & shop drawings for various items incorporating complete technical details prior to procurement of equipment/materials, for the approval of the Engineer-in-charge. The submittals for items mentioned in the tender document but not restricted to the following:

a.	VFD
b.	RTD sensor
c.	DPT sensor

Test certificates for various items shall also be submitted by the contractor.

7.4 List of Approved Makes for Air conditioning Works

S. No.	Items	Makes
1	Air handling unit/ Treated Fresh Air Unit	System Air/Flaktwood/ Zeco/Edgetech
2	Exhaust Air Unit	System Air/Flaktwood/ Zeco/Edgetech/Zair
3	Pipe (MS & GI)	Tata/Jindal(Hissar)/QST/Jindal(Star)
4	Blower	Nicotra/Comferi/ Kruger
5	Cooling coil	Zeco/Edgetech/ AHRI Certified
6	Hepa Filter	Thermadyne /Anfilco/ Dyna Air Filtration
7	Fan Coil Units	Cruise/Zeco/Edgetech/Kubic Midea/Trane
8	Duct (factory fabricated)	Rola Star / Techno Fabri-duct/Zeco/Ductofab
9	Water strainers (Y-strainer/pot strainer)	Emerald/Sant/D.S. Engineering / Maharaja Casting/Advance
10	Proportional thermostat	Siemens /Honeywell/Johnson
11	3 Way Motorized/ Mixing / Diverting valves	Siemens /Honey-well/Johnson/ Danfoss/Advance
12	Pressure gauges for water line/Refrigerant	Emerald / Fiebeg/ H. Guru
13	Thermometers	Emerald/ Japsin
14	V-Belts	Fenner India/ Dunlop
15	Fibre glass wool	UP Twiga /Ownes Corning
16	Nitrile Rubber insulation (Open/close cell) with specification as per BOQ.	Armacell/ K-flex/ A-flex/ Supreme/Aerolam
17	Fire retardant flexible duct	Air flow / Twiga/ATCO/GP spira/caryaire

	connection	
18	Gasket for ducts	Prima Kool / Nuprine
19	Anchor Fasteners	Hilti / Fischer
20	Extruded Aluminum grilles & diffusers Fresh air louvers/Dampers	Caryaire/ Ravi Star/ Air Flow/Air master/Titus/System air
21	Fire damper	Ravi Star/Air Flow/ Mapro/System air/Ruskin Titus/Greenheck
22	Duct attenuator	AirFlow/Ravi Star/ Contin-ental/Mahajan
23	Vibration isolators	Resistolex /Gerb / Base/ Dunlop
24	Motors	Siemens/Crompton/ABB/Bharat Bijlee
25	Fuse switch unit/switch fuse unit/HRC fuse	Larsen Toubro / Siemens / Schneider (MG)/Havells
26	Humidistat	Honeywell/Danfoss/Penn
27	Condenser/ Chiller	Trane/Carrier/York/Daikin
28	Polyurethane Foam (PUF)	Malanpur/ Lloyd /Best Opuf
29	Thermocole	Pioneer/Styrin
30	Chemical Reagent	Antiscalant/ Descalant / Antifungal Hibird / amacid/ Maic
31	VFD with sensors	ABB/DANFOSS/ Siemens
32	Cooling Tower	Paharpur/Flow air-tech Pvt.Ltd/Bell/Advance
33	Cooling Tower PVC Fills	Paharpur/Bell/Advance/Flow air tech
34	Window/Split Air conditioner/ Hi-wall split AC	Voltas/Hitachi / Carrier/Panasonic/Blue star/ Toshiba/Daikin
35	Dosing pump	M/s Ion Exchange (I) Ltd/ Milton Royal
36	Tower AC units	Voltas/Hitachi / Carrier/Panasonic/Blue star/ Toshiba/Daikin

37	Inverter VRF system	Voltas/Hitachi/ Carrier/Panasonic/Blue star/ Toshiba/Daikin/ Mitsubishi Electric
38	Hi wall type chilled water FCU	Cruise/Zeco/Edgetech/Kubic Midea/Trane
39	Wet scrubber	Zeco/Edgetech/ZAIR
40	Air washer (Evaporative cooling unit)	Carryaire/Zeco/Zair/Edgetech/Airflow
41	Pre-Insulated Pipe	Permapipe/Urecon/Sevenstar/Eurotube
42	VAV Boxes	Ruskin Titus/Honeywell/Trox/Trane/Johnson Controls/Tristar
43	Self-Cooled PAC server Rack	Schneider/Emersion/ Flakt
44	Victaulic coupling	Sevcon/Victaulic/Smith Copper
45	Dehumidifier	Bry-Air/Munters/Bri
46	PICV valve	Advance/Siemens/Danfoss/Honeywell
47	Axial Fans	Krugar/Nicotra/Comefri/Green Deck/Airflow
48	Spiral Flat Oval Duct (with GSS sheets of preferred make)	Dustech/GP spira/Spiral Tubes/Western air ducts/ Ductofab/Seven star
49	Silicone flexible duct connector	Easyflex/Airflow//Resistoflex/Dustech
50	Motorized butterfly valve/ Modulating Valve/Solenoid valve	Advance/Danfoss/Belimo/Johnson Control/Zoloto/Tyco/Victaulic/Honeywell
51	Expansion Bellow	Easyflex/Resistoflex/Cori
52	Fire rated vane Axial/Fire rated tube Axial/Vane Axial/Tube Axial Fan	Nicotra/Comferi/Kruger/Greenheck/Airflow/system air/Zair
53	Inline Fan	Nicotra/ Kruger/Greenheck/Airflow/system air
54	Propeller fan	Nicotra/ Kruger/Caryaire/Crompton/GE
55	Butterfly valve	Audco / Advance / Honeywell/ Kirloskar/ L&T

56	Check Valve (Non-return valve)	Audco/SKS/Advance/ Zoloto/ Honeywell
57	Balancing valve	Advance /Audco/ Honey- well/Danfoss
58	Centrifugal pump / Monobloc Pump	Grundfoss/Armstrong/Willo/Xylem
59	Water Softening Plant	Ion Exchange Ltd. / Milton Royal
60	Pressure switch	Indfoss / Honeywell
61	Bronze ball valve	Emerald/ Zolto / Leader/ Sant
62	Bronze ball valve with Y strainer	Emerald / Rapid control/ BAP
63	Suction guide	Anergy instrument Pvt.Ltd./Johnson/Pump OEM make
64	Water cooled screw chilling unit	Trane/Carrier/York/Daikin
65	Chemical reagent	Eco friendly bio clean pond clarifier/Volga
66	Sand filter	M/s Ion Exchange (I) Ltd / Pentair
67	Compressor	Emerson/Tecumsheh/Bohn/Danfoss
68	Cold room/Deep freezer	Danfoss/Blue Star/Bohn
69	Air-cooled ductable split/ceiling mounted Cassette type air-conditioning unit	Voltas/Hitachi / Carrier/Panasonic/Blue star/ Toshiba/Daikin
70	PVC water tank	Syntex/ Polycon
71	Water Cooler	Blue Star/Usha/Sidwal/Voltas
72	Control cables	CCI/ Fort Gloster/ Universal/ Incab/ Havells/KEI
73	Modular type Variable Refrigerant Flow/ Variable Refrigerant Volume air cooled Out- door units with specification as per BOQ	Voltas/Hitachi/carrier/Panasonic/Blue star/Daikin/Mitsubishi Electric

74	High static pressure VRF/VRV ceiling mounted ductable type Indoor Unit with specification as per BOQ.	Voltas/Hitachi/carrier/Panasonic/Blue star/Daikin/Mitsubishi Electric
75	Copper refrigerant piping with specification as per BOQ	Mandev/Rajco/ Maxflow
76	uPVC plumbing drain pipe with specification as per BOQ.	Supreme /Finolex
77	Fabricated GSS/GI Sheet with specification as per BOQ.	Jindal/Tata/SAI/Bhushan
78	80Amp, 4P, 300 Ma Weather proof RCB with specification as per BOQ.	L&T, Schneider, ABB
79	XLPE Class-O tubular insulation with specification as per BOQ.	Supreme / K-Flex/ A-Flex/Aerolam
80	PAC Unit with specification as per BOQ	Schneider (Uniflair)/StulzChspl (In- dia) Pvt.Ltd /Emerson Climate Technologies/ Bluebox
81	Electrical Panel with specification as per BOQ.	Siemens /L&T/Schneider / Le grand/Tecnic / ABB/ C&S/Neptune Milestone switchgear/Tricolite/ Essaar/Morden switch gear/Adlec
82	Portable type dehumidifier with Specification as per BOQ.	White Westinghouse/Power Pye Electronics/Bryair/Munter
83	GI volume control duct damper with specification as per BOQ.	Airmaste Equipment Emirates/Omega/Airflow
84	Soft duct (Fabric Duct)	Duct Sox/Prihoda
85	Smoke cum fire damper (Bare Damper)	Dynacraft/Mapro/Servex/Ruskin
86	Smoke cum fire damper (Actuator)	Belimo/Joventa/Honeywell/Siemens

87	Automatic Pressurization cum expansion tank	Flamco/Reflex/ IMI Hydronics/Ballandgosset
88	Dirt separator	Flamco/Reflex/ IMI Hydronics/Spirotech

Any other item not covered in the above list shall be ISI marked and as approved by Engineer In Charge

8 Terms Conditions of Contract

8.1 Terms Conditions for the minor works under the contract

1. The contract will be used only to execute original works/ minor works/ repair works of urgent nature. It can also be used for any works of restoration as a result of a disaster in campus causing damage to institute infrastructure/ works related to emergency services/ works of institute importance/ works concerned to safety health and environment of campus community. The works undertaken through such contracts are categorized as time bound and should be executed as per Table 6.
2. The contractor should always keep his establishment ready to commence the work immediately after the issue of the work of any amount. The schedule for the issued works under the contract should be at per Table 6. Work requests of urgent nature shall be started at the earliest after receiving orders from the engineer-in-charge but it should be documented with photo and video evidence for all hidden items. Submission of this evidence is mandatory for all works executed without a pre-approved quantity take off sheets.
3. During the execution, the noise creation should be minimized to the extent possible and the works may be carried at odd hours and more than one shift as per requirement.
4. The performance of the instruments or tools to be used should be checked precise before using them on site.
5. The contractor and his/her personnel has to build a well-coordinated system with the users regarding execution of the works.

8.2 Timely Completion

1. All work components must be started simultaneously and has to be delivered together or early within the given time schedule.
2. The contractor has to deploy the labor and supervisory staff in shifts to meet the targeted completion date. The work may be executed in extended shifts or two shifts.
3. Number of days from the date of issue of letter of acceptance for reckoning date of start shall be as per Schedule. If the Contractor commits default in commencing the execution of the work as aforesaid, the performance guarantee shall be forfeited.
4. The contractor shall procure the required materials in advance so that there is sufficient time for testing of the materials and approval of the same before use in the work, as required.

8.3 Rates

1. Unless otherwise provided in the schedule of quantities of the work the rates tendered by the contractor shall be all inclusive and shall apply to all heights, lifts, leads and depths of the building (inclusive of GST) and nothing extra shall be payable to him on this account.
2. The rates for all items of work shall, unless clearly specified otherwise, include cost of all labours, materials and other inputs involved in the execution of the item irrespective of whether they have been specifically mentioned in the tender document or not.
3. In case the same item (s) appear more than once in the schedule of work / BOQ under the same sub head or among the different subhead of works, the lowest rate quoted for that item (s) shall be considered for the particular item(s) wherever appeared in any part of BOQ / Schedule of works for the purpose of tender evaluation although web generated e-price bid may incorporate different quoted rate for same item(s) as per the quoting pattern of the tenderer. The tendered amount thus worked out shall be final &shall be binding on the contractor.
4. No double scaffolding is payable in single story houses including parapet wall. In multistor- ied houses the payment of double scaffolding shall be made after 3.5 meter from plinth protected level. The necessary deductions for single scaffolding be made from the items. Contractors are advised to visit the site & quote the rates accordingly.
5. The rates quoted by the contractor will be deemed to be inclusive of any extra expenditure of this reason. The contractor has to increase the manpower or other tools etc. to do the work as per the quantum of work provided to him at his own expenses. Nothing shall be paid on this account.
6. The contractor shall provide at his own cost suitable weighing, surveying and leveling and measuring arrangements as may be necessary at site for checking. All such equipment shall be got calibrated in advance from laboratory, approved by the Engineer-in-Charge. Nothing extra shall be payable on this account.
7. Other agencies may also simultaneously execute and install the works and the contractor shall afford necessary facilities for the same. The contractor shall leave such recesses, holes, openings, trenches etc. as may be required for such related works (for which inserts, sleeves, brackets, conduits, base plates, clamps etc. shall be available as specified elsewhere in the contract) and the contractor shall fix the same at the time of casting of concrete, stone work and brick work, if required, and nothing extra shall be payable on this account.
8. All material shall only be brought at site as per program finalized with the

Engineer-in- Charge. Any pre-delivery of the material not required for immediate consumption shall not be accepted and thus not paid for.

9. MCCB's, switches, sockets, wires, cable, light fixtures, earthings and other electrical items covered under the contract should conform to approved manufacturers specifications, where CPWD Specifications are not applicable. The contractor should get the materials (fixtures/fittings) tested from approved labs wherever required at his own cost.
10. The contractor shall be responsible for the watch and ward / guard of the buildings, safety of all fittings and fixtures including sanitary and water supply fittings and fixtures provided by him against pilferage and breakage during the period of installations and thereafter till the building is physically handed over to the client department. No extra payment shall be made on this account.
11. The rates quoted by the Contractor are deemed to be inclusive of site clearance, setting out work, profile, establishment of reference bench mark(s), taking spot levels, construction of all safety and protection devices, barriers, preparatory works, working during monsoon, working at all depths, height, lead, lift and location etc until / unless specified otherwise and any other incidental works required to complete this work. Nothing extra shall be payable on this account.

8.4 Quality and Workmanship

1. The contractor shall be entirely responsible and answerable for all the works done by him regarding quality, adherence to the laid down specifications, terms and conditions, warranty/guarantee etc. and he shall be liable to bear any compensation that may be levied by the department under any of the clauses of the agreement.
2. The materials having ISI mark shall have precedence over the one conforming to IS Specifications.
3. The proposed buildings are Institute housing and quality of work is paramount importance. Contractor shall have to engage well experienced skilled labour and deploy modern T&P and other equipment to execute the work.
4. Samples of all materials and fittings to be used in the work in respect of brand manufacturer and quality shall be approved from the Engineer-in-Charge, well in advance of actual execution and shall be preserved till the completion of the work.
5. All materials used in the work shall be new and of good quality, conforming to the relevant specifications as per good engineering practice. All the materials proposed to be used in the work should be approved from Engineer in Charge before use in work.
6. Articles bearing BIS certifications mark shall only be used unless no manufacturer

has got BIS/ISI mark for the particular material. Any material/fitting whose sample has not been approved in advance and any other unapproved material brought by the contractor shall be immediately removed as soon as directed. Where the make of any particular material is not specified in the Contract document, the material shall be supplied as per makes desired by the engineer-in-charge.

7. It will be the responsibility of the contractor / bidder to ensure use of genuine materials in the work. The department reserves the right to get (any / all materials / components) inspected by the manufacturer or their authorized representatives at any stage of the execution of work. If any of the materials, supplied and used in work is found spurious at any stage, then the department reserves the right to ask the contractor to replace it by genuine one and make suitable recovery till it is done, even if any payment against that material is already made.

8. The contactor should get the make/TDS documents approved before procuring any material at site. The TDS/Make once approved shall not be changed without any valid recorded reasons. No material to be brought and used at site without the prior knowledge & approval of Engineer-in-Charge.

9. The department may ask for any valid document like manufacturer's test certificate, document for purchase of the material, document for import/shipment of imported materials etc. as deemed fit by the engineer-in- charge to ascertain genuinely of material supplied by/used in the work by the contractor. The contractor shall remain bound to submit all

   such documents to the department failing which payment may not be made or if already paid may be recovered/ withheld from subsequent running account payment.

10. All equipment and their components, and all the materials to be used in the work shall be suitable for the environmental conditions at the location of the work.

11. The contractor shall ensure quality control measures on different aspects of construction including materials, workmanship and correct construction methodologies to be adopted. He shall have to submit quality assurance programme within two weeks of the award of work. The quality assurance programme should include method statement for various items of work to be executed along with check lists to enforce quality control.

12. The contractor shall get the source of all other materials, not specified elsewhere in the document, approved from the Engineer-in-Charge. The contractor shall stick to the approved source unless it is absolutely unavoidable. Any change shall be done with the prior approval of the Engineer-in-Charge for which tests etc. shall be done by the contractor at his own cost. Similarly, the contractor shall submit brand/ make of various materials not specified in the agreement, to be used for the approval of the Engineer-in-Charge along with samples and once approved, he shall stick to it.

13. Other Laboratories: The contractor shall arrange carrying out of all tests required under the agreement through the laboratory as approved by the Engineer-in-Charge and shall bear all charges in connection therewith including fee for testing. The said cost of tests shall be borne by the contractor/department in the manner indicated below.

    (a) By the contractor, if the results show that the test does not conform to relevant CPWD Specifications / BIS code or specification mentioned elsewhere in the documents.

    (b) By the department, if the results conform to relevant CPWD Specifications / BIS code or specification mentioned elsewhere in the documents.

    If the tests, which were to be conducted in the site laboratory, are conducted in other laboratories for whatever the reasons, the cost of such tests shall be borne by the contractor.

14. Sample of materials fittings and other articles required for execution of work shall be got approved from the Engineer-in-Charge. Articles manufactured by companies of repute and approved by the Engineer-in-Charge shall only be used. Articles bearing BIS certification mark shall be used in case the above are not available, the quality of samples brought by the contractor shall be judged by standards laid down in the relevant BIS specifications. All materials and articles brought by the contractor to the site for use shall conform to the samples approved by the Engineer-in-Charge which shall be preserved till the completion of the work.

15. The contractor shall ensure quality construction in a planned and time bound manner. Any sub-standard material/work beyond set out tolerance limit shall be summarily rejected by the Engineer-in-Charge.

16. BIS marked materials except otherwise specified shall be subjected to quality test at the discretion of the Engineer-in-Charge besides testing of other materials as per the specifications described for the item/materials. Wherever BIS marked materials are brought to the site of work, the contractor shall if required, by the Engineer-in-Charge furnish manufacturers test certificate or test certificate from approved testing laboratory to establish that the material produced by the contractor for incorporation in the work satisfies the provisions of BIS codes relevant to the material and/or the work done.The contractor shall procure all the materials at least in advance so that there is sufficient time to testing and approving of the materials and clearance of the same before use in work.

17. All materials brought by the contractor for use in the work shall be got checked from the Engineer-in-Charge or his authorized representative of the work on receipt of the same at site before use.

18. The contractor shall be fully responsible for the safe custody of the materials

issued to him even if the materials are in double lock and key system.

8.5 Natural calamity

No payment will be made to the contractor for any damage caused by rain, snow fall, floods, dampness, fire, sun or any other natural cause whatsoever during the execution of work. The damage to the work due to above reason, if any, shall have to be made good by the contractor at his own cost and no claim on this account shall be entertained.

8.6 Safety and Security

1. The contractor has to follow all safety norms as laid down in National Building Code of India. All the workers shall be equipped with the required safety gadgets while working at site such as ISI marked helmets, Shoes and safety belts, gumboots, gloves etc.The contractor, the authorized representative(s), workmen etc., shall strictly observe orders pertaining to fire precautions prevailing in the area.
2. The contractor shall be fully responsible for the safe custody of materials brought by him/ issued to him even though the materials may be under double lock key system.
3. Contractor will arrange proper metal ladders, M.S. double scaffolding (for working, painting, etc. at higher levels) at his own cost and will take all safety measures like double harness safety belt, mechanized electrically operated platform etc. If it is observed that work is proceeding without adequate safety precautions, work may be stopped by Engineer-in- charge and in such cases, contractor will be solely responsible for delay and its consequences thereof.
4. The contractor shall be responsible for the watch and ward/guard of the buildings, safety of all fittings and fixtures including sanitary and water supply fittings and fixtures provided by him against pilferage and breakage during the period of installations and thereafter till the building is physically handed over to the department. No extra payment shall be made on this account.
5. The contractor shall take all precautions to avoid accidents by exhibiting necessary caution boards day and night speed limit boards red flags, red lights and providing barriers. He shall be responsible for all dangers and incidents caused to existing / new work due to negligence on his part. No hindrances shall be caused to traffic during the execution of the work.
6. It shall be ensured by the contractor that no electric live wire is left exposed or unattended to avoid any accidents in this regard.
7. The Institute shall not have any responsibility or liability in case of any accident injury to the personnel to the contractor at work site or to the general public at the work site due to mishandling equipment by the personnel of the contractor or any other similar reason. The responsibilities and liabilities for such accidents and

incidents shall be borne by the contractor.

8.7 Approach to Site

1. The tenderer shall see the approaches to the site. In case any approach from main road is required at site or existing approach is to be improved and maintained for cartage of materials by the contractor, the same shall be provided, improved and maintained by the contractor at his own cost.
2. Contractor shall take all precautionary measures to avoid any damage to adjoining property. All necessary arrangement shall be made at his own cost.

8.8 Acts and Laws

1. The Contractor shall keep himself fully informed of all acts and laws of the Central & State Governments, all orders, decrees of statutory bodies, tribunals having any jurisdiction or authority, which in any manner may affect those engaged or employed and anything related to carrying out the work. All the rules & regulations and bye-laws laid down by Collector / MC etc. and any other statutory bodies shall be adhered to, by the contractor, during the execution of work.
2. The Contractor shall also adhere to all traffic restrictions notified by the local authorities.
3. All statutory taxes, levies, charges (including water and sewerage charges, charges for temporary service connections and / or any other charges, as applicable) payable to such authorities for carrying out the work, shall be borne by the Contractor.
4. The Contractor shall arrange to give all notices as required by any statutory / regulatory authority and shall pay to such authority all the fees that is required to be paid for the execution of work. He shall protect and indemnify the Institute and its officials & employees against any claim and /or liability arising out of violations of any such laws, ordinances, orders, decrees, by himself/herself or by his/her employees or his/her authorized representatives. Nothing extra shall be payable on these accounts.
5. The fee payable to statutory authorities for obtaining the various permanent service shall be borne by the Institute.

8.9 Labour and Laws

1. The Contractor shall display all permissions, licenses, registration certificates, bar charts, other statements etc. under various labour laws and other regulations applicable to the works, at his site office.
2. Huts for labour are not permitted within the premises of the Institute. No extra cost shall be payable even if the contractor provides such accommodation at a place as is acceptable to the local body.

8.10 Nondisclosure Agreement

1. The Agency shall take all precautions not to disclose, divulge and/or disseminate to any third party any confidential information, proprietary information on the Institute business or security arrangements (including but not limited to the Assignment instructions, Schedules and other subsequent Arrangements) and/or business of the Institute. The obligation is not limited to any Scope and the Agency shall be held responsible in case of beach of the confidentiality of Institute's information.
2. If the Agency receives enquiries from Press/Media/Radio/Television or other bodies/persons, the same shall be referred by the Agency to Institute immediately on receipt of such queries.

8.11 Indemnification:

1. The agency shall be directly responsible to indemnify the Institute against all charges, dues, claims, etc. arising out of the disputes relating to the dues and employment of the personnel deployed and further for any claim/compensation against all damages and accidents caused due to negligence on the part of the agents, employees and other personnel of the agency.
2. That the contractor shall keep the IITK indemnified against all claims whatsoever in respect of the employees deployed by the contractor. In case any employee of the contractor so deployed enters in dispute of any nature whatsoever, it will be the primarily responsibility of the contractor to contest the same. In case IITK is made party and is supposed to contest the case, IITK will be reimbursed for the actual expenses incurred towards Counsel Fee and other expenses which shall be paid in advance by the Contractor to IITK on demand. Further, the contractor shall ensure that no financial or Any other liability comes on IITK in this respect of any nature whatsoever and shall keep IITK indemnified in this respect.

8.12 Force Majeure:

If at any time, during the continuance of this contract, the performance in whole or in part by either party of any obligation under this contract is prevented or delayed by reasons of any war, hostility, acts of public enemy, civil commotion, sabotage, fires, floods, explosion, epidemics quarantine restriction, strikes, lockouts or acts of god (hereinafter referred to as events) provided notice of happenings of any such event, is served by party seeking concession to the other as soon as practicable, but within 21 days from the date of occurrence and termination thereof. Provided the Party satisfies Institute adequately of the measures taken by it. Neither party shall, by reason of such event, be entitled to terminate this contract, nor shall either party have any claim for damages against the' other in respect of such non-performance or delay in performance. Further, the services under the contract shall be resumed as soon as practicable after such event has come to an end or ceased to exist and the decision of Institute as to whether the services have to resume or not shall be final and conclusive, provided

further, that if the performance in whole or in part of any obligation under this contract is prevented or delayed by reason of any such event for a period exceeding 60 days, Institute may at his option, terminate the contract.

8.13 Dispute resolution

1. The institute reserves the right to amend rules whenever and wherever considered necessary and appropriate. The same shall be intimated to the agency in due course.
2. Any dispute arising out of and in relation to this agreement shall be referred to the arbitration by sole arbitrator to be appointed by Director of the Institute. The arbitration would be conducted and governed by and under the provisions of Arbitration Act, 1996 and its amendments. Any legal dispute will be subject to jurisdiction of Kanpur Courts only and no other court shall have the jurisdiction.
3. Any dispute arising out of and in relation to this agreement shall be referred to the arbitration by sole arbitrator to be appointed by Director of the Institute. The arbitration would be conducted and governed by and under the provisions of Arbitration Act, 1996. Any legal dispute will be subject to jurisdiction of Kanpur Courts only and no other court shall have the jurisdiction.

8.14 Arbitration

1. Except as otherwise provided anywhere in this Agreement, if any dispute, difference, the question of disagreement or matter, whatsoever, arises between the parties, as to the meaning, operation or effect of the Agreement or out of or relating to the Agreement or breach thereof, the same shall be referred to a Sole Arbitrator, to be appointment by the Director of the Institute at the time of the dispute.
2. If the Arbitrator, to whom the matter is originally referred, dies or refuses to act or resigns for any reasons from the position of arbitration, it shall be lawful for the Director of the Institute to appoint another person to act as Arbitrator in the manner aforesaid. Such person shall be entitled to proceed with the reference from the stage at which it was left by its predecessor, provided both the parties consent to this effect, failing which, the arbitrator shall be entitled to proceed on the matter de- novo.
3. It is a term of the Agreement that the party invoking the arbitration shall specify all disputes to be referred to arbitration at the time of invocation of arbitration under the clause.
4. It is a term of the contract that the cost of arbitration shall be borne by the parties themselves.
5. The place of the arbitration shall be Kanpur Nagar, Uttar Pradesh, India.
6. Subject as aforesaid, the provisions of the Arbitration and Conciliation Act, 1996 and any statutory modifications, amendments or re-enactment thereof and rules made

thereunder and for the time being in force, shall apply to the arbitration proceeding under this clause.

7. Except as otherwise provided anywhere in this Agreement, the Arbitration proceedings shall be conducted in English and the Agreement shall be constructed, interpreted and governed by the law of India, for the time being in force.

8.15 Jurisdiction of Courts

The court(s) at Kanpur Nagar, Uttar Pradesh, shall have the exclusive jurisdiction to try any as all the disputes(s) between the parties arising out this Agreement.

8.16 E&M Works

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

(a) Schedule of quantities

(b) Technical specifications of the NIT

(c) Approved Drawing (If any)

(d) CPWD General specification Part – I (Internal) 2014, BIS Codes amended up to date, practices

(e) CPWD General Specifications for Electrical Works–Part-II(External), 2014 amended up to date.

(f) Relevant IS or other international code in case IS code is not available.

(g) Indian Electricity Act 2003 and Indian Electricity Rules 1956 amended up to date.

(h) Local Fire Regulations applicable at the place of installation. Relevant and applicable foreign standards and specifications amended up to date.

(i) Any other relevant act or rules and local by-laws.

2. contractor will identify one of the supervisors for taking care of implementation of Safety systems.

3. Smoking is strictly prohibited at workplace.

4. Nobody is allowed to work without wearing safety helmet. Chinstrap of safety helmet shall be always on. Drivers, helpers and operators are no exception.

5. No one is allowed to work at or more than three meters height without wearing safety belt and anchoring the lanyard of safety belt to firm support preferably at shoulder level.

6. No one is allowed to work without adequate foot protection.

7. Usage of eye protection equipment shall be ensured when workmen are engaged for grinding, chipping, welding and gas-cutting. For other jobs as and when site safety co-coordinator insists eye protection has to be provided.

8. All safety appliances like Safety shoes, Safety gloves, Safety helmet, Safety belt, Safety goggles etc. shall be arranged before starting the job. .

9. All excavated pits shall be barricaded & barricading to be maintained till the backfilling is done. Safe approach to be ensured into every excavation.

10. Adequate illumination at workplace shall be ensured before starting the job at night.

11. All the dangerous moving parts of the portable / fixed machinery being used shall be adequately guarded.

12. Ladders being used at site shall be adequately secured at bottom and top. Ladders shall not be used as work platforms.
13. Material shall not be thrown from the height. If required, the area shall be barricaded and one person shall be posted outside the barricading for preventing the trespassers from entering the area.
14. Other than electricians no one is allowed to carry out electrical connections, repairs on electrical equipment or other jobs related thereto.
15. All electrical connections shall be made using 3 or 5 core cables, having a earth wire.
16. Inserting of bare wires for tapping the power from electrical sockets is completely prohibited.
17. A tools and tackles inspection register must be maintained and updated regularly.
18. Debris, scrap and other materials to be cleared from time to time from the workplace and at the time of closing of work every day.
19. All the unsafe conditions, unsafe acts identified by contractors, reported by site supervisors and / or safety personnel to be corrected on priority basis.
20. No children shall be allowed to enter the workplace.
21. All the lifting tools and tackles shall be stored properly when not in use.
22. Clamps shall be used on Return cables to ensure proper earthling for welding works.
23. Return cables shall be used for earthling.
24. All the pressure gauges used in gas cutting apparatus shall be in good working condition.
25. Proper eye washing facilities shall be made in areas where chemicals are handled.
26. Connectors and hose clamps are used for making welding hose connections.
27. All underground cables for supplying construction power shall be routed using conduit pipes.
28. Spill trays shall be used to contain the oil spills while transferring / storing them.
29. Tapping of power by cutting electric cables in between must be avoided. Proper junction boxes must be used.
30. All the E&M works shall be carried out as per direction and to the satisfaction of the Engineer-in-charge.
31. If the specifications for any item or its component are not available in the CPWD specifications cited above, relevant BIS specification as amended up to date shall be followed, whether or not the specific reference of a particular BIS specification has been made in this specification/ tender document.

32. Wherever any reference to any Indian Standard specification occurs in the document relating to this contract the same shall be inclusive of all amendments issued there to or revisions thereof, if any, up to the date of opening of tenders.

33. All materials should conform to relevant BIS specifications wherever the same exists in absence of stipulation in this tender document.

34. Where manufacturers furnish specific instructions / recommendations relating to the ma- terials used in this job and/or their installation, covering points not specifically mentioned in these documents, these instructions shall be followed in all cases and shall be deemed to be included in the schedule of work whether they have been specifically mentioned or not. All chase cuttings in the wall, for recessed conduits & boxes and drilling the holes shall be done with power operated machines only. No chase shall be allowed to be cut manually with the use of hammer & chisel.

35. All cuttings in cement plaster and brick shall be made good by using cement mortar 1:3 (1 part cement, 3-part coarse sand) The cut surfaces shall be repaired by an experienced mason only so as to match the repaired plaster with the original. All such repaired surfaces shall be cured for 3 to 4 days to keep the surfaces wet, using water spray machine (hand/motor operated) and avoid unnecessary flooding of the area.

36. The structural and architectural drawings shall at all times be properly co-related before executing any work.

37. For the purpose of recording measurements and preparing running account bills, the abbreviated nomenclature indicated in the publications Abbreviated Nomenclature of Items of DSR 2022 shall be accepted. The abbreviated nomenclature shall be taken to cover all the materials and operations as per the complete nomenclature of the relevant items in the agreement and relevant specifications. In case of items for which abbreviated nomenclature is not available in the aforesaid publication and also in case of extra and substituted items for which abbreviated nomenclature are not provided for in the agreement, full nomenclature of item shall be reproduced in the measurement books and bill forms for running account bills. For the final bill, however, full nomenclature of all the items shall be adopted in preparing abstract in the electronic measurement books and in the bill forms.

38. The following drawings must be submitted to Executive Engineer seven days of award of work.

(a) G.A and schematic drawings of MV switchgear/distribution /conduit layout/wiring drawing, Fire Alarm panel showing material and size of sheet steel/bus bars / inter connections and make and ratings of switchgear i/c details of protection, metering, indicating and inter lock etc.

(b) Conduit layout for lights, fans, socket outlets, telephone outlets, network & fire

alarm system and sub mains showing size of conduits, no. of wires and size of wires in each run, location and size of accessories like junction boxes, ceiling boxes for hooks, draw boxes and switch boxed etc.

(c) Cable routing drawings showing details of size, type and no. of cables and mode of installation.

39. On completion of works and before issuance of completion certificate, the contractor submit completion drawings in the form of three complete set of originals (reproducible).

(a) As built GA and schematic drawings of MV panels, distributions boards, wiring, cable laying with sizes, earthling details, fire alarm panels, etc. showing material and size of sheet steel/bus bars/ connections and make and rating of switchgear i/c details of protection, meter indicating and interlocks etc.

(b) Technical literature, test certificates and operation and maintenance manuals required

40. Works Inspection and Testing of Equipment: Prior to dispatch of equipment the Institute reserves the right to inspect the same at the manufacturer's works and the contractor shall provide and secure every reasonable access and facility at the manufacturers works for inspection, for witness of all acceptance and routine tests as per relevant Indian Standards.

Contractor shall give a reasonable notice of about 15 days for the purpose of test, and witness of all major equipment's.

41. Pre-commissioning test: All routine tests shall be carried out on the electrical equipment. Protective & measuring devices should be checked for calibration of MCCB's/MCB's, panel & cable meggaring, earthing measurements etc.

केन्द्रीय लोक निर्माण विभाग

कार्यालय ज्ञापन

No. DG/MAN/410

ISSUED BY AUTHORITY OF DIRECTOR GENERAL, CPWD

NIRMAN BHAWAN, NEW DELHI DATED: 22.10.2021

Subject: Addition of new Para 4.10.2 in CPWD Works Manual 2019 regarding testing charges to be borne by contractor.

It has been noticed that following provisions are sometimes being made in the NITs / Agreements by the NIT approving authorities:

"The cost of test shall be borne by contractor/ department in the manner as below:

i. By the contractor, if the result shows that material does not conform to the relevant codes/ specification.
ii. By the department, if the results show that the material conforms to relevant codes/ specification."

It has been decided by the competent authority that testing charges shall be borne by the contractor in all cases. Accordingly following new para is added in CPWD Works Manual -2019.

Existing Provision	Modified Provision
4.10 Preparation of NIT **4.10.2 No Provision**	**4.10 Preparation of NIT** **4.10.2 Testing charges to be borne by contractor** **Following provision shall be incorporated by the NIT approving authority in the NIT:** **All expenditure to be incurred for testing of samples e.g. packaging, sealing, transportation, loading, unloading etc. including testing charges shall be borne by the contractor. The NIT shall have list of approved laboratories for testing as approved by ADG / SDG.**

This issues with the approval of competent authority.

(वी.पी. साहू) 22.10.2021

अधीक्षण अभियंता(सी.एंड एम.)

Issued from file No. CSQ/CM/16(1)/2021 e-file 9116587

प्रतिलिपि: सभी केलोनिवि तथा लोनिवि दिल्ली के अधिकारियों को आवश्यक सूचना एवं कार्यवाही हेतु।(केलोनिवि वेबसाईट के माध्यम से).