

Name of work

Supply, Installation, Testing & Commissioning of Water Cooled Central AC Plant of Capacity 4600 TR (4x1050 TR +1X400 TR) with Electrical (remaining) & Plumbing (Highside) works (Package - 4) of GSMST at IIT Kanpur

BID DOCUMENT



SUPERINTENDING ENGINEER
INDIAN INSTITUTE OF TECHNOLOGY KANPUR
October 2025

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Superintending Engineer

1 Notice Inviting e-Tenders

The Superintending Engineer on behalf of Board of Governors of Indian Institute of Technology Kanpur invites online percentage rate tenders from enlisted contractors in CPWD and/ or the eligible firms / agencies satisfying the eligibility criteria mentioned in the document.

NIT No: 26/AC/SE/2025

1	Name of work	:	Supply, Installation, Testing & Commissioning of Water Cooled Central AC Plant of Capacity 4600 TR (4x1050 TR +1X400 TR) with Electrical (remaining) & Plumbing (Highside) works of GSMST (Package - 4) at IIT Kanpur.
2	Estimated Cost inclusive of GST	:	Rs. 53,64,10,405.00
3	Earnest Money Deposit (Rs.)	:	Rs. 63,64,104/- (In favour of Director IIT Kanpur)
4	Duration of contract	:	Nine (09) 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
7	Time allowed for sub- mission of EMD in hardcopy by lowest bidder	:	As per CPP portal data

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 quotation / 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

2 Information and Instructions for Bidders for E-Tendering

The Superintending Engineer on behalf of Board of Governors of Indian Institute of Technology Kanpur invites online percentage rate tenders from enlisted contractors in CPWD and/ or the eligible firms / agencies satisfying the eligibility criteria mentioned in the document

2.1 Schedule

1	Name of organization	: Indian Institute of Technology Kanpur
2	NIT No	: 26/AC/SE/2025
3	Location	: Indian Institute of Technology Kanpur
4	Tender / Quotation type (open / limited / EOI / auction / single)	: Open
5	Tender / Quotation category (services / goods /works)	: Works
6	Type of Contract (work / supply / auction / service / buy / empanelment / sell)	: Work
7	Form of contract (IITK-7/8)	: IITK-7
8	Work Category Electrical	: Air-conditioning
9	Is multi-currency allowed?	: No
10	Date of publishing / issue / start	: 24.10.2025
11	Document download start date	: 24.10.2025
12	Document download end date	: 14.11.2025
13	Date & time of pre-bid meeting	: 31.10.2025 at 11:30 AM
14	Venue of pre-bid meeting	: SE office, IWD IITK
15	Last date & time of uploading of bids	: 14.11.2025, 5:00 PM
16	Date & time of opening of Technical bids	: 17.11.2025, 3:00 PM
17	Bid Validity Days	: 90 days after opening of technical bid
18	Earnest Money Deposit (EMD)	: Rs. 63,64,104/- Scanned copy of the proof of EMD deposition to be uploaded with the tender. The hardcopy of the EMD receipt shall be submitted in the office of Superintending Engineer ,IWD IIT Kanpur

19	Non Refundable Processing fees	NIL
20	No. of Bids / Covers (1 / 2 / 3 / 4)	: 2
21	Address for communication	: Office of Superintending Engineer- Indian Institute of Techno- logy Kanpur, Kanpur, U.P. Pin - 208016
22	e-mail address	: vktiware@iitk.ac.in , seiwd@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.

2.1.1 GENERAL INSTRUCTION AND INFORMATION TO BIDDERS

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. The bid can only be valid after 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 on website CPP 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 percentage rate. However, if a tenderer does not quote any percentage above/below on the total amount of the tender or any section / sub head in percentage rate tender, 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 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 taxes, cess, duties, levies, etc. inclusive of GST required for execution of the

work.

14. If the work involves addition/upgradation/alteration/renovation the work shall be in compliance with 3 Star GRIHA rating and as per environmental policies of Institute. Nothing extra shall be payable on this account.
15. The enlistment of the contractors, if applicable, 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.
16. The description of the work is as follows: **“Supply, Installation, Testing & Commissioning of Water Cooled Central AC Plant of Capacity 4600 TR (4x1050 TR +1X400 TR) with Electrical (remaining) & Plumbing (Highside) works of GSMST (Package - 4) at IIT Kanpur”.**
17. The work is estimated to cost **Rs. 53,64,10,405/-** However, this estimate given is mere approximation for guide.
18. 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.
19. The time allowed for carrying out the entire work will be Nine (09) months from the date of start as defined in Schedule “F” or from the first date of handing over of the site, whichever is later, in accordance with the phasing as detailed in special conditions of contract in the bid document.
20. The sites for the work will be handed over as per the special terms and conditions of the document. An approved program of completion submitted by the contractor after award of work based on the available / to be available works for addition/alteration/upgradation.
21. 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.
22. 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.
23. While submitting the revised bid, contractor can revise the percentage rate any number of times (he need not re-enter rate of all the items) but before last time and date of submission of bid as notified.
24. Earnest Money Deposit receipt scanned copy shall be uploaded to the e-Tendering website within period of submission.
25. 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.
26. 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.
27. Copy of Enlistment Order and other documents as specified in the bid shall be scanned and uploaded to the e-tendering website within the period of bid submission.
28. 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

technical bid.

29. The bid submitted shall become invalid if:
- (i) The bidder is found ineligible.
 - (ii) The bidder does not upload scanned copies of all the documents stipulated in the bid document.
 - (iii) If a tenderer quotes does not quote any percentage above/below on the total amount of the tender in percentage rate tender, the tender shall be treated as invalid and will not be considered as lowest tenderer.
30. 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 or Deposit at Call receipt of any scheduled bank/ Banker's cheque of any scheduled bank/ Demand Draft of any scheduled bank/ Pay order of any Scheduled Bank of any scheduled bank (in case guarantee amount is less than Rs. 1,00,000/-) or Government Securities or Fixed Deposit Receipts or Guarantee Bonds of any Scheduled Bank or the State Bank of India in accordance with the prescribed form.
31. 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.
32. 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'.
33. 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.
34. Intending Bidders are advised to get familiarized with the specifications /rules related (i.e., **Supply, Installation, Testing & Commissioning of Water Cooled Central AC Plant of Capacity 4600 TR (4x1050 TR +1X400 TR) with Electrical (remaining) & Plumbing (Highside) works of GSMST (Package - 4) at 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.

35. 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.
36. 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.
37. 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.
38. The contractor shall not be permitted to bid for works in the Office of Infrastructure and Planning / 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 and Office of Infrastructure and Planning. 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 Infrastructure and Planning/ 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.
39. 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 service, 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 service.
40. 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
41. 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, sign the contract consisting of 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
42. Standard C.P.W.D. Form 7 or other Standard C.P.W.D. Form as applicable.
43. 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.

44. After acceptance of the bid by competent authority, Superintending Engineer 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 One such signed set of agreement shall be handed over to Engineer-In- Charge and PMC (Project Management Consultant) of the project.
45. All materials brought by the contractor for use in the work shall be got checked from the PMC / Engineer-in-Charge or his authorized representative of the work on receipt of the same at site before use.
46. Maintenance of Register: - All the register of tests to be carried out at construction site or in outside laboratories shall be maintained by the contractor which shall be issued to the contractor by PMC on behalf or Engineer-in-Charge. All test register are to be maintained by the contractor with duly Signature & seal on daily basis. All the entries in the register will be made by the designated engineering staff of the contractor and same should be regularly authenticated by PMC and submitted to Engineer-in-Charge.
47. Contractor shall be responsible for safe custody of all the test registers to be maintained at site.
48. Submission of copy of test certificate of materials/equipment with each running account bill shall be mandatory. These test certificate should be duly checked and signed by PMC on behalf of Engineer-in-Charge

49. **Insurance Policy**

Before commencing the execution of work, the Contractor shall, without in any way limiting his obligations and liabilities, insure at his own cost and expense against any damage or loss or injury, which may be caused to any person or property, at site of work. The Contractor shall obtain and submit to the Engineer-in-Charge proper Contractor All Risk Insurance Policy for an amount 1.25 times the contract amount for this work, with Engineer-in-Charge as the first beneficiary. The insurance shall be obtained in joint names of Engineer-in-Charge and the Contractor (who shall be second beneficiary). Also, he shall indemnify the Department from any liability during the entire execution of the work.

Further, agency shall obtain and submit to the Engineer-in-Charge, a third-party insurance policy with the Engineer-in-Charge as the first beneficiary.

The Contractor shall, from time to time, provide documentary evidence as regards payment of premium for Insurance Policy for keeping them valid till the completion of the work. Without prejudice to any of its obligations and responsibilities specified above, the Contractor shall within 15 days from the date of letter of acceptance of the tender and thereafter at the end of each quarter submit a report to the Department giving details of the Insurance Policy along with Certificate of this insurance policy being valid, along with documentary evidences as required by the Engineer-in-Charge/PMC. No work shall be commenced by the Contractor unless he obtains the Insurance Policy as mentioned above. Also, no payment shall be made to the Contractor on expiry of insurance policy unless renewed by the Contractor. Nothing extra shall be payable on this account. No claim of hindrance (or any other claim) shall be entertained from the contractor on these accounts.

50. **Project Monitoring**

The Agency shall prepare the phase wise (monthly) resource chart (materials, manpower and machinery) based on the project execution schedule as per clause 5.1 of GCC.

- (i) The Agency shall submit the photographs & videos of progress of work on fortnightly basis to make it possible to create a short film of the entire execution of

- the work to be kept in archive.
- (ii) Agency shall a detailed Monthly progress & program report through PMC to the Engineer-in-Charge by 5th of every month. The format of monthly progress & program report shall be as approved by Engineer-in-Charge.
 - (iii) The agency will make it possible to be represented by a senior level executive who have sufficient financial powers to take decisions required for completing the project in time.
 - (iv) The agency shall stick to the construction schedule, if there is any hindrance or delay due to any reason the same shall be mitigated through engaging extra manpower, material and machinery.
51. The requirement of technical staff given in various specialized works is as per requirements given in clause 32 of NIT document. The actual deployment of these technical staff will be as per execution of work and direction of the Superintending Engineer, IITK.
52. Payment shall be regulated as under
- (a) 75% of the tendered value on receipt of the materials listed in BOQ at site be submitted to claim the payment.
 - (b) 15% of the tendered value on installation and connection.
 - (c) 10% of the tendered value on testing and commissioning.
53. Running bill and final bill for components shall be facilitated by Engineer-in-Charge after checking & certifying by the PMC to the contractor.
54. The work shall be treated as complete when all the components of the work are complete.
55. It will be obligatory on the part of bidder to sign the contract document for all components before the first payment is released.
56. In case of reduction in scope of work no claim on account of reduction in value of work, loss of expected profit, consequential overheads etc. shall be entertained.
57. 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.
58. The 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.
59. The contractor/ agency must have to co-operate with any other agency deployed by IIT Kanpur for laying of pipeline/cables and other works for the agency has to make itself available and provide full co-operation during installation, if required.
60. 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.**
61. 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.**
- 62.** Entire work under the scope of composite tender including major and all minor components shall be executed under one agreement. Whereas a supplementary agreement with the same rate, terms & conditions as specified in the original bid have to executed with IIT Kanpur/GSMST authorized agency for the Operation and Non comprehensive AMC part of the tender after successful commissioning of the project as per para 5.20 of CPWD Works Manual 2024, updated upto date. The form of supplementary agreement is at Appendix-II

2.2 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 soft-copies 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 CPP 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.

2.2.2 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.

2.2.3 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.

2.2.4 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 understand 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.

2.2.5 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. Bidder has to select the payment option as "on-line" to pay the tender processing fee as applicable and enter details of the instrument
4. 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.

OR

In some cases, financial bids can be submitted in PDF format as well (in lieu of BOQ).

5. 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.
6. 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.
7. The uploaded tender documents become readable only after the tender opening by the authorized bid openers.
8. 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.

9. Add scanned PDF of all relevant documents in a single PDF file of compliance sheet.

2.2.6 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.

2.2.7 General instruction to bidders for e-tendering

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 website <https://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 at <https://eprocure.gov.in/eprocure/app>.

Superintending Engineer
Institute Works Department

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 evaluation:

1. Scanned copy of EMD
2. GST Registration Certificate or GST Undertaking as per 5.1
3. EPF & ESI Registration
4. Copy of PAN card
5. Affidavit for not being blacklisted/debarred/restrained As per 5.2
6. Turnover and Other Financial statement of the Agency as per 5.3
7. Bankers certificate as per 5.4 **Or** Net Worth Certificate from certified Chartered Accountant as per 5.5
8. Performance report of works executed as per 5.6
9. Structure and Organization of the Agency as per 5.7
10. Declaration on Details of the Bidder(s) as per 5.8
11. Details of Similar Nature of Works Completed as per 5.9
12. Declaration about Site Inspection as per 5.10
13. Enlistment order of the contractor in appropriate class and category issued by CPWD or others.
14. Certificate of Incorporation
15. Scanned copy of “A” class Electrical License.
16. Letter of Transmittal as per 5.11
17. Tender Acceptance Letter 5.12
18. Certificate for tender as per 5.13
19. CPWD-7 5.14
20. Certificate of Incorporation, if any
21. Manpower details of the company
22. Health, safety and Environment policy
23. List of tools & plants
24. Integrity Pact should be signed and scanned copy of the same shall be uploaded along with technical bid. At the time of award of the work the hard copy of the same on a non-judicial Stamp Paper of Rs.100/- shall be submitted which shall be the part of the contract agreement.

The hard copy of earnest money deposit receipt (EMD) shall be submitted in the office of Superintending Engineer, Central office , IWD IIT Kanpur before the opening of the technical bid on **14.11.2025** till 3:00 PM. In absence of the EMD in hardcopy, the bidder shall be not eligible for opening of their technical bid and shall be rejected.

2.3.2 Envelope - 2: Financial Bid

Price bid should be submitted in BOQ format and shall be uploaded only on CPP portal.

2.4 GENERAL INFORMATION & DEFINITION

2.4.1 General: The Indian Institute of Technology, Kanpur, is an institution of premier National importance situated at Kanpur "Construction of central AC plant (4 x 1050 TR+ 1 x 400 TR) capacity & electrical works for Gangwal School of Medical Science & Technology at IIT Kanpur." It is a very prestigious and time-bound project being monitored by the highest authority

2.4.2 Definitions:

In this document the following words and expressions have the meaning hereby assigned to them.

Employer: Means the Board of Governors, IIT Kanpur, acting through the **Superintending Engineer, IWD IIT Kanpur**.

Bidder and/or contractor: Means the individual, proprietary firm, firm in partnership, limited company private or public or corporation.

“Year” means “Financial Year” unless stated otherwise.

“Architect” shall mean every partner of the firm **M/s HOSMAC INDIA PVT LTD**, Mumbai duly appointed by the Institute for the work and in the event of ceasing to be the Architects, such other firms or persons as may be appointed by the Institute.

“Project Management Consultant (PMC)” shall mean every partner of the firm **M/s TATA consulting Engineers Limited(TCE)** as duly appointed by the Institute for rendering project management services to supervise, the daily ongoing works, daily recording, checking & certify all the measurements, daily checking of quality of ongoing works and preparing the records of all testson testing registers for smooth completion of the quality work, prepare & certify the bills of the contractor for payment in time, ensuring the safety at site submitting the monthly progress report including recording of hindrances on hindrance register to the Institute for the record and in the event of ceasing to be the PMC, such other firms or persons as may be appointed by the Institute.

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:

1. Average annual financial turn over:

- i. Average annual financial turnover of works should be at least 50% 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.

- ii. Bankers certificate should be as per 5.5 Or Net Worth Certificate from certified Chartered Accountant as per 5.6

Bankers certificate from a commercial bank or Net-worth certificate:

Bankers certificate of the amount equal to 40% of the Estimate cost put to tender (ECPT)

Or

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

2. Experience:

Firms/Contractors must have completed satisfactorily

- i) One similar work of 80% value of the estimated cost put to tender

Or

- ii) Two similar work of 60% value of the estimated cost put to tender or

- iii) Three similar work of 40% value of the estimated cost put to tender

Works completed during last 7 years ending on date 30.09.2025.

And

One completed work of similar nature costing not less than Rs. 2145.64 Lacs with some Central Government Department / State Government Department / Central Autonomous Body / Central Public Sector Undertakings/State PSU/State Autonomous Body.

Definition of similar work: Similar type of work means “Supply, installation, testing & commissioning of water cooled central chilled water AC plant with at least 1 no. of individual chiller of minimum capacity of 800 TR along with chilled water pumps, condenser pumps, cooling towers, chiller plant manager (Optional) and associated controls in same project of water cooled central AC plant including Electrical works.”

Note: 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 tenders.

3. Having valid “A” Class Electrical License.
4. Should have average annual financial turnover of **Rs. 2682.05**Lacs of electrical works during the last three years ending 31-03-2025.
5. Bankers certificate from a commercial bank or Net-worth certificate:
Bankers certificate of the amount equal to 40% of the Estimate cost put to tender (ECPT)
Or
Net-Worth certificate of minimum 10% of the estimated cost put to tender issued by certified chartered Accountant with UDIN
6. Should have the calculated bidding capacity equal to or more than the estimated cost of the work.
7. Should have valid registration of EPF, ESIC and GST.
8. **The tenderer shall have to furnish an affidavit on non judicial stamp paper of Rs. 10.00 as under:**

“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 light, then I/We shall be debarred for tendering in IIT Kanpur contracts in future forever. Also, if such a violation comes to light before date start of work, the Superintending Engineer shall be free to forfeit the entire amount of Earnest Money Deposit / Performance Guarantee.”

9. INTEGRITY PACT

The contractor shall download the Integrity Pact, which is a part of tender document, affix his signature& seal in the presence of a witness and upload the same while submitting the online bids. In absence of duly signed integrity pact the bids shall not be considered for technical evaluation

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

1. **Legal:** Unregistered Partnership Firm and Joint Venture or Consortium are not eligible.
2. **Registration:** Bidder should be registered with the Income Tax Department, Employees Provident Fund (EPF) Organization, Employees State Insurance (ESI) Corporation & GST. Bidders are not eligible in absence of these documents.

3. Office:

Bidders have to establish its local accessible office at IIT Kanpur registered with local GSTIN to run the awarded work.

4 Bid Evaluation

4.1 Evaluation Criteria :-The detailed submitted by the bidders will be evaluated in the following manner:

- 4.1.1** The initial criteria prescribed in para **3.0** above in respect of experience of eligible similar works completed, Banker's Certificate/Net worth certificate, financial turnover, bidding capacity, Integrity pact etc. as mentioned in para 3.0 will first be scrutinized and the bidder's eligibility for the work be determined.
- 4.1.2** The bidders qualifying the initial criteria as set out in para 3.0 above will be evaluated for following criteria by scoring method on the basis of details furnished by them and on the basis of inspection of ongoing and completed work carried out by the scrutiny committee duly constituted by the Director, IIT Kanpur. If inspection of the submitted work is not taken up by the Committee, the marks may be awarded on the basis of the performance (quality) of the submitted works completed and on the basis of the partial completed value of the ongoing works mentioned in the furnished document.

(a)	Financial strength (5.3 Form 'A' & 5.4Form'B'/5.5 Form B1)	Maximum 20 marks
(b)	Experience in eligible similar nature of work during last seven years (5.9 Form 'C')	Maximum 20 marks
(c)	Performance on works (5.6 Form 'D') – Time over run	Maximum 20 marks
(d)	Performance on works (5.6 Form 'D-1') – Quality	Maximum 40 marks
		Total 100 marks

To become eligible for short listing the bidder must secure at least fifty percent marks in each (section a, b, c & d) and sixty percent marks in aggregate.

The department, however, reserves the right to restrict the list of such qualified contractors to any number deemed suitable by it.

Note- The average value of performance of works for time over run and quality for completed works shall be taken on the basis of performance report and on the basis of inspection of ongoing and completed work carried out by the scrutiny committee duly constituted by the Director, IIT Kanpur of the eligible similar works.

4.1.3 Evaluation of performance

Evaluation of the performance of contractors for the eligibility shall be done by the scrutiny committee. All the eligible Similar Works executed and submitted by the bidders may be got inspected by the committee. The marks for the quality shall be given based on this inspection, if inspection is carried out. If inspection of the submitted work is not taken up by the Committee, the marks may be awarded on the basis of the performance (quality) of the submitted works completed and on the basis of the partial completed value of the ongoing works mentioned in the furnished document.

4.1.4 Scoring method of evaluation:

The scoring for evaluation mentioned in these columns shall be done as given in eligibility documents and evaluation criteria, Annexure-A

ANNEXURE- A CRITERIA FOR EVALUATION OF THE PERFORMANCE OF CONTRACTORS FOR PRE-ELIGIBILITY

Attributes	Sub attributes	Marks	Evaluation Criteria			
(a)	Financial Strength	20 marks	60% marks for minimum eligibility criteria. 100% marks for twice the minimum eligibility criteria or more Pro-rata basis in between (i) & (ii)			
	Average Annual Turnover	16 Marks				
	Banker’s Certificate OR Net worth certificate	4 Marks				
(b)	Experience in Similar class of Works	20 Marks	60% marks for minimum eligibility criteria. 100% marks for twice the minimum eligibility criteria or more Pro-rata basis in between (i) & (ii)			
(c)	Performance on Works					
	Parameter calculation for points	Score	Maximum Marks			
	If TOR=	1.0	2.0	3.0	>3.50	20
	(i) Without levy of compensation	20	15	10	10	
	(ii) With Levy of compensation	20	5	0	-5	
	(iii) Levy of compensation not decided	20	10	0	0	
	TOR = AT/ST, where AT=Actual Time; ST=Stipulated Time (+) Justified Period of Extension of Time.					
(d)	Performance of works (quality) as per assessment in Form- 'D-1' (40 Marks)					
	Completed works (Maximum 25 Marks)	Ongoing works (Maximum 15 Marks)	Total marks Assessed			

4.2 Financial Bid Evaluation

For financial bids, the following points shall be followed:

- After evaluation of Pre-eligibility conditions, a list of short listed agencies will be prepared.
- Thereafter the financial bids of only the pre- qualified (As per Pre-Qualification Criteria) and technically acceptable bidders shall be opened at the notified time, date and place 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 employer 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.

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(s))

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 ny 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(s))

Or

.....
(An authorized Officer of the firm with stamp)

.....
(Signature of Notary with seal)

5.3 Financial Information

FORM 'A'

FINANCIAL INFORMATION

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

Financial Year

Year	2020-21	2021-22	2022-23	2023-24	2024-25
Gross Annual turnover on construction works					
Profit / Loss. (Standalone Financial Turnover)					

2. Financial arrangements for carrying out for proposed work.

Signature of Chartered Accountant

.....

Name of Chartered Accountant

.....

Membership No. ICAI

Date and Seal

.....

Signature of the bidders(s)

***The bidder should give information strictly in above format.**

5.4 Banker's Certificate from a scheduled Bank

FORM 'B'

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.

5.5 Net Worth Certificate by certified Chartered Accountant

FORM 'B1'

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 state- ment of the account during the financial year, the net worth of M/s./Sh.....(Name & Registered Ad- dress 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)

5.6 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

Date:

Signature of Superintending Engineer or Equivalent

FORM 'D'
PROJECTS UNDER EXECUTION OR AWARDED

Sl. No.	Name of work/project and location	Owner or sponsoring organization	Cost of work in crores of Rupees	Date of commencement as per contract	Stipulated date of completion	Up to date percent-age progress of work	Slow progress if any, and reasons thereof	Name and address/telephone number of officer to whom reference may be made	Remarks
1	2	3	4	5	6	7	8	9	10

Certified that the above list of work is completed and no work has been left out and that the information given is correct to my knowledge and belief.

Signature of Bidder(s)

FORM 'D-1'

Assessment of Quality for Completed as well as ongoing works

Name of Work:-

Date of Inspection:-

Date of submission of report:-

A	General Observation & Operational Aspects	Yes/ No
1.	Availability of approval from local bodies in case of Construction of Private Buildings	
2.	Availability of approved drawings	
3.	Observation on seepage/ leakage in the Transformer	
4.	Whether Chiller with VFD or not	
5.	Whether all chilled water pipeline properly insulated and direction of water flow marked	
6.	Whether Pumps are variable or fixed	
7.	Whether arrangement for expansion tank/air separator are available	
8.	Available outlet temperature from cooling tower, approach of tower	
9.	Whether CPM of the plant works taken up	
10.	Whether water softener plant used for condenser water.	
B.	Quality of Work	Marks Assessed
1.	Quality of AC Plant Chiller/heat pumps installation	
2.	Quality of Pump Installation	
3.	Quality of Piping and valves Works	
4.	Quality of Cooling Tower installation	
5.	Quality of CPM and control work	
6.	Quality of Insulation Work	
7.	Quality of overall workmanship in AC Plant	
8.	Quality of earthing works	
9.	Quality of electrical panel installation works	
10.	Quality of Water Softener/Treatment plant workmanship	

5.7 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 of submission 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, 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 convicted by the court of law? If so, give details.
9. Any other information considered necessary but not included above.

(Signature of of Bidder(s))

5.8 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 to the 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 address	:
4	Address of office	:
5	Contact people	:
6	Name & Designation	:
7	Landline & Mobile numbers	:
8	E-mail IDs	:
9	PAN No.	:
10	GST No.	:
11	EPFO Reg. No.	:
12	ESIC Reg. No.	:
13	Annual Turnover for the last 5 years (Enclose copies of audited balance sheet and P&L A/c.)	
13.1	2024-2025	:
13.2	2023-2024	:
13.3	2022-2023	:
14	Copy of EMD receipt with signature	:
15	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

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16 Has the applicant ever been : YES / NO ,If yes, give details
convicted by a court of law? of the case

17 Details of any litigation in which the ap- :
plicant is/was involved.

18 All forms submitted as desired in the bid : Yes / No

19 Undertaking regarding 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.

Date:

Signature of Bidder(s) with seal

5.9 FORM- 'C'

Details of Similar Nature of Works Completed by Agency

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

Sl. No.	Name of work/project and location	Owner or sponsoring organization	Cost 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	Name and address/telephone number of officer to whom reference may be made	Remarks
1	2	3	4	5	6	7	8	9	10

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

Date:

Signature(s) of with seal of bidder

FORM 'C'-1
Calculation of bidding capacity
Details of existing commitments and ongoing works.

S. No.	Name of work/ project and location	Owner or sponsoring organization	Contract value in crore of rupees	Date of commencement as per contract	Stipulated date of completion	Upto date percentage progress of work	Remaining work in percentage (100-column 7)	Existing commitment Column 4 x Column 8 /100	Name and address/ telephone number of officer to whom reference may be made	Remarks
1	2	3	4	5	6	7	8	9	10	11

Total (B) =

Maximum turnover in last seven years = Rs.....

Updated value of max. turnover (A) = Rs.....

No. of years (N) =

Bidding Capacity= {[AxNx1.5]-B} =

A = Maximum turnover in construction works executed in any one year during the last seven years taking into account the completed as well as works in progress. The value of completed works shall be brought to current costing level by enhancing at a simple rate of 7% per annum.

N = Number of years prescribed for completion of work for which bids have been invited.

B = Value of existing commitments of ongoing works during the period of execution of work for which bids have been invited.

Certificate:

I certify that all the awarded and ongoing works have been included in the above list.

(Signature of Bidder(s))

5.10 Declaration About Site Inspection

Declaration about Site Inspection

(By Bidder)

To

The Superintending Engineer

Subject: Submission of Tender for the work of “**Supply, Installation, Testing & Commissioning of Water Cooled Central AC Plant of Capacity 4600 TR (4x1050 TR +1X400 TR) with Electrical (remaining) & Plumbing (Highside) works of for GSMST (Package - 4) at 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)

5.11 Letter of Transmittal

To

The Superintending Engineer
Indian Institute of Technology Kanpur,
UP - 208016

Name of Work: **Supply, Installation, Testing & Commissioning of Water Cooled Central AC Plant of Capacity 4600 TR (4x1050 TR +1X400 TR) with Electrical (remaining) & Plumbing (Highside) works of for GSMST (Package - 4) at 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.

1. I/We hereby certify that all the statements made and information supplied in the enclosed forms and accompanying statement are true and correct.
2. I/we have furnished all information and details necessary for eligibility and have no further pertinent information to supply.
3. I/We also authorize the Superintending Engineer, 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.
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.			
3.			
4.			

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.

Enclosures:

Date of submission:

Signature(s) of Bidder with seal

5.12 Tender Acceptance Letter

(To be given on Company Letter Head)

To,
Superintending Engineer
IIT Kanpur-208016

Sub: Acceptance of Terms & Conditions of Tender.

Tender Reference No: Date:

Name of Tender / Work:

Dear Sir,

- 5.12.4** 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).
- 5.12.5** 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.
- 5.12.6** The corrigendum(s) issued from time to time by your department/ organization too have also been taken into consideration, while submitting this acceptance letter.
- 5.12.7** I / We hereby unconditionally accept the tender conditions of above mentioned tender document(s) / corrigendum(s) in its totality / entirety.
- 5.12.8** I / We do hereby declare that our Firm has not been blacklisted/ debarred/ terminated/ banned by any Govt. Department/Public sector undertaking.
- 5.12.9** 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/ organization 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.

(Signature of the Bidder, with Official Seal)

5.13 Certificate for Tender

(To be given on Company Letter Head)

Date:

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:

1. "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.]"
2. "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)

Yours Faithfully,

5.14 CPWD-7

CPWD-7

PERCENTAGE RATE TENDER & CONTRACT FOR WORKS

Tender for the “Supply, Installation, Testing & Commissioning of Water Cooled Central AC Plant of Capacity 4600 TR (4x1050 TR +1X400 TR) with Electrical (remaining) & Plumbing (Highside) works of for GSMST (Package - 4) at IIT Kanpur.”

1. To be uploaded as per details uploaded in CPP portal at www.eprocure.gov
2. To be opened in the presence of tenderers who may be present at the time of opening in the Office of Superintending Engineer, 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 pre-qualification/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, CPWD SOP 2024 corrected up to the last date of bid submission, CPWD works manual 2024 corrected up to the last date of bid submission and 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.

A sum of **Rs. 63,64,104/-** is here by forwarded in receipt treasury challan/ Deposit as call receipt of a scheduled bank / Fixed deposit receipt of scheduled bank/ Demand draft of a scheduled bank/ bank guarantee issued by scheduled bank as earnest money deposit. If I/we, fail to furnish the prescribed performance guarantee or fail to commence the work within prescribed period, I/ we agree that the said Board of Governors, IIT Kanpur or his successors in office shall without prejudice to any other right or remedy to be at liberty to forfeit the said earnest money absolutely. Further, if I/we fail of commence the work as specified, I/we agree that Board of Governors, IIT Kanpur or his successor in office shall without prejudice to any other right or remedy available in law, be at liberty to forfeit the said earnest money and the performance guarantee absolutely, otherwise the said earnest money shall be retained by him towards security deposit to execute all the works referred to the tender documents upon the terms & condition contained or referred to therein and to carry out such deviations as may be ordered, up to maximum of the percentage mentioned in schedule "F" and those in excess of that limit at the rates to be determined in accordance with the provision contained in clause 12.2 and 12.3 of the tender form.

Further, If I/we, withdraws tender or makes any modification in the terms & conditions of the tender which is not acceptable to the department after the last date of submission of bids, then the

INDIAN INSTITUTE OF TECHNOLOGY KANPUR

Institute shall without prejudice to any other right or remedy, be at liberty to forfeit 100% of the earnest money absolutely irrespective of letter of acceptance for the work is issued or not.

Further, I/we agree that in case of forfeiture of earnest money or both earnest money & performance guarantee as aforesaid, I/we shall be debarred for participation in the retendering 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 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

Date:

Signature(s) of Contractor(s) with seal

Address:

Occupation:

5.15

**Manpower details of company
FORM 'G'**

DETAILS OF TECHNICAL & ADMINISTRATIVE PERSONNEL TO BE EMPLOYED
FOR THE WORK

Sl. No.	Designation	Total	Number available for this work	Name	Qualifications	Professional	How these would be involved in this work	Remarks
1	2	3	4	5	6	7	8	9

Signature of Bidder(s)

5.16

**List of tools and plants
FORM 'H'**

DETAILS OF CONSTRUCTION PLANT AND EQUIPMENT LIKELY TO BE USED IN
CARRYING OUT THE WORK FOR THE WORK.

Sl. No.	Qualification	Unit	Capacity or type	Age	Condition	Presently owned	Leased	To be Purchased	Present location	Remarks
1	Hydra Crane	Nos.								
2	Chain Pulley Block	Nos.								
3	Welding Machine with safety kit	Nos.								
4	Gas cutter machine with safety kit	Nos.								
5	Hydro Testing Equipment	Nos.								
6	Ultrasonic Flowmeter	Nos.								
7	Multimeter/Meggar	Nos.								

Signature of Bidder(s)

5.17 Health, Safety and Environment Policy

FORM 'I'

HSE COMPLIANCE CERTIFICATIONS

Sr.No.	Name of Certification	Yes/No	Date of Issue	Valid Upto
1	ISO 9001 (Quality)			
2	ISO 14001 (Environment)			
3	OHSAS 18001/ISO 45001 (Health & Safety)			
4	Any Other Certification			

5.18 Integrity Pact

Pre-Contract Integrity Pact
(Applicable for all tenders of the value above Rs.1 Crore)

General

This pre-bid pre-contract Agreement (hereinafter called the Integrity Pact) is made on _____ day of the month of _____ 202__.

BY AND BETWEEN

The Indian Institute of Technology Kanpur represented through "**The Registrar**", having its office located at G.T. Road, Kalyanpur, Kanpur, Uttar Pradesh – 208016 (hereinafter called the "**BUYER**", which expression shall mean and include, unless **the** context otherwise requires, his successors in office and assigns) of the **First Party**;

AND

M/s _____ a company incorporated under the Companies Act, 2013 through its representative/authorized signatory (insert name and designation of the officer) vide resolution dated _____ passed by the Board of Directors, having its registered office at _____

(hereinafter referred to as "**The Bidder(s)/Contractor(s)**") which terms or expression shall, unless excluded by or repugnant to the subject or context, mean and include its successor-in-office, administrators or permitted assignees) of the **Second Party**;

WHEREAS, the Institute/Buyer has floated the Tender bearing No. _____ (hereinafter referred to as "**Tender/Bid**") and intends to award, under laid down organization procedures, contract(s) for _____ (Name of the work/goods/ services). The Institution values full compliance with all relevant laws of the land, rules, regulations, economic use of resources and of fairness/transparency in its relations with its Bidder(s) and/or Contractor(s).

AND WHEREAS, the BIDDER is a private company/public company/Government undertaking/partnership/registered export agency, constituted in accordance with the relevant law in the matter and the BUYER is a body corporate and has been established under the provisions of the Institutes of Technology Act, 1961.

AND WHEREAS, in order to achieve these goals, in consultation with the CVC, the Govt. of India, Ministry of Education has appointed Independent External Monitors (IEMs), who will monitor the tender process and the execution of the contract for compliance with the principles mentioned above.

NOW, THEREFORE, to avoid all forms of corruption by following a system that is fair, transparent and free from any influence/prejudiced dealings prior to, during and subsequent to the currency of the contract to be entered into with a view to:-



Enabling the BUYER to obtain the desired said stores/equipment at a competitive price in conformity with the defined specifications by avoiding the high cost and the distortionary impact of corruption on public procurement, and

Enabling BIDDERS to abstain from bribing or indulging in any corrupt practice in order to secure the contract by providing assurance to them that their competitors will also abstain from bribing and other corrupt practices and the BUYER will commit to prevent corruption, in any form, by its officials by following transparent procedures.

The parties hereto hereby agree to enter into this Integrity Pact and agree as follows:

Section 1: Commitments of the BUYER

1. The BUYER commits itself to take all measures necessary to prevent corruption and to observe the following principles: -
 - (a) No employee of the BUYER, personally or through family members, shall in connection with the tender for, or the execution of a contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.
 - (b) The BUYER shall treat all Bidder(s) with equity and reason during the tender process. The BUYER shall, in particular, before and during the tender process, provide to all Bidder(s) the same information and shall not provide to any Bidder(s) confidential / additional information through which the Bidder(s) could obtain an advantage in the tender process or the contract execution.
 - (c) The BUYER shall exclude from the process all known persons having conflict of interest.
2. If the BUYER obtains information on the conduct of any of its employees which is a criminal offence under the IPC/PC Act, or if there be a substantive suspicion in this regard, the BUYER shall inform the Chief Vigilance Officer, IIT Kanpur and in addition shall initiate disciplinary proceedings.

Section 2: Commitments of BIDDERS

1. The BIDDER commits itself to take all measures necessary to prevent corrupt practices, unfair means and illegal activities during any stage of its bid or during any pre-contract or post-contract stage in order to secure the contract or in furtherance to secure it and in particular commit itself to the following:-
 - (a) The BIDDER will not offer, directly or through intermediaries, any bribe, gift, consideration, reward, favour, any material or immaterial benefit or other advantage, commission, fees, brokerage or inducement to any official of the BUYER, connected directly or indirectly with the bidding process, or to any person, organisation or third party related to the contract in exchange for any advantage in the bidding, evaluation, contracting and implementation of the contract.

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- (b) The BIDDER further undertakes that it has not given, offered or promised to give, directly or indirectly any bribe, gift, consideration, reward, favour, any material or immaterial benefit or other advantage, commission, fees, brokerage or inducement to any official of the BUYER or otherwise in procuring the Contract or forbearing to do or having done any act in relation to the obtaining or execution of the contract or any other contract with the Government for showing or forbearing to show favour or disfavour to any person in relation to the contract or any other contract with the Government.
- (c) The Bidder(s)/Contractor(s) of foreign origin shall disclose the name and address of the Agents/representatives in India, if any. Similarly, the Bidder(s)/Contractor(s) of Indian Nationality shall furnish the name and address of the foreign entity or associates, if any. Further details as mentioned in the "Guidelines of Indian Agents of Foreign suppliers" shall be disclosed by the Bidders(s)/Contractor(s). Further, as mentioned in the Guidelines all payments made to the Indian Agent/representative have to be in Indian Rupees only.
- (d) BIDDERS shall disclose the payments to be made by them to agents/brokers or any other intermediary, in connection with this bid/contract.
- (e) The BIDDER further confirms and declares to the BUYER that the BIDDER is the original manufacturer/integrator/authorised government sponsored export entity of the defence stores and has not engaged any individual or firm or company whether Indian or foreign to intercede, facilitate or in any way to recommend to the BUYER or any of its functionaries, whether officially or unofficially to the award of the contract to the BIDDER, nor has any amount been paid, promised or intended to be paid to any such individual, firm or company in respect of any such intercession, facilitation or recommendation.
- (f) The BIDDER, either while presenting the bid or during pre-contract negotiations or before signing the contract, shall disclose any payments he has made, is committed to or intends to make to officials of the BUYER or their family members, agents, brokers or any other intermediaries in connection with the contract and the details of services agreed upon for such payments.
- (g) The BIDDER will not collude with other parties interested in the contract to impair the transparency, fairness and progress of the bidding process, bid evaluation, contracting and implementation of the contract.
- (h) The BIDDER will not accept any advantage in exchange for any corrupt practice, unfair means and illegal activities.
- (i) The BIDDER shall not use improperly, for purposes of competition or personal gain, or pass on to others, any information provided by the BUYER as part of the business relationship, regarding plans, technical proposals and business details, including information contained in any electronic data carrier. The BIDDER also undertakes to exercise due and adequate care lest any such information is divulged.

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- (j) The BIDDER commits to refrain from giving any complaint directly or through any other manner without supporting it with full and verifiable facts.
- (k) The BIDDER shall not instigate or cause to instigate any third person to commit any of the actions mentioned above.
- (l) If the BIDDER or any employee of the BIDDER or any person acting on behalf of the BIDDER, either directly or indirectly, is a relative of any of the officers of the BUYER, or alternatively, if any relative of an officer of the BUYER has financial interest/stake in the BIDDER's firm, the same shall be disclosed by the BIDDER at the time of filing of tender. The term 'relative' for this purpose would be as defined in Section 2(77) of the Companies Act, 2013.
- (m) The BIDDER shall not lend to or borrow any money from or enter into any monetary dealings or transactions, directly or indirectly, with any employee of the BUYER.

Section 3: Disqualification from tender process and exclusion from future contracts:

1. If the Bidder(s)/Contractor(s), before award or during execution has committed a transgression through a violation of Section 2, above or in any other form such as to put their reliability or credibility in question, the Institute/Buyer is entitled to disqualify the Bidder(s)/Contractor(s) from the tender process or take action as per the procedure mentioned in the "Guidelines on Banning of Business Dealing".
2. Any violation of Integrity Pact would entail disqualification of the bidder(s) and exclusion from future business dealings, as per the existing provisions of GFR-2017, PC Act, 1988 and other Financial Rules/Guidelines etc. as may be applicable to the organization concerned.

Section 4: Compensation for Damages:

1. If the Institute/Buyer has disqualified the Bidder(s) from the tender process prior to the award according to Section 3, the Institute/Buyer is entitled to demand and recover the damages equivalent to Earnest Money Deposit/Bid Security.
2. If the Institute/Buyer has terminated the contract according to Section 3, or if the Institute/Buyer is entitled to terminate the contract according to Section 3, the Institute/Buyer shall be entitled to demand and recover from the Contractor liquidated damages of the Contract value or the amount equivalent to Performance Bank Guarantee.

Section 5: Previous Transgression

1. THE BIDDER(S) to disclose any transgressions with any other public/government organization that may impinge on the anti-corruption principle. The date of such transgressions, for the purpose of disclosure by the BIDDER(s) in this regard, would be the date on which cognizance of the said transgression was taken by the competent authority. The period for which such transgression(s) is/are to be reported by the bidders

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shall be the last **three years** to be reckoned from date of bid submission. The transgression(s), for which cognizance was taken even before the said period of three years, but are pending conclusion, shall also be reported by the BIDDERS.

2. The BIDDER agrees that if it makes incorrect statement on this subject, BIDDER can be disqualified from the tender process or the contract, if already awarded, can be terminated for such reason.

Section 6: Equal Treatment of all Bidders/Contractors/Sub-Contractors:

1. In the case of sub-contracting, the principal/main Contractor shall take the responsibilities of adoption of the Integrity Pact by the Sub-contractor.
2. The BUYER will enter into agreements with the identical conditions as this one with all bidders and Contractors.
3. The BUYER will disqualify from the tender process all bidders who do not sign this Pact or violate its provisions.

Section 7: Criminal Charges against violating Bidder(s)/Contractor(s)/Sub-Contractors:

1. If the Buyer obtains knowledge of the conduct of a Bidder, Contractor or Sub-contractor, or of an employee or a representative or an associate of a Bidder, Contractor or Sub-contractor which constitutes corruption, or if the Institute/Buyer has substantive suspicion in this regard, the Institute/Buyer will inform the same to the Chief Vigilance Officer, IIT Kanpur.

Section 8: Sanctions for Violations

1. Any breach of the aforesaid provisions by the BIDDER or anyone employed by it or acting on its behalf (whether with or without the knowledge of the BIDDER) shall entitle the BUYER to take all or any one of the following actions, wherever required: -
 - (i) To immediately call off the pre contract negotiations without assigning any reason or giving any compensation to the BIDDER. However, the proceedings with the other BIDDER(s) would continue.
 - (ii) The Earnest Money Deposit (in pre-contract stage) and/or Security Deposit/Performance Bond (after the contract is signed) shall stand forfeited either fully or partially, as decided by the BUYER and the BUYER shall not be required to assign any reason, therefore.
 - (iii) To immediately cancel the contract, if already signed, without giving any compensation to the BIDDER.
 - (iv) To recover all sums already paid by the BUYER, and in case of an Indian BIDDER with interest thereon at 2% higher than the prevailing Prime Lending Rate of State Bank of India, while in case of a BIDDER from a country other than India with interest thereon at 2% higher than the LIBOR. If any outstanding payment is due to the BIDDER from the BUYER in connection

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with any other contract for any other stores, such outstanding payment could also be utilized to recover the aforesaid sum and interest.

- (v) To encash the advance bank guarantee and performance bond/warranty bond, if furnished by the BIDDER, in order to recover the payments already made by the BUYER, along with interest.
 - (vi) To cancel all or any other Contracts with the BIDDER. The BIDDER shall be liable to pay compensation for any loss or damage to the BUYER resulting from such cancellation/rescission and the BUYER shall be entitled to deduct the amount so payable from the money(s) due to the BIDDER.
 - (vii) To debar the BIDDER from participating in future bidding processes of the Institute for a minimum period of two years, which may be further extended at the discretion of the BUYER.
 - (viii) To recover all sums paid in violation of this Pact by BIDDER(s) to any middleman or agent or broker with a view to securing the contract.
 - (ix) In cases where irrevocable Letters of Credit have been received in respect of any contract signed by the BUYER with the BIDDER, the same shall not be opened.
 - (x) Forfeiture of Performance Bond in case of a decision by the BUYER to forfeit the same without assigning any reason for imposing sanction for violation of this Pact.
2. The BUYER will be entitled to take all or any of the actions mentioned at para 9.1 (i) to (x) of this Pact also on the Commission by the BIDDER or anyone employed by it or acting on its behalf (whether with or without the knowledge of the BIDDER), of an offence as defined in Chapter IX of the Indian Penal Code, 1860 or Prevention of Corruption Act, 1988 or any other statute enacted for prevention of corruption.
3. The decision of the BUYER to the effect that a breach of the provisions of this Pact has been committed by the BIDDER shall be final and conclusive on the BIDDER. However, the BIDDER can approach the Independent Monitor(s) appointed for the purposes of this Pact.

Section 9: Fall Clause

1. The BIDDER undertakes that it has not supplied/is not supplying similar product/systems or subsystems at a price lower than that offered in the present bid in respect of any other Ministry/Department of the Government of India or PSU and if it is found at any stage that similar product/systems or sub-systems was supplied by the BIDDER to any other Ministry/Department of the Government of India or a PSU at a lower price, then that very price, with due allowance for elapsed time, will be applicable to the present case and the difference in the cost would be refunded by the BIDDER to the BUYER, if the contract has already been concluded.

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Section 10: Independent Monitors

1. The IEMs have been appointed by the Ministry of Education in consultation with the Central Vigilance Commission. The details of the IEMs are as follows:
 - (a) Mr. Ranvir Singh, IEM1@iitk.ac.in
 - (b) Mr. P.V.V. Satyanarayana, IEM2@iitk.ac.in
2. The task of the Monitor shall be to review independently and objectively, whether and to what extent the parties comply with the obligations under this Pact.
3. The Monitor shall not be subject to instructions by the representatives of the parties and perform their functions neutrally and independently.
4. Both the parties accept that the Monitor has the right to access all the documents relating to the project/procurement, including minutes of meetings.
5. As soon as the Monitor notices, or has reason to believe, a violation of this Pact, he will so inform the Authority designated by the BUYER.
6. The BIDDER(s) accepts that the Monitor has the right to access without restriction to all Project documentation of the BUYER including that provided by the BIDDER. The BIDDER will also grant the Monitor, upon his request and demonstration of a valid interest, unrestricted and unconditional access to his project documentation. The same is applicable to Subcontractors. The Monitor shall be under contractual obligation to treat the information and documents of the BIDDER/Subcontractor(s) with confidentiality.
7. The BUYER will provide to the Monitor sufficient information about all meetings among the parties related to the Project provided such meetings could have an impact on the contractual relations between the parties. The parties will offer to the Monitor the option to participate in such meetings.
8. The Monitor will submit a written report to the designated Authority of BUYER within 8 to 10 weeks from the date of reference or intimation to him by the BUYER / BIDDER and, should the occasion arise, submit proposals for correcting problematic situations.
9. A person signing the IP Pact shall not approach the Court while representing the matter to IEMs and shall await the decision in the matter.
10. The IP would be implemented through a panel of Independent External Monitors (IEMs), appointed by the Ministry. The IEM would review independently and objectively whether and to what extent parties have complied with their obligations under the Pact on receipt of any complaint by them from the Bidder(s).
11. Integrity Pact (IP), in respect of a particular contract, shall be operative from the date IP is signed by both parties. The IEMs shall examine all the representations/ grievances/complaints received by them from the bidders or their authorized representatives related to any discrimination on account of lack of fair play in modes of procurement and bidding systems, tendering method, eligibility conditions, bid

evaluation criteria, commercial terms & conditions, choice of technology/specifications etc.

12. For ensuring the desired transparency and objectivity in dealing with the complaints arising out of the tendering process, the matter should be examined by the full panel of IEMs jointly, who would look into the records, conduct an examination, and submit their joint recommendations to the Management. In case the full panel is not available due to some unavoidable reasons, the available IEM(s) will conduct examination of the complaints. Consent of the IEM(s), who may not be available, shall be taken on the records.
13. In the event of any dispute between the management and the contractor relating to those contracts where Integrity Pact is applicable, in case, both the parties are agreeable, they may try to settle dispute through mediation before the panel of IEMs in a time-bound manner. If required, the organization may adopt any mediation rules for this purpose.

In case, the dispute remains unresolved even after mediation by the panel of IEMs, the organization may take further action as per the terms & conditions of the contract.

The fees/expenses on dispute resolution shall be equally shared by both parties.
14. If the Monitor has reported to the Management of the BUYER a substantiated suspicion of an offense under the relevant IPC/ PC Act, the Management of the BUYER will take action after examination of the veracity of the intent of the action.
15. The word "**Monitor**" would include both singular and plural.

Section 11: Facilitation of Investigation

1. In case of any allegation of violation of any provisions of this Pact or payment of commission, the BUYER or its agencies shall be entitled to examine all the documents, including the Books of Accounts of the BIDDER, and the BIDDER shall provide necessary information and documents in English and shall extend all possible help for the purpose of such examination.

Section 12: Law and Place of Jurisdiction

1. This Pact is subject to Indian Law. The place of performance and jurisdiction is the seat of the BUYER i.e., Kanpur Nagar.

Section 13: Other Provisions

1. The actions stipulated in this Integrity Pact are without prejudice to any other legal action that may follow in accordance with the provisions of the extant law in force relating to any civil or criminal proceedings.
2. Changes and supplements, as well as termination notices, need to be made in writing. Side agreements have not been made.



3. In case of a joint venture, all the partners of the joint venture should sign the Integrity Pact. In case of sub-contracting, the principal contractor shall be solely responsible for the adherence to the provisions of IP by the sub-contractor(s).
4. Issues like Warranty/Guarantee etc. shall be outside the purview of the IEMs.
5. This Integrity Pact is deemed as part of the contract.

Section 14: Validity

1. The validity of this Integrity Pact shall be from the date of its signing and extend up to 5 years or the complete execution of the contract to the satisfaction of both the BUYER and the BIDDER/Seller, including the warranty period, whichever is later. In case BIDDER is unsuccessful, this Integrity Pact shall expire after six months from the date of the signing of the contract.
2. Should one or several provisions of this Pact turn out to be invalid; the remainder of this Pact shall remain valid. In this case, the parties will strive to come to an agreement with their original intentions.

IN WITNESS WHEREOF, the parties hereunto set their hands and seals and executed this Integrity Pact as of the date/month/year first above written in the presence of following witnesses:

For & on behalf of
The Indian Institute of Technology Kanpur
(First Party)
 Signed, Sealed and delivered by

Vishwa
 Name: **Vishwa Ranjan** विश्व रंजन / Vishwa Ranjan
 Designation: **Registrar** कुलसचिव / Registrar
 Address: **IIT Kanpur** भारतीय प्रौद्योगिकी संस्थान कानपुर
 (Authorized Signatory) INDIAN INSTITUTE OF TECHNOLOGY KANPUR
 कानपुर - 208 016 (उ.प्र.) भारत
 KANPUR - 208 016 (U.P.) INDIA

For & on behalf of
The M/s
(Second Party)
 Signed, Sealed and delivered by

Name:
 Designation:
 Address:
 (Authorized Signatory vide resolution
 dated passed by the Board of
 Directors)

In the presence of Witness:

1. (Indenter)
2.

1.
2.

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6 Proforma of Schedules

PROFORMA OF SCHEDULES

6.1 SCHEDULE 'A': Schedule of Quantities

Schedule of Quantities : BOQ uploaded separately

6.2 SCHEDULE 'B': Schedule of materials to be issued to the contractor

Schedule of materials to be issued to the contractor: NIL

6.3 SCHEDULE 'C': Tools and plants to be hired to the contractor

Tools and plants to be hired to the contractor: NIL

6.4 SCHEDULE 'D': Extra schedule for specific requirements/document for the work, if any

Extra schedule for specific requirements/document for the work, if any: NIL

6.5 SCHEDULE 'E': Reference to General Conditions of Contract

Reference to General Conditions of Contract	:	General Conditions of Contract 2023 for Construction Works & Maintenance work and as amended / modified up to the last date of sub- mission of Bid.
Name of Work	:	Supply, Installation, Testing & Commissioning of Water Cooled Central AC Plant of Capacity 4600 TR (4x1050 TR +1X400 TR) with Electrical (remaining) & Plumbing (Highside) works (Package - 4) of GSMST at IIT Kanpur.
Total Estimated cost of work	:	Rs. 53,64,10,405/-
Earnest Money	:	Rs. 63,64,104/-
Performance Guarantee	:	5% of tendered value
Security Deposit	:	2.5% of tendered value will be deducted from each bill. Same would be released after successful completion of Three year defect liability period and as per special conditions of the contract.

6.6 SCHEDULE 'F': General Rules and Directions

GENERAL RULES & DIRECTIONS:

Officer Inviting tender: Superintending Engineer

6.6.1 Definitions

- | | | |
|-----------------------|---|-------------------------|
| 1. Inviting Authority | : | Superintending Engineer |
| 2. Engineer-in-Charge | : | Executive Engineer |

3. Accepting Authority	:	B&WC
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4. Percentage on cost of materials and Labour to cover all overheads and profits	:	15%
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5. Standard Schedule of Rates	:	
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For Electrical Work: DSR (E&M), 2025&
MR with up-to-date correction slip

6. Department	:	Institute Works Department, IIT Kanpur
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7. Standard CPWD Contract Form	:	General Conditions of Contract 2023, SOPs 2024, CPWD Works manual 2024, CPWD Form 7 as amended / modified up to the last date of submission of Bid. 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. b- The GST shall be subject to revision during the contract period as applicable from time to time as per Government of India guideline.
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6.6.2 Clauses

Clause 1

i. Time allowed for submission of Performance Guarantee, Programme Chart (Time and Progress) and applicable labour licenses, registration with EPFO, ESIC and BOCW welfare board or proof of applying thereof from the date of issue of the letter of acceptance	:	7 days
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ii. Maximum allowable extension with late fee @ 0.1% per day of Performance Guarantee amount beyond the Period provided in (i) above : **7 days**

Clause 1A	: Applicable. The Defect liability period shall be Three year from the date of handing over of the assigned works to the user/Institute
Clause 2	
Authority for fixing compensation under Clause 2	: DOIP, IIT Kanpur
Clause 2	
Whether Clause 2 shall be applicable	: YES
Clause 5	:
(i): Number of days from the date of issue of letter of acceptance for reckoning date of start	: 7 Days
ii: Milestones	: Time allowed for execution of work along with the amount to be withheld in case of non-achievement of milestone are shown in Table 6
Clause 6: Computerized Measurement Bill	: <i>Applicable</i>
Clause 7 Gross work to be done together with net payment/Adjustment of advances for material collected, if any, since the last such payment for being eligible to interim payment	: Not Applicable
Clause 7A	: Applicable
Clause 10A	: Applicable
Clause 10B (i)	: Applicable
Clause 10B (ii)	: Not Applicable
Clause 10B (iii)	: Not Applicable
Clause 10C	: <i>Not Applicable</i>
Clause 10CA	: <i>Not Applicable</i>
Clause 10CC	: Not applicable

Clause 11 : CPWD Specification Vol. I-2023, II-2023 & IV-2013, Heating, Ventilation & Air-Conditioning (HVAC) specification 2024 and latest CPWD specifications of all E&M items, with correction Slips issued up to the last date of receipt of tenders (herein called CPWD Specifications also) and as per NIT for E&M works. Specifications to be followed for execution of Civil work and E&M works

Clause 12: Type of work : Original Work

Clause 12.2 & 12.3: Deviation limit beyond which clause 12.2 & 12.3 shall apply for Building work : Applicable

Clause 16 Competent Authority for deciding reduced rates: For HVAC items : As per Table 7

and For Electrical items of work

Clause 17 - Defect liability period completion of contract whichever is later : Three year and those listed in Special Conditions of Contract Document

Clause 18 - List of mandatory machinery, tools & plants to be deployed by the contractor at site : As per the scope of the 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 : Milestone chart

Sl. No.	Description of mile stone	Period for completion from date of start	Withheld amount for non achievement of mile stone.
1	AC Plant Layout , SLD and other shop/GFC drawings submission by contractor	2 months	1 % of the accepted tendered value
2	Technical data sheet submission of equipment's i.e. Chillers, Pumps, Cooling Tower, AHU, Ducting, Piping, valves, Insulation, Electrical panels, Cables, Water Treatment Plants		
3	Submission of cable schedule by contractor		
4	Building internal HVAC start work		
5	LT cable delivery, Pipeline Delivery	4 months	0.5 % of the accepted tendered value
6	AHU/Ducting/Valves/Insulation Delivery		
7	Delivery of Chillers, Pumps, cooling Tower	7 months	1 % of the accepted tendered value
9	Installation of Chillers, Pumps, cooling Tower		
10	Delivery of Electrical Panels, WTP,		
11	Laying of cables		
12	Installation of electrical panels, WTP, AHU, Ducting, Piping etc		
13	Installation of Plumbing Pumps	9 months	0.5 % of the accepted tendered value
14	Commissioning of AC Plant		
15	Commissioning of Low side HVAC		
16	Commissioning of WTP		
17	Commissioning of CPM		

Table 7: Authority to decide

(i)	Extension of time (EOT)	:	DOIP
(ii)	Rescheduling of milestones	:	Superintending Engineer, IIT Kanpur
(iii)	Shifting of date of start in case of delay in handing over of site	:	Superintending Engineer, IIT Kanpur

Table 8: Materials for which all India Wholesale Price Index to be followed Nearest
Materials (other than

Sl.No	Material covered under this clause	cement, reinforcement bars and the structural steel) for which All India Wholesale Price Index to be followed	Base Price (with GST) of Materials, covered under clause 10 CA
	Portland Pozzolana		
1	Cement (PPC)/ Ordinary Pozzolana Cement	Nil	Nil
2	Steel for Reinforcement TMT Fe 500D Primary	Nil	
	<u>Manufacturer</u>	Nil	
3	Structural Steel (Primary producers)	Nil	

Table 9: Requirement of Technical staff, Clause 32						
Sl No.	Requirement of Technical staff <i>Qualification</i> (Of Major + Minor component)	<i>Number</i>	Minimum experience in Year	Minimum experience in Year	Rate at which recovery shall be made from the contractor in the event of not fulfilling provision of <u>Clause 32</u>	
					Figures	Words
1	Graduate Engineer (Mechanical)	1	20	Project Manager	Rs. 60000/- PM	Rs. Sixty Thousand Only.
2	Graduate Engineer (Electrical)	1	12	Project Manager	Rs. 45000/- PM	Rs. Twenty-Five Thousand Only
3	Diploma Engineer	2	5 & 10	Project Planning/ quality/ billing Engineer (Electrical/Mechanical)	Rs. 25,000/- pm per month per person	Rs. Fifteen Thousand only per month per person

Note 2: Project/Site Engineer for Electrical work mentioned must be required from the beginning of the work electrical work has to happen in a coordinated manner to meet the date of handover of site as per special terms and conditions.

7. Scope of work

7.1 Project Brief

1. Supply, Installation, Testing & Commissioning of Water Cooled Central AC Plant of Capacity 4600 TR (4x1050 TR +1X400 TR) with Electrical (remaining) & Plumbing (Highside) works (Package - 4) of GSMST at IIT Kanpur as specified in BOQ.

Note: The scope of the works listed above is indicative only. For the details of the works, please refer to the BOQ and the work has to be done strictly as per the specifications in the BOQ.

8 Specifications for HVAC Works

TECHNICAL SPECIFICATION

Section 1: Chillers

Section 2: Pumps

Section 3: Cooling Tower

Section 4: Expansion Tank System

Section 5: Dirt Separator

Section 6: Water Softener Plant

Section 7: BMS (Building Management System)

Section 8: Piping

Section 9: Insulation

Section 10: Associated controls

Section 11: Water Plumbing

Section 12: Electrical Works

Section-1. Chiller Specification:

This chapter covers the requirements of chillers suitable for centrifugal types of refrigerating machines for air-conditioning.

1 Types

This section covers the shell and tube type water chillers. These may be again of the following types:-

a) For reciprocating type units the chiller shall be Direct expansion (DX) type b) For centrifugal type units the chiller shall be of Flooded type or falling film type .c) For screw type units the chiller shall be of Direct expansion (DX) type or Flooded type or falling film type..

1.1 Shell and Tube Type Water Chillers

1.1.1 Rating

- i) In a package water chilling machine, the chiller shall match the compressor capacity specified in the tender specifications. The chiller shall be selected for 4.4 mechanical C temperature drop of water through the chiller for reciprocating/scroll compressor & 5.5deg C for centrifugal & screw type compressors .
- ii) The fouling factor shall be 0.0001 hr. sq.mtr. degree C temperature difference/K. Cal. Unless otherwise specified in the tender specifications.

Material and Construction

i) The water chiller shall be horizontal, shell and tube type, designed, constructed and tested for the refrigerant specified in the tender specifications.

ii) The chiller shall be designed for a working pressure on the refrigerant side suitable for the refrigerant offered, and on the water side for 10kg./sq.cm. gauge.

i) The end plates of chiller shall be made of MS of thickness not less than 25mm.

iv) The shell of the chiller shall be made of MS of thickness not less than 8mm with electric fusion welded seams.

v) The tubes shall be of seamless, hard drawn copper with a minimum tube wall thickness of 0.71 mm for plain tubes & minimum 0.63mm at the root of fins.

vi) The tubes shall be plain for DX type chillers and may be either plain or internally finned for flooded type chillers as per manufacturer's design.

vii) The tubes shall be rolled into grooves in the tube sheets and flared at ends.

viii) Intermediate tube supports of steel or polypropylene shall be provided at spacing not less than 1250 mm for flooded type chiller and 500mm for DX type chiller to prevent sagging / vibration of tubes.

ix) The flooded chillers shall have water boxes designed for multi pass flow. The DX type chillers shall be provided with adequate number of properly spaced baffles so that

the water passes through the tube bundle many times.

x)The chiller shall be smooth finished with one coat of zinc chromate primer before the insulation is applied.

xi)The chiller shall be sand blasted from both inside (before insertion of tubes) & outside.

Connections and Accessories :For DX Type Chiller

Cycling shutdowns with a VSD shall include:

- i)VSD shutdown – requesting fault data
- ii)VSD – stop contacts open
- iii)VSD initialization failed
- iv)VSD - high phase A,B,C instantaneous current
- v)VSD – phase A,B,C gate driver
- vi)VSD – single phase input power
- vii)VSD – high DC bus voltage
- viii)VSD – pre charge DC bus voltage imbalance
- ix)VSD – high internal ambient temperature
- x)VSD – invalid current scale selection
- xi)VSD – low phase A, B, C inverter heat sink temp.
- xii)VSD – low converter heat sink temperature
- xiii)VSD – pre-charge - low DC bus voltage
- xiv)VSD – logic board processor
- xv)VSD – run signal
- xvi)VSD – serial communications

Motor starter

i)For constant speed compressorStarter for motor shall be as per details given under para —MotorStarterl.

ii)For variable speed compressor

- a) In Case of VSD starter, it will vary the compressor motor speed by controlling the frequency and voltage of the electrical power to the motor. The adaptive capacity control logic shall automatically adjust motor speed and compressor pre-rotation vane position independently for maximum part-load efficiency by analyzing information fed to it by sensors located throughout the chiller

b) To Limit Harmonic generation from VSD, Active Harmonic Filters as per IEEE 519 must be used at the source itself.

c) Drive will be PWM type utilizing IGBT's with a power factor of 0.95 or better at all loads and speeds.

d) Make of VSD shall be exactly same as per OEM/approved make list. The variable speed drive shall be with all power and control wiring between the drive and chiller factory installed and unit mounted, including power to the chiller oil pump. The VFD of chiller may preferably be unit mounted, but standalone VFD is also acceptable. In both cases, it should be factory fitted. The chiller and its VFD should be integrated at the chiller OEM's factory, and the VFD coupled chillers performance demonstrated at 4 points (100%, 75%, 50% & 25% of load) prior to dispatch of the chillers and shall be verified during inspection at the factory end.

e) Field power wiring shall be a single point connection and electrical lugs for incoming power wiring will be provided.

iii) The following features will be provided:

- (a) Door interlocked circuit breaker capable of being padlocked.
- (b) UL listed ground fault protection.
- (c) Over voltage and under voltage protection.
- (d) 3-phase sensing motor over current protection.

Sensing thermostat in each room. It shall sense room temperature and vary the supply air when cooling.

RADIANT COOLING SYSTEM

Scope This section describes the basic requirement of Radiant cooling system with embedded pipes inside the slab during casting of the floors/slab of a building.

Principle The principle of Radiant cooling system is based on the utilization of the thermal mass of building components. Due to the large thermal storage mass of walls, cool room temperatures can comfortably be enjoyed even in the summer when the outside temperature is high. The heat loads arising in the room are absorbed by cool solid building elements. The storage characteristic of solid concrete parts is utilized by polymers pipes carrying cooling realizing "limitless" thermal storage.

Features i. The pipe shall be of high-quality and all central components of laying systems shall be pressure-resistant, rugged and impermeable to oxygen.

ii. For subsurface heating and cooling permanently sealed compression sleeve jointing technique shall be used.

iii. The system shall be corrosion resistance.

iv. The pipe shall have good abrasion resistance.

v. Even temperature profiles shall be maintained.

vi. The pipe material shall be such that minimum noise gets transmitted along the pipe.

1.1.2 System advantages and benefits

- i. Easy and quick assembly
- ii. Comfortably temperature-controlled floor surface
- iii. Minimal air speeds
- iv. No upsetting of dust
- v. Optimum room arrangement flexibility
- vi. Low operating temperatures
- vii. Suitable for heat pump and solar power systems
- viii. No maintenance costs

The DX type chiller shall be provided with the following connections and accessories and conforming to the Section —Refrigeration Piping where applicable: -

- a) Refrigerant inlet and outlet connections
- b) Thermostatic / Electronic type expansion valve(s) with adjustable superheat control and external equalizer part,
- c) Line solenoid valve, or pilot solenoid valves as required.
- d) Water inlet and water outlet connections
- e) Drain connection with stop valve for water side only.
- f) Vent connection with valve.
- g) Flow switch in water line.

For Flooded Type Chiller The flooded type chiller shall be provided with the following connections and accessories and conforming to section —Refrigeration Piping where applicable:

- a) Refrigeration inlet and outlet connections.
- b) Liquid refrigerant float for level control/ expansion valve/ fixed or variable orifice.
- c) Pressure relief device.
- d) Charging connection with valve.
- e) Eliminator plate.
- f) Drain and vent connections with valves
- g) Water inlet and outlet connections

h) Proper oil return system.

i) Flow switch/pressure switch/differential flow switch/ flow sensor in the water line (s).

Pressure Testing

a) The chiller shall be tested in the works to 1.5 times the maximum working pressure for the refrigerant specified in the tender specifications, or 21 kg./sq.cm. (Pneumatic) (for high pressure refrigerant) & 45 PSIG (3.16kg/Cm²) (Pneumatic) (for low pressure refrigerant) chiller's, whichever is higher.

b) The water side of the chiller shall also be tested to a hydraulic pressure of 10 kg./sq.cm. at the works.

c) Pressure test certificates shall be produced in respect of each chiller.

Insulation

The insulation shall be done as per section 9.

Equipment Class	Maximum kW/TR at ARI conditions	Minimum COP * at ARI conditions	Minimum IPLV	Test Standard
Air Cooled Chiller <530 kW (<150tons)	1.21	2.9	3.16	ARI 550/590-1998
Air Cooled Chiller ≥530 kW (≥150 tons)	1.15	3.05	3.32	ARI 550/590-1998
Centrifugal Water Cooled Chiller <530 kW (<150tons)	0.61	5.8	6.09	ARI 550/590-1998
Centrifugal Water Cooled Chiller ≥530 kW and <1050 kW (≥ 150 tons and <300 tons)	0.61	5.8	6.17	ARI 550/590-1998
Centrifugal Water Cooled Chiller ≥1050 kW (≥300 tons)	0.56	6.3	6.61	ARI 550/590-1998
Reciprocating Compressor, Water Cooled Chiller all sizes	0.84	4.2	5.05	ARI 550/590-1998
Rotary Screw and Scroll Compressor, Water cooled chiller <530 kW (<150 tons)	0.75	4.7	5.49	ARI 550/590-1998
Rotary Screw and Scroll Compressor, Water cooled chiller ≥530 kW and <1050 kW (≥ 150 tons and <300 tons)	0.65	5.4	6.17	ARI 550/590-1998
Rotary Screw and Scroll Compressor, Water cooled chiller ≥1050 kW (≥300 tons)	0.61	5.75	6.43	ARI 550/590-1998

Chiller Plant Optimizer: Chiller Plant Optimizer shall be provided in the plant room for Chilling Unit (s), Chilled Water Pumps /Primary Chilled Water Pumps, secondary chilled water pumps, Condenser Water Pumps and Cooling Towers . The Chiller Plant Optimizer shall be of the same manufacturer/ OEM as that of the Chilling Unit.

REFRIGERANT PLUMBING Design aspects of Refrigerant Plumbing

i) Refrigerant piping shall be designed and installed so as to:

- a) ensure circulation of adequate refrigerant at all loads.
- b) ensure oil return to crank case of compressor positively and continuously.
- c) keep pressure losses within limits, especially in suction lines.

ii) Outdoor airflow rate/ floor area: 1.5-2.5 (6) l/s/m²

ii) Outdoor airflow rate/ effective length: 5-12 l/s/mix) Cooling capacity / floor area: 120 (200) W/m²x) Cooling capacity / beam effective length: 350 (500) W/mxi) Heating capacity / floor area: 60 (80) W /m²) Heating capacity / beam effective length: 200 (300) W/m

iii) Technical specifications

i) The active chilled beam shall have an integral recirculation air path through the perforated front panel. The induced room air flow rate shall be manually adjustable via three setting positions without influencing the primary air supply flow rate. The airflow rate of the chilled beam shall be adjustable without plugging or changing the nozzles.

ii) The primary air flow rate shall be adjustable over a wide range via a supply air unit integrated into the chilled beam.

iii) Outdoor air flow rate control shall not have any effect on coil cooling and heating capacities.

iv) The beam with adjustable air flow rate shall have only one duct connection. The appearance of the chilled beams with constant air flow and variable air flow rate shall be the same.

v) The front panel shall be openable from either side in order to allow general maintenance and cleaning. The front panel shall be removable without any special tools.

vi) The air supply to the room space shall be either unidirectional or bi-directional.

vii) The position of the duct connection shall be changeable without the use of any special tools.

viii) The frame, front, and side panels shall be made of galvanized steelplate.

ix) All visible parts shall be white/ painted to match the ceiling colour.

x) All pipes shall be manufactured from copper, and connection pipes with a wall thickness of 0.9-1.0 mm.

xi) The fins shall be manufactured from aluminum.

xii) Optionally, heating shall be incorporated within the heat exchanger by means of two 10-mm pipes, connected in series.

xiii) All joints shall be soldered and factory pressure-tested.

xiv) The pipework's operation pressure should be 1.0 MPa.

xv) The active chilled beam shall have an air flow adjustment damper as an option and a measurement tap to allow air flow measurement.

xvi) As an option, an exhaust valve shall be integrated into the chilled beam.

xvii) In tropical countries like India, The chilled beam should have drain pan and pump to collect and dispose-off the condensate.

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

VAV Diffusers The modules shall vary the supply air volume to provide both VAV heating and VAV cooling in individual rooms controlled through a room temperature

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

CHILLED BEAMS System description Chilled beam system is an air conditioning system for cooling, heating and ventilation in spaces for good indoor climate and individual space control. The chilled beam system is an air/water system that utilizes the heat transfer properties of water and provides comfortable indoor climate energy efficiently.

System mounting: The Chilled Beams shall be ceiling mounted and consisting of a heat exchanger, a number of nozzles and a plenum in which dehumidified air is supplied.

System operation: Chilled beam systems are designed to use the dry cooling principle operating with conditions in which condensation is prevented by control applications. Ventilation using active chilled beams is an efficient mixing ventilation application that results in uniform air quality. Supply air is diffused from linear slots on either both sides or on only one side of the chilled beam. Ventilation in passive chilled beam systems is typically arranged using mixing ventilation with ceiling or wall diffusers. Alternatively, floor diffusers can be used. Cooling Active chilled beams use the primary air to induce and recirculate the room air through the heat exchanger of the unit, resulting in high cooling capacities and excellent thermal conditions in the space. Passive beam operation is based on free convection in the heat exchanger and supply air distribution is realized with separate diffusers. Heating Integration of heating into chilled beams is recommended when heating capacity is low enough (200-300 W/m) and the U-value of the windows prevent a down-draught under the window.

Typical input values and operation range i) Room temperature: 23-25 °C

ii) Supply air temperature: 16-19 °C

iii) Water inlet temperature: 14-16 °C

iv) Target duct pressure level: 70 -120 Pa

v)Target water flow rate: 0.02-0.08 kg/s

vi) Sound pressure level < 35 db (A)79

d)prevent oil/liquid refrigerant from entering the compressor when the compressor is working as well as when it has stopped.

i)prevent trapping of oil in evaporator or suction lines, which may return to the compressor in the form of slug.

ii)Hot gas lines: a)Oil shall be entrained and carried by hot gas under all load conditions likely to be encountered in normal operation .

iii)Liquid Lines :

a)Liquid lines shall be designed to ensure that flashing of liquid refrigerant does not occur by minimizing the pressure drop suitably, by avoiding long vertical risers, and appropriate sub cooling.

b)Each liquid line shall be provided with a permanently installed refrigerant drier of throw away or rechargeable type. The drier shall be installed in a valve line.

c)Flow indicator (moisture indicating type) shall be installed on all liquid lines.

iv)Suction Lines :

a)Oil shall be entrained and carried by the suction gas under all conditions of load likely to be encountered in normal operation.

b)Piping shall be designed for a suitable velocity of refrigerant(similar to hot gas line) to ensure that oil will not separate from the gas and drain to the compressor in slugs.

c)The refrigeration system shall be equipped with controls for pump down system so that the evaporator and suction line are emptied before the compressor shuts off, thus preventing liquid refrigerant and oil from entering the compressor when restarted.

d)Refrigerant lines shall be sized to limit pressure drop between evaporator and condensing unit to less than 0.2 kg. per sq.cm.(3 psi).

v)Isolating valve shall be provided to enable isolation of each compressor in case of multiple compressor units (as built in valves), strainer, drier and any other components as may be required for proper operation and maintenance.

vi)Thermostatic / Electronic type expansion valve/ float valve shall be provided in refrigerant circuit of DX system/ flooded system.

Material i)Refrigerant plumbing for reciprocating type refrigeration plant and packaged type AC plants shall be with copper tubes, with tube thickness conforming to L type to ATM standards. The tubes shall be bright annealed copper upto and including 15 mm size. The tube shall be suitable for the duty involved.

Fittings like bends, tees, sockets etc. shall be of wrought copper or forged brass and shall be suitable for the duty involved. Flare type compression fittings of forged brass shall be allowed upto 15 mm piping size. Tubes upto and including 15 mm size may be bent to form 90 degree bends with inside radius not less than 3 tube diameters. For bigger

sizes, bend fittings as mentioned above must be used.

Where specified in the tender specification, mild steel may be provided for refrigeration piping, with seamless MS tubes and fittings of heavy class conforming to IS: 1239. All liquid lines and instruments lines shall however be of copper only. Refrigerant plumbing for centrifugal/ screw type chilling machine shall be of mild steel or wrought iron / copper to manufacturer's standards. Valves shall be of the packed, back-seating type for both copper and MS refrigerant plumbing work, and these shall be of forged or cast brass construction.

Pressure Testing:

i) After completion of the piping installation, the entire chilling unit shall be pressure tested with dry nitrogen or any other inert gas at the following pressures for the particular refrigerant to be used: -Refrigerant Test pressure (Kg./Sq.cm. (Gauge)High pressure side Low pressure sideR-134a This test shall be carried out as follows: -

a)The system shall be charged with nitrogen or inert gas to 1.0 Kg./sq.cm. gauge and all joints shall be checked for leakage with a mixture of four part water, one part liquid soap and a small amount of glycerin. Leaks shall be marked, pressure released and repairs done. Brazed joints, which leak, shall be opened and redone. These shall not be repaired by addition of brazing alloy to the joints.

b)The system shall now be charged with nitrogen or the inert gas to the pressure specified in the above table and the process of locating leaks and repairs shall be repeated.

ii)Final pressure test :After all the leaks have been repaired, the system shall be retested with the test pressure maintained for a period of not less than 8 hours. No measurable drop in pressure should be detected after the pressure readings are adjusted for temperature changes. Pressure gauges, controls and compressors may be valve off during pressure testing. coil circuit should be sized for adequate water velocity but not exceeding 1.8 m/s. The air velocity cross the coil shall not exceed 155 m/min.

Fan : This shall consist of two light weight aluminum impellers of forward curved type, both statically and dynamically balanced, along with properly designed GI sheet casings. The two impellers shall be directly mounted on to a double shaft, single phase multiple winding motor capable of running at three speeds.

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

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

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

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

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

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

INSULATION :The drain pan shall be insulated as per para PAINTING

Any pathogens growing in the stagnant tank will also be dispersed in the air. Ultrasonic humidifiers should be cleaned regularly to prevent bacterial contamination from being spread throughout the air. The amount of minerals and other materials can be greatly reduced by using distilled water, though no water is absolutely pure. Special disposable demineralization cartridges may also reduce the amount of airborne material,

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

i)Pressure gauges at the inlet and outlet of the coil with tubing and gauge cock.

ii)Stem type thermometers at the inlet & outlet of coil with tubing & gauge cock.

iii)Butterfly valve at the inlet and outlet of coil.

iv)Balancing valve at the outlet of coil.

v)Y-strainer at the inlet of coil.

vi)Motorised 3-way diverting/ mixing valve along with proportionate thermostat. Controls The air handling unit shall be so installed as to transmit minimum amount of vibration to the building structure. Adequate vibration isolation shall be provided by use of rubber/ neoprene pads and/or vibration isolation spring mountings.

FAN COIL UNITS: General -The fan coil units shall be floor/ wall/ ceiling mounted draw through type complete with finned coil, fan with motor, insulated drain pan, cleanable air filters and fan speed regulator and other controls as described. Casing The casing shall be fabricated out of minimum 1.25mm thick G.S.S. sheet. Cooling coil The coil shall be of seamless copper tubes with aluminum fins. The fins shall be uniformly bonded to the tubes by mechanical expansion of the tubes.

The MICROPROCESSOR CONTROLLER: Each chilling unit shall be complete with a microprocessor based interactive control console in a locked enclosure factory mounted (directly on the unit), prewired with all operating and safety controls and tested. It will provide start, stop, safety, interlock, capacity control and indications for operation of the chiller units through a alphanumeric / graphical display. Controls shall provide to view and change digital programmable essential set points, cause of shutdown and type of restart required. a)Leaving chilled water temperature, b)Percent current limit.c)Remote reset temperature range. All safety and cycling shutdowns shall be enunciated through the alphanumeric/ graphical display and consist of day, time, cause of shutdown and type of restart required. Cycling shutdown shall include low leaving chilled water temperature, chiller/ condenser water flow interruption, power fault, internal time clock and anti-recycle. Safety shutdowns shall include low oil pressure, high compressor discharge

temperature, low evaporator pressure, motor controller fault and sensor malfunction.

The default display screen shall indicate the following minimum information

- i) date and time
- ii) return and leaving chilled water temperatures
- iii) return and leaving condenser water temperatures
- iv) differential oil pressure
- v) percent motor rated current
- vi) evaporator & condenser refrigerant saturation temperatures
- vii) chiller operating hours (hour run) and
- viii) number of compressor starts
- ix) oil sump temperature (not required for reciprocating compressor)
- x) status message

Security access shall be provided to prevent unauthorized change of set points, to allow local or remote control of the chiller and to allow manual operation of the prerotation vanes and oil pump. The chiller shall be provided with ports compatible with open protocol building management system offered, to output all system operating information, shutdown/ cycling message and a record of last four cycling or safety shutdowns to a remote printer (option) . The control centre shall be programmable to provide data logs to the printer at a set time interval. Control centre shall be able to interface with an automatic controls system to provide remote chiller start/ stop; reset of chilled water temperature, reset of current limit, and status messages indicating chiller is ready to start, chiller is operating, chiller is shut down on a safety requiring reset and chiller is shut down on a recycling safety.

The microprocessor control system shall include the interlocking of compressor motor with chilled and condenser water flows, guide vane position of compressor in case of centrifugal units and lubricating oil pump pressure. On initiation of start, the microprocessor control system shall check all pre-start safeties to verify that all prestart safeties are within limits. (If one is not, an indication of the fault will be displayed and the start aborted).

INSTALLATION: The complete chilling unit shall be installed over a RCC foundation and shall be adequately isolated against transmission of vibrations to the building structure. Special attention shall be paid to the alignment of the driving and driven shaft. Final alignment shall be checked at site in presence of the Engineer-in-charge using a dial indicator. Necessary foundation bolts, nuts, leveling screws etc wherever required for mounting the unit shall be provided by the contractor.

PAINTING: The equipment shall be supplied as per manufacturer's standard finish painting

CENTRIFUGAL COMPRESSORS (CONSTANT SPEED AND VARIABLE SPEED)

Type- Centrifugal compressor shall be open/ semi-sealed type. It shall be AHRI/Eurovent certified.

It shall be working on CFC and HCFC free refrigerant. It shall work on HFC-A1 (Only R134A) or HFO –A1/B1 refrigerant as per ASHRAE/NBC 2016 allowed standard. The impeller shall be of shrouded design and made of cast aluminium alloy of high strength and protected against corrosion. This shall be statically and dynamically balanced and over speed tested, so as to ensure vibration free operation. The impeller shaft or drive end of the gear shaft, as the case may be, shall be connected with the motor through a flexible coupling in case of open design and rotor shaft in case of hermetic design. The compressor casing shall be of high strength ductile casting and of such design that servicing can be carried out without disturbing connections. Drive gear 49 made up of the evaporator & evaporator fan. The compressor can be provided along with the condenser or the evaporator depending upon the manufacturer's practice or the required application at site.

ii). The compressor motor shall be interlocked with the following:

i) Air flow switch in the evaporator fan discharge.

ii) Air flow switch in the condenser fan discharge.

Interlocking : The compressor motor shall be interlocked with the following:

i) Air flow switch in the evaporator fan discharge

ii) Differential pressure switch in the condenser water line

iii) Condenser water pump

iv) Cooling tower fan motor

Filters

i) Cleanable aluminum wire mesh/ synthetic media type air filters, at least 25 mm thick, shall be provided, swung fit to prevent air by pass.

ii) Face velocity across the filters shall not exceed 100 m/min. Humidification Where close control of RH is required provision of pan type humidifier shall be made as per specifications. Micro process controller Each packaged units shall be equipped with a micro-processor controller having all operating & safety controls. Insulation of packaged units shall be as per specification. Power Consumption Rating for Packaged Air Conditioner under test conditions Cooling Capacity Maximum Power Consumption in Watts Tons of Refrigeration Water Cooled Air Cooled

AIRCOOLED PACKAGED TYPE PLANTS

Scope : This chapter covers the requirements of packaged type air-conditioning plants with air-cooled condensers of 5, 7.5, 10 ,15 and 20 TR capacities. General Construction The air-cooled package unit shall be supplied in two portions –outdoor portion made up of the condenser & condenser fan and indoor unit

i) The centrifugal compressor shall be preferably variable speed.

ii) The variable speed compressor shall have compressor/ chiller manufacturer's factory matched variable speed drive.

iii) Where the impeller is designed for operation at speed higher than the drive motor, necessary speed increasing gear shall be connected to the impeller shaft in a self aligning and balanced way. The gears and pinion shall be pressure lubricated.

ii) Variable speed drive (VSD) drive shall be installed with appropriate controls in accordance with section

iii) Bearings : The compressor shall incorporate the necessary design features to take both axial and radial thrusts. The bearings shall be of self aligning type. The bearing shall be

pressure lubricated during operation and shall be completely sequenced and interlocked with the startup of the machine in such a way that oil pump should start earlier than the machine and the machine should start after some time, provided the required oil temperature and pressure is maintained during the startup period.

- iv) Shaft seal : The compressor shaft seal (in case of open type machines) shall be as per manufacturer's standard design. The seal should have small face area and low rubbing speed. It should provide an efficient seal under both vacuum and pressure lubricated during compressor operation. The seal must effectively prevent the leakage of refrigerant along the shaft during shut down periods. During operation an oil film should prevent outward leakage of refrigerant.
- v) Lubrication system : Lubrication system must ensure complete forced and speed lubrication (at a pressure and controlled temperature) to all bearing surfaces under any speed conditions, at start up, at shut down and during operation at various loads. Adequate arrangement shall be provided to take care of lubrication during failure of power or abnormal shutdown. Full lubrication must be available to the machine during acceleration and deceleration periods through an automatic auxiliary motor driven pump. The lubrication system should include the following:

a) Filter mesh size shall be as per manufacturer's standard.

b) Oil level indicator: Oil coolers and oil heaters (with built-in thermostat to aid maintaining constant temperature) The compressor shall be complete with all accessories such as drive arrangement (for open drive machines), capacity control, safety controls.

Capacity Control :

a) The compressor shall be equipped for modulating the capacity from 100% upto the 20% at constant condenser entering water temperature without surging and hot gas bypass. The pre rotation vanes located at the impeller inlet for controlling the capacity shall be aero foil shaped and shall be made as per manufacturer's standard. The vane position shall be controlled through hydraulic/ linkage system.

b) The positioning of the vane shall be through microprocessor-based controller with its sensing elements in the outgoing chilled water lines. The automatic damper will enable maintenance of specified chilled water temperature within ± 0.11 deg C. Safety Control : Safety controls shall be provided as per specifications — Equipment Safety controls. Inter locking It shall be as per specifications Drive motor:

i) The drive motor shall be an independent and coupler type or semi-hermetic/ hermetic type depending on the design adopted by the manufacturer.

ii) The electric motor shall be of squirrel cage type and shall be suitable for operation on 400/415 V $\pm 10\%$, 3 phase, 50 Hz, AC supply. All Compressor motors in Screw and Centrifugal chillers with variable speed compressors shall be provided with VFD and shall also be suitably designed for use with Variable Frequency Drive.

iii) Synchronous speed of the motor shall not exceed 3000 RPM.

iv) Continuous BHP rating of the motor shall not be less than the maximum power requirement of the compressor and drive under specified design conditions.

v) The motor shall be TEFC or SPDP as per installation requirement for open type chiller unit and Totally Enclosed refrigerant cooled for hermetic / semi hermetic type chiller unit. For outdoor (exposed to atmosphere) chiller applications, TEFC motor shall be used .

vi) Motor protection during over current shall be provided through winding temperature sensor in case of refrigerant cooled motors/ current sensing in each phase through microprocessor in case of open type air cooled motors.

vii) Power factor correction capacitors as required to maintain a displacement power factor of 95% at all load conditions shall be provided.

Control Console : Drain valve, air vent, test cock connection, facility with valves for descaling of tubes etc. Cooling Coil

i) Cooling coil shall be 3 or 4 rows deep, as per manufacturer's standards, made of copper tubes of minimum 0.5 mm thickness and aluminium fins of minimum 0.15 mm thickness, mechanically bonded to the coils.

ii) No of fins per cm of tube shall be 4 to 5.

iii) Coil shall be fitted with equalizing copper distributor to ensure that each coil circuit receives equal amount of refrigerant.

iv) The coil shall be designed for a face velocity of not more than 155m/min. Coil shall be thoroughly evacuated, dried and pressure tested to 21 Kg /sq.cm (300 psi).

Refrigerant Plumbing:

i) The unit shall be complete with refrigerant plumbing using copper tubes. Plumbing work shall be in accordance of these specifications.

ii) The refrigerant circuit shall include thermo-static expansion valve and suction gas strainer.

iii) The work shall include provision of suction line insulation as per manufacturer standards.

Fan and Drive

i) Fan shall be statically and dynamically balanced single/double inlet centrifugal type, designed for quiet operation. The fan wheel shall be constructed of aluminium or galvanised steel. Self-oiling bearing easily accessible for maintenance, with thrust collar shall be provided. Preferably, the bearings shall be life lubricated sealed type, mounted on vibration absorbing resilient supports.

ii) The fan shall be belt driven through adjustable pulley permitting air quantity to be varied by adjusting the fan speed. Suitable fan belt tension adjusting arrangement shall be provided.

iii) The fan motor shall be mounted within the cabinet. This shall be of TEFC enclosure, squirrel cage, induction motor of suitable HP for the duty involved. This shall be located with proper alignment with fan pulley for the belt drive.

iv) Starter (DOL) and independent SPP shall be provided.

v) The CMH and static pressure of the fan shall be as specified in the schedule of work. A conditioned air outlet from the cabinet should be provided with suitable flanges in order to connect it to the canvas of the supply air ducting at the cabinet top.

vi) A return grill of streamlined design shall be provided in the elevation in front of the filter section. This grill should be easily removable for inspection / maintenance of filter.

Compressor:

i) Compressor shall be scroll hermetic or semi hermetic type suitable for CFC/HCFC free refrigerant.

ii) It shall be fitted with suction and discharge stop valves, permitting full servicing facilities, built in safety controls, filters, release valves, control valve and other standard accessories.

iii) The compressor shall be installed on vibration isolating resilient material, so as to ensure operation with the minimum noise and vibrations.

iv) Each compressor shall be provided with protection against high refrigerant pressure and low refrigerant pressure, anti-cycle timer, indication lamps, fault alarm etc through microprocessor controller.

v) Compressor shall be designed for 4.4 deg C suction temperature and 43.3 deg C discharge temperature.

Compressor Drive:

i) The compressor motor shall be squirrel cage induction motor capable of continuous operation at 415 V +10% , 50 Hz, 3 phase AC supply.

ii) The motor shall be suction cooled, in case of sealed semi-hermetic type units.

iii) The starter shall be as per para 13.9 and shall be provided on the packaged unit itself.

Condenser:

i) Condenser shall be of horizontal shell and tube construction with M.S. shell and integrally finned copper tubes. Thickness of tube shall be minimum 1.0 mm before finning.

ii) The end covers shall be removable type and suitable provision shall be made in the unit cabinet, enabling easy cleaning of condenser tubes.

iii) The condenser shall serve as liquid receiver for the refrigerant circuit & shall be complete with following: -

a) Inlet and outlet refrigerant connections.

b) Inlet and outlet water connections.

c) Relief / purge valve and connections.

The chiller shall be controlled by a stand-alone microprocessor based control center. The chiller control panel shall provide control of chiller operation and monitoring of chiller sensors, actuators, relays and switches. The chiller control panel shall also provide: 1. System operating information including:

i) return and leaving chilled water temperature

ii) return and leaving condenser water temperature

iii) evaporator and condenser saturation temperature

iv) differential oil pressure

v) percent motor current

vi) evaporator and condenser saturation temperature

vii) compressor discharge temperature

viii) oil reservoir temperature

ix) compressor thrust bearing positioning and oil temperature

x) operating hours

xi) number of compressor starts

Digital programming of set points through the universal keypad including:

- i) leaving chilled water temperature
- ii) percent current limit
- iii) pull-down demand limiting
- iv) six-week schedule for starting and stopping the chiller, pumps and tower
- v) remote reset temperature range

Status messages indicating:

- i) system ready to start
- i) system running
- ii) system coast down
- iii) system safety shutdown-manual restart
- iv) system cycling shutdown-auto restart
- v) system pre-lube
- vii) start inhibit

The text displayed within the system status and system details field shall be played as a color coded message to indicate severity: red for safety fault, orange for cycling faults, yellow for warnings, and green for normal messages. 5. Safety shutdowns enunciated through the display and the status bar, and consist of system status, system details, day, time, cause of shutdown, and type of restart required. Safety shutdowns with a fixed speed drive shall include:

- a) evaporator – low pressure
 - i) evaporator – transducer or leaving liquid probe
 - ii) evaporator – transducer or temperature sensor
 - iv) Condenser – high pressure contacts open
 - iii) condenser –high pressure
 - vi) condenser –pressure transducer out of range
 - vii) auxiliary safety –contacts closed
 - viii) discharge –high temperature
 - ix) discharge –low temperature
 - x) oil –high temperature
 - xi) oil –low differential pressure
 - xii) oil –high differential pressure
 - xiii) oil –sump pressure transducer out of range

- xiv) oil –differential pressure calibration
- xv) oil –variable speed pump –pressure set point not achieved
- xvi) control panel –power failure
- xvii) motor or starter –current imbalance
- xviii) thrust bearing –proximity probe clearance
- xix) thrust bearing –proximity probe out –of –range
- xx) thrust bearing –high oil temperature
- xxi) Thrust bearing –oil temperature sensor
- xxii) Watchdog –software reboot.

Safety shutdowns with a VSD Shall include:

- b) VSD shutdown –requesting fault data
- iv) VSD –stop contacts open
- v) VSD –110 % motor current overload
- vi) VSD –high phase A, B,C inverter heat-sink temp.
- vii) VSD –high converter heat-sink temperature

Cycling shutdowns enunciated through the display and the status bar, and consists of system status, system details, day, time, cause of shutdown, and type of restart required. Cycling shutdowns with a fixed speed drive shall include:

- c) multiunit cycling –contacts open
- ii) system cycling –contacts open
- iii) oil –low temperature differential
- iv) oil –low temperature
 - iv) control panel –power failure
 - v) leaving chilled liquid –low temperature
 - vi) leaving chilled liquid –flow switch open
 - vii) motor controller –contacts open
 - viii) motor controller –loss of current
 - ix) power fault
- xi) control panel –schedule

- x) starter –low supply line voltage
- xi) starter –high supply line voltage
- xii) proximity probe –low supply voltage
- xiii) oil -variable speed pump -drive contacts open

For variable speed compressor

a) In Case of VSD starter, it will vary the compressor motor speed by controlling the frequency and voltage of the electrical power to the motor. The adaptive capacity control logic shall automatically adjust motor speed and compressor pre-rotation vane position independently for maximum part-load efficiency by analyzing information fed to it by sensors located throughout the chiller.

b) To Limit Harmonic generation from VSD, Active Harmonic Filters as per IEEE 519 must be used at the source itself.

c) Drive will be PWM type utilizing IGBT's with a power factor of 0.95 or better at all loads and speeds.

d) Make of VSD shall be exactly same as per OEM/approved make list. The variable speed drive shall be with all power and control wiring between the drive and chiller factory installed, including power to the chiller oil pump. The VFD of chiller may preferably be unit mounted, but standalone VFD is also acceptable. In both cases, it should be factory fitted.

e) Field power wiring shall be a single point connection and electrical lugs for incoming power wiring will be provided.

iii) The following features will be provided:

- (a) Door interlocked circuit breaker capable of being padlocked.
- (b) UL listed ground fault protection.
- (c) Over voltage and under voltage protection.
- (d) 3-phase sensing motor over current protection.
- (e) Single phase protection.
- (f) Insensitive to phase rotation.
- (g) Over temperature protection.

Digital readout at the chiller unit control panel of output frequency, output voltage, 3-phase output current, input Kilowatts and Kilowatt-hours, self-diagnostic service parameters. Separate meters for this information will not be acceptable. For capacity > 300 TR, IKW/TR shall not exceed 0.054. For variable speed compressor IPLV of the compressor shall not exceed 0.35.

Section 2

I. Pumps

SCOPE: This chapter covers the general requirements of water circulating pumps for central air-conditioning, central heating, ETAC and cold room applications. This section does not cover either humidification pumps or spray pumps for spray over coils.

2.1 TYPE:

The pumps shall be skid mounted vertical inline centrifugal type direct driven with a 3 phase, 415 + 10%volts, 50 Hz., A.C. motor. The motor for Chilled Water Pumps shall be integrated/mounted with Variable Frequency Drive. The motor starter for Condenser Water Pump shall be in accordance. The motor shall be screen protected drip proof (SPDP) fan cooled or TEFC type. The efficiency class of motors shall be IE 3 class as per IS 12615. The pumps may be either of vertical split casing (HSC) type with operating speed not exceeding 1500 rpm, or solid casing, mono block type with operating speed not exceeding 3000 rpm as specified in the tender documents. Efficiency of the pumps at selection should be preferably 70 % or above.

2.2

RATING

The pumps shall be suitable for continuous operation in the system. The head and discharge requirements shall be as specified in the tender documents. The discharge rating shall not be less than the flow rate requirement of the respective equipments through which the water is pumped. The head shall be suitable for the system and shall take into consideration the pressure drops across the various equipments and components in the water circuit as well as the frictional losses. The pumps offered shall be of high efficiency. Pump motors greater than or equal to 3.7 kW (5 hp) shall be controlled by variable speed drives.

2.3

MATERIAL AND CONSTRUCTION

- i)The centrifugal pumps shall conform to IS1620/HI standard. ii)The pump casing shall be of heavy section close grained cast iron. The casing shall be provided with air release cock, drain plug and shaft seal arrangement as well as flanges for suction and delivery pipe connections as required.
- xxi) The impeller shall be of bronze or gunmetal. This shall be shrouded type with machined collars. Wear rings, where fitted to the impeller, shall be of the same material as the impeller.
- iv)As far as possible, long radius elbows and gradual changes in shape shall be used to maintain uniform velocity accompanied by decreased turbulence, lower resistance and minimum noise. The ratio of the size of the duct to the radius of the elbow shall be normally not less than1:1.5.
- v)Flanged joints shall be used at intervals not exceeding 2500 mm. Flanges shall be welded at corners first and then riveted to the duct.

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

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

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

Air Outlet and Inlets (Supply and Return)

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

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

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

iv) Circular ceiling outlets/intakes shall have either flush or anti smudge outer cone as specified in the tender specifications. Flush outer cones shall have the lower edge of the cone not more than 5 mm below the under side of the finished ceiling into which it is fitted. Anti smudge cones shall have the outer cone profile designed to reduce dirt deposit galvanized steel sheets, in case of G.I. sheet ducting or 1.8 mm thick aluminium sheet, in case of aluminium sheet ducting and shall be stiffened with 25 mm x 25 mm x 3 mm angle iron braces.

v) Circular ducts, where provided shall be of thickness as specified in IS:655 as amended up to date.

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

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

ii) Flanges for matching duct sections, stiffening angles (braces) and supporting angles

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

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

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

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

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

iii) All the ducts upto 600 mm longest side shall be cross broken between flanges by a single continuous breaking. Ducts of size 600 mm and above shall be cross broken by single continuous breaking between flanges and bracings. Alternatively, beading at 300 mm centres for ducts upto 600 mm longest side, and 300 mm centers for ducts above 600 mm size shall be provided for stiffening shall be smooth finished for minimum frictional loss. The impeller shall be secured to the shaft by a key.

iv) The shaft shall be of stainless steel and shall be accurately machined. The shaft shall be balanced to avoid vibrations at any speed within the operating range of the pump.

v) The shaft sleeve shall be of bronze or gunmetal. This shall extend over the full length of the stuffing box or seal housing. The sleeve shall be machined all over and ground on the outside.

vi) The bearings shall be ball or roller type suitable for the duty involved. These shall be grease lubricated and shall be provided with grease nipples/cups. The bearings shall be effectively sealed against leakage of lubricant.

vii) The shaft seal shall be stuffing box type unless otherwise specified, so as to allow minimum leakage compatible with the operation of the seal. The stuffing box shall be of adequate length and shall be packed with graphite asbestos or any other suitable material for the operating temperature. A drip well shall be provided beneath the seal.

viii) In the case of HSC pumps, the same shall be directly coupled to the motor shaft through, a flexible coupling protected by a coupling guard. In case of mono block pumps with solid casing, the motor and pumps shall be on a common shaft.

ix). ACCESSORIES Each pump shall be provided with the following accessories: -

a) Pressure gauges at suction and discharge sides,

b) Butterfly valves on suction and discharge, and

c) Reducers, as may be required to match the sizes of the connected pipework.

d)Non—return valve at the discharge.

INSULATION The thermal insulation of the pump casing for hot/chilled water circulating pumps shall be of the same type and thickness as provided for the connected pipe work

INSTALLATION i)The pump and motor assembly shall be skid mounted and arranged for ease of maintenance and to prevent transmission of vibration and noise to the building structure or excess vibration to the pipe work.

PAINTING The pumps shall be supplied with the manufacturer's standard finish painting.

VARIABLE FLOW HYDRONIC SYSTEMS

Variable Fluid Flow in Chilled or Hot Water System Secondary Chilled or hot-water systems shall be designed for variable fluid flow and shall be capable of reducing pump flow rates to no more than the larger of: a)50% of the design flow rate, or the minimum flow required by the equipment manufacturer for proper operation of the chillers, or boilers.8.9.2Automatic Isolation Valves Water cooled air-conditioning or heat pump units with a circulation pump motor greater than or equal to 3.7 kW (5 hp) shall have two-way automatic isolation valves on each water cooled air-conditioning or heat pump unit that are interlocked with the compressor to shut off condenser water flow when the compressor is not operating .

Section-3 Cooling Tower

COOLING TOWERS

SCOPE

This chapter covers the general requirements of cooling towers for packaged units, central air-conditioning plants and cold rooms.

TYPE

The cooling tower shall be of Mechanical draft type. Fan on Mechanical draft towers may be on the inlet air side or exit air side. In case of former it is called forced draft type and in case of later it is called Induced draft type. On the basis of direction of air flow and water flow, Mechanical draft cooling tower can be counter flow or cross flow type as per the manufacturer design. This may be of any of the following construction as may be specified in the tender specifications:-

- a)In wooden construction with wood or PVC fill and RCC basin,
- b)In fiber glass reinforced plastic (FRP) construction with PVC fill and FRP basin,
- c)In masonry construction. The mechanical draft cooling towers of wooden construction and masonry construction, being un-common now, have been excluded from the scope of these specification.

DESIGN

- i)Rating :The cooling tower shall be rated for the heat rejection capacity specified in the tender specifications. All cooling towers shall be certified by CTI (Cooling Tower

Institute).

ii)Range: The Cooling tower shall be designed to cool the requisite quantity of water through 4.2 degree C or as specified in the tender specifications, against the prevailing wet bulb temperature.

iii)Wet Bulb approach: The cooling tower shall be selected for a wet bulb approach of not more than 2.77 degree C.

iv)Outlet temperature: The cold water temperature from the cooling tower shall match the entering temperature for which the condenser selection is made.

v)Flow rate: The water flow rate through the cooling tower shall match that through the condenser.

vi)Multi cell design :The induced draft cooling tower shall be of one or more cells.

vii)Drive Motor : The fan motor shall be premium efficiency IE3 class , as per IS 12615.7.4

MATERIAL AND CONSTRUCTION : Fibre glass Reinforced Plastic (FRP) Cooling tower

i)The structural framework of the cooling tower including all members shall be designed for the load encountered during the normal operation of the cooling tower and its maintenance. The structure shall be rugged and rigid to prevent distortion and shall include tie arrangements as may be necessary.

ii)The cooling tower shall be induced draft type, with FRP casing in square/ rectangular/ octagonal/ circular shape, and with an FRP base to match the shape of the casing.

iii)The air intake shall be from openings all along the circumference of the casing near its base in case of circular shape. Air Intake shall be along the sides in case of square or octagonal/ rectangular cooling tower. These openings shall be covered with hot dip galvanised expanded metal mesh screens.

iv)The basin shall have a holding capacity adequate for operation for at least 30 minutes without addition of make-up water to the basin. The construction should be such as to eliminate the danger of drawing air into the pump when operating with minimum water in the basin. v)The basin fittings shall include the following: -

a)Bottom /side outlet,

b)Drain connection with valve,

c)Ball type automatic make-up connection with valve,

d)Overflow connection,

e)Bleed off with valve, from inlet header to overflow pipe.

vi)The supporting framework for the tower casing and the water basin shall be made of hot dip galvanized steel and it shall be further protected with epoxy painting.

vii)The filling shall be of PVC. Thickness of PVC fills shall not be less than 0.2mm. These shall be of such construction as to provide low air resistance, large wetted surface for a high heat transfer efficiency, and easy replace ability.

viii)The water distribution may be either through self-rotating or fixed type sprinklers or through balancing, sub balancing and spreader troughs(unpressurised system) —open gravity type with polypropylene nozzle, 105. A bird wire screen made of 12 mm mesh in 1.6 mm steel wire held in angle or channel frame shall be fixed to the rear face of the louver frame by screens.

Fresh Air Intakes

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

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

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

iv)Additional intermediate equally spaced supports and stiffeners shall be provided to prevent sagging/ vibrating of the louvers, at not more than 750mm centres where the louver's length is longer than 750mm ensuring uniform water loading and distribution of water over the fill. All pipes and fittings shall be of PVC. The sprinklers shall operate from the residual velocity head at the headers. Due care shall be taken with regard to corrosive effects and maintainability in the design of the water distribution system.

v)Drift eliminators of PVC shall be provided for maximum removal of entrained water droplets. The spacers and tie rods used shall be of plastic material.

vi)The fan shall be multi-blade axial flow type, made of aluminium alloy or FRP. The fan assembly shall be statically and dynamically balanced.

vii)The fan drive shall be from a three phase induction motor of efficiency class IE3 as per IS 12615, either direct or through a spiral gear work. The entire drive arrangement shall be designed for a minimum noise and it shall be rigidly supported to the tower structure.

viii)The motor starter shall be in accordance with specification.

ix)To ensure safety of personnel at the time of working on cooling tower a steel ladder shall be provided in such a manner and location as necessary to give safe and complete access to all the parts of the cooling tower requiring inspection or adjustments. The ladder shall be bolted to the tower at the top and grouted in masonry at the bottom end.

INSTALLATION : The cooling tower shall be installed on pre FRP coated M.S. girders fixed in masonry foundations with cement concrete footing. Second class brick work and cement mortar having one part cement & six parts sand shall be used for the masonry work. 12mm sand cement plaster shall be provided over the brick work. These may be located at a well-ventilated place either at ground level and contiguous to the plant room, or on the terrace of the building in consultation with the Architect. In case the cooling towers are located on the terrace of the building, the structural loading of the terrace shall be considered. For this respective columns are to be raised by two feet at the terrace. Cooling towers shall be installed in such a way that their load is transferred directly to the columns for which necessary Mild steel-I sections shall be provided by the air-conditioning

contractor. The cooling towers shall be rested on Mild Steel-I sections & not on terrace slab. Sufficient free space shall be left all around for efficient operation of the cooling tower. Cooling tower shall be not less than 75cm above the ground/ floor level unless otherwise stated in the tender specifications. 6mm neoprene pads shall be placed between the tower and the girder for vibration isolation whereas directed by the Engineer-in-charge. Guy-wires of suitable sized shall be used to secure firmly to its base wherever necessary.

PAINTING: The cooling towers shall be supplied with the manufacturer's standard finish painting.

Section-4 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, have to be used.

- Expansion, pressurization and de-aeration of the chilled water system to be provided by an integrated unit comprising of Pressure-less expansion tank, coalescing pall rings, Pressurization unit c/w Pump fittings and state of the art digital controller & with twin pumping system.
- Vessel volume shall be calculated according to the system expansion volume. Every vessel in the unit shall have the same size. Levelling of the vessel shall be facilitated by adjustable feet. Condensate drain cock shall be installed within the base of the vessel. Efficiency of the vessel volume shall be minimum 80%. A coalescing (PALL RINGS) de-aerator shall be installed within the inlet of the expansion vessel providing removal of micro-bubbles >15 µm. An automatic air vent with air intake preventer must installed on the top of the vessel. The expansion vessel(s) shall be fitted with a replaceable butyl rubber bladder with rupture sensor in accordance with DIN 4807-3. As unit is subject to atmospheric pressure, tank pressure rating should be 6 Bar. Maximum continual working temperature of the bladder shall be 70 °C (158 °F). Main vessel must have a weight sensor and therefore must be connected to the Pressurization unit using flexible hoses. RAL 3002 epoxy powder coating. The use of secondary vessel & level sensor is not necessary.

- The pressure-less expansion vessel(s) shall be cylindrical, welded and comply to EN 13831:2007.
- Manufactured and designed in accordance with European Pressure Equipment Directive PED 2014/68/EC.
- The pressurization unit shall be sized appropriate to the total system expansion volume and maximum operating pressure.
- System pressure shall be regulated within ± 0.2 bar (2.9 psi) of the set pressure. High and low pressure alarm setting shall be selectable by the user.
- Top-up function shall be programmed according to system requirements. The unit shall be fitted with an integral, adjustable flood limiter to shut down the system in the event of a serious leak. Water level in the expansion vessel(s) shall be maintained to a minimum value.
- Flexible Connection must include a de-aeration sensor for signaling the controller to continue/stop the active de-aeration.
- Backflow Preventer c/w, water meter, ball valve and non-return valve, strainer/Particle filter/ and shut-off valve according to DIN 1988 and DIN EN 1717 in top up connection.
- The pressurization unit shall have two Flow regulating, solenoid valve in spill lines with duty/standby/assist function to avoid pressure peaks in the system and a safety relief valve for protection of vessel, two multistage pumps (orientation vertical/horizontal) with non-return valve, The use of electrically actuated ball valve in the spill line is not permitted since it takes time to react and increases pressure peaks which leads to malfunctioning of the system.
- The controller shall display the vessel contents, system pressure and status of the main operating components in real-time on the graphical display. This acts as confirmation that pump(s) or valves are operating and responding as required, while also verifying the system setup.
- The controller shall regulate the pump unit to provide duty/standby or parallel/backup operation and shall be selectable in dual pump units.
- Controller shall display fault code and generate the alarm in case of any fault situation.
- Pressurization unit shall be factory assembled. The product shall be installed according to the manufacturer's instructions using manufacturer's approved components.
- The unit shall be BMS compatible with RS 485 communication protocol.
- The controller shall be Microprocessor based touch screen with IP54 protection class.

3.8 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:

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.

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

xi) 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.

3.9 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 10 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.

3.10 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.

3.11 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.

Section 5:- DIRT SEPARATOR

Dirt Separators - Furnish and install In-Line (600 mm) Microbubble type flanged steel Dirt Separator suitable for maximum pressure of 1600 Kpa (16bar) and 110 deg C operating temperature and sized for the full capacity / flow. The MS tank shall be heavy duty with external anti corrosion painting.

The entering velocities not to exceed 1.2 meters per second at specified flow rate. Units specifically designed for high velocity systems may have an entering velocity of up to 3.0 meters per second. The separator must conform to design as per Pressure Equipment Directive PED (2014/68/EU) standards. The material standard shall be EN/ISO: S235JR

The core element is a tube mesh construction and the flow to be guided through an area with a greater cross-section than the connection dimensions in order to reduce the flow. The ensuing turbulence caused by the tube mesh causes heavy dirt particles to move to the bottom of the vessel from where they can be drained out and also be with magnetic separation facility. The Dirt separator shall be able to remove effectively dirt particles down to 4 microns. There shall be high capacity auto air vent.

The pressure drop across the dirt separator shall not exceed 0.5 bar.

Section-8: PIPING

PIPE MATERIALS

8.1 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.

8.2 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.

Screw 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.

Section 9

INSULATION WORK

9.1 SCOPE

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

9.2 Material for Chiller Insulation.

*Supply and installation of **XLPE**- Chemically Cross Linked Closed Cell Polyethylene foam in **black color with extra flexibility and UV resistive** thermal insulation with nominal density of the material shall be **30 kg/m³ ± 10%**, having thermal conductivity of **0.0329 W/m °k at 23 °C**, mean temperature, as per IS 3346:1980. Material shall be resistant to growth of Fungus as per **ASTM C 1338** and resistant to growth of Bacteria as per **ASTM E 2180** for applying on the chiller. **The minimum thickness for chiller insulation shall be 50 mm in multi layers. The top layer shall be with UV painted factory manufactured glass cloth (Preferably grey or as approved by Engineer In Charge).***

*Fire characteristics shall confirm to **BS 476 Part 7, Class 1**, for Surface Spread of Flame and meet requirement of Fire Propagation as per **BS 476 Part 6**, having an index **(I) of 5.06** with lamination and **5.17** for plain materials and sub-indices $i_1(2.71)$; $i_2(1.65)$; $i_3(0.70)$. Visibility due to smoke shall confirm to Class A as per Standard UIC 564 – 2 Appendix 15.*

*Compliance to **BS EN 13501-1:2007 + A1:2009** (Reaction to fire performance) for 25 mm thickness sheet with Alupet + self - adhesive with classification **BS1D0** in category of combustible thermal insulation with less fire propagation, low heat emission, zero smoke and zero fire droplets.*

*Compliance to **UL 94 HF -1&ASTM E84** with results **FSI-15** and **SDI-5**.*

9.3 MATERIAL-TYPES

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

- 9.3.1 For insulation of water piping, pumps and tanks:-
 9.3.1.1 Expanded polystyrene(T.F. Quality)
 9.3.1.2 Resin bonded glasswool
 9.3.1.3 Polyvinyl Nitrile (Closed cell rubber foam)
 9.3.1.4 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.

- 9.3.2 For Insulation of duct work:-
 (a) Resin bonded glasswool.
 (b) Polyvinyl Nitrile (Closed cell rubberfoam)
 9.3.3 For acoustic lining of duct work and AHU rooms:-
 (a) Resin bonded glasswool.
 (b) Resin bonded mineralwool.
 9.3.4 For suction line, Chilled water pipe :-
 (a) Expanded Polysterene(T.F.Quality)
 (b) Polyvinyl Nitrile (Closed cell rubberfoam)

- (v) For double skinAHUs:
 (a) Polyurethane foam (PUFinsulation)

9.4 MATERIALSPECIFICATIONS

The insulation material shall satisfy the following requirements: -

- 9.4.1 For thermal application onpipes.

Material	Minimum Density (Kg/cu.m)	Maximum Thermal conductivity (K.cal/ hr. degree C/m at 10 Deg C mean temp.)
Resin bonded glass wool	32	0.031
Expanded polystyrene (TF)	20	0.035
Polyvinyl Nitrile foam	55	0.034

9.4.2 For thermal insulation of ducts:

<u>Material</u>	<u>Minimum</u>
<u>Density(Kg / cu.m)</u> Resin bonded glasswool	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.

9.4.3 For acoustic lining:

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

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

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

9.5 INSULATION THICKNESS

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

9.5.1 For pipe insulation (for chilled water as well as hot water application

Pipe Size(mm)	Glass fibre /Exp. Polystyrene(mm)
150 & below	50
Above 150	75

ii) For Duct insulation

Application	Fibre glass (mm)
Thermal for AC area	12.5
Thermal for Non AC area	25
Acoustic	25

iii) For room acoustic lining

Resin bonded glasswool	50 mm
Resin bonded mineral wool	50 mm

iv) For pumps:

Expanded polystyrene TF quality	50 mm
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v) Chiller Insulation

Thickness of XLPE insulation used for chiller insulation shall not be less than 50 mm.

- vi) Expansion tank
- vii) *Thickness of XLPE insulation used for chiller insulation shall not be less than 50 mm.*

9.6 APPLICATION OF INSULATION ON PIPES (including suction line insulation)

- (i) The surface to be insulated shall be first cleaned and a coat of zinc chromate primer shall be given. The insulation shall be fixed tightly to the surface with cold setting adhesive CPRX compound. All joints shall be staggered and sealed. The second layer of insulation wherever required shall be similarly applied over the first layer.
- (ii) Pipes shall be preferably pre insulated at factory, meeting the requirement or the insulation shall be finished at site asunder:
 - (a) For pipes laid inside the building, the insulation over the pipe work shall be finished with 0.63 mm thick aluminium sheet cladding over a vapour barrier of 120 gm/ sq.m. polythene sheet with 50 mm overlap and tied down with lacing wire and complete with type 3, grade-I roofing felt strip (as per IS 1322 as amended upto date) at the joints..
 - (b) For pipes outside the building laid above ground the finishing over the pipe insulation shall be finished with 0.63 mm G S sheet cladding over a vapour barrier of 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 applied by means of cold setting CPRX compound..
 - (c) For pipes outside the building laid under ground 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.

9.7 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 or XLPE insulation as per the requirement.

9.8 APPLICATION OF INSULATION ON EXPANSION TANK

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

- 9.8.1 Surface shall be thoroughly cleaned with wire brush and rendered free from all dust & grease.
- 9.8.2 The two layers of hot bitumen shall be applied.
- 9.8.3 The insulation slabs will then be fixed in one layer and joints shall be sealed with hot bitumen.
- 9.8.4 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.
- 9.8.5 The insulation shall then finally be finished with aluminium cladding of thickness not less than 0.5mm.

9.9 APPLICATION OF INSULATION (THERMAL) ON DUCT

- 9.9.1 The surface of duct on which the external thermal insulation is to be provided shall be thoroughly cleaned with wire brush and rendered free from all dust and grease.
- 9.9.2 Two coats of cold compound adhesive (CPRX compound) shall be applied over the duct. (Any other adhesive recommended by the manufacturers may also be used with the approval of the Engineer-in-charge).

9.10 APPLICATION OF DUCT LINING (ACOUSTIC INSULATION)

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

- 9.10.1 The Inside surface of duct on which the acoustic lining is to be provided shall be thoroughly cleaned with wire brush and rendered free from all dust and grease.
- 9.10.2 Then 25 x 25 sq.mm section of minimum 1.25 mm thick G.I. sheet shall be fixed on both ends of the duct piece.
- 9.10.3 The insulation slabs shall then be fixed between these section of ducts using CPRX adhesive compound and stickpins.
- 9.10.4 The insulation shall then be covered with Reinforced plastic/ fibre glass tissue **with proper overlap**, sealing all joints so that no fibre is visible.
- 9.10.5 The insulation shall finally be covered with minimum 0.5 mm thick perforated aluminium sheet having perforations between 20-40%.

9.11 APPLICATION OF ACOUSTIC LINING IN AHU ROOMS

- 9.11.1 The wall/ roof surface should be thoroughly cleaned with wire brush.
- 9.11.2 A 610x610 mm frame work of 25mm x 50mm x 50mm x 25mm shape channel made of 0.6mm thick G.S.S. shall be fixed to walls leaving 610mm from

floor by means of raw plugs in walls and dash fasteners in ceiling. Similar frame work shall also be fixed on ceiling by means of dash fasteners.

- 9.11.3 Resin bonded glass wool/ mineral wool as specified cut to size will be friction fitted in the frame work and covered with tissue paper.
- 9.11.4 Aluminium perforated sheet having perforation between 20-40% of thickness not less than 0.8mm shall be fixed over the entire surface neatly without causing sag/ depression in between and held with screws. Sheet joints should overlap minimum 10mm.
- 9.11.5 Aluminum beading of 25mm wide and thickness not less than 1.00 mm shall be fixed on all horizontal/ vertical joints by means of screws.

9.12 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.
- b) Duct insulation and acoustic lining shall be measured on the basis of surface area along the outer surface (ref IS14164 of 2008) of insulation thickness. Thus the surface area of externally thermal insulated or acoustically lined duct shall be based on the perimeter at the centre of thickness of insulation, multiplied by the centre-line length of ducting including tapered pieces, bends, tees, branches etc. as measured for bare ducting. In the case of tapering pieces, their average perimeter shall be considered.

SECTION- 10 Valves, Y-Strainer and associated controls

CONTROLS

10.1 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.

10.2 EQUIPMENT SAFETY CONTROLS

10.2.1 Compressor:

10.2.1.1 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 cut-in 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.

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

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

10.2.2 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.

10.2.3 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.

10.2.4 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.

10.3 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.

10.3.1 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).

10.3.2 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.

10.3.3 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.

10.3.4 Compressor Capacity Control

The capacity control arrangement shall be in accordance with section I for centrifugal type compressor.

10.4 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.

10.5 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 as per para 12.2 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.

10.6 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.

5.6.1 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.

10.6.2 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.

10.6.3 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.

10.6.4 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.

10.6.5 Spray humidifiers, where specified, shall be as per details given under para 6.2.3.6.1.

10.6.6 Pan humidifiers where provided shall be as per para 6.2.3.6.2.

10.6.7 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.

10.6.8 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.

10.8 VARIABLE SPEED DRIVE (VSD)

10.8.1 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-rating 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-rating 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 thereof with necessary hardware and terminal blocks, including toggle switch etc. to override 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.

10.8.2 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 deration, 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.

10.8.3 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.

SECTION 11

WATER PLUMBING WORK

SCOPE

This chapter covers the requirements of plumbing work in chilled water, hot water, water in condenser circuit and drains, to be executed as part of heating, ventilating and air conditioning.

11.1 PLUMBING DESIGN

Pipe sizes shown in tender documents are purely for contractor's guidance. The contractor shall be responsible for selection of sizes as per detailed engineering to be done by him. Plumbing design to be done by the Air-conditioning contractor shall conform to the following:-

- i) Water velocity in pipes shall not exceed 2.5m/sec.
- ii) Butterfly/ Ball valves shall be provided at
 - a) suction and delivery sides of pumps.
 - b) inlet and outlet of each condenser, chiller, cooling tower, hot water generator.
 - c) all drain connections from equipments.
 - d) Inlet & outlet of every heat exchanger coil, namely for AHU's, FCUs's, convector etc.
- iii) Non return valve shall be provided at the delivery of each pump. This shall be of swing type.
- iv) Balancing valve shall be provided at the outlet side of chiller, condenser, heating and cooling coils to regulate the maximum flow rate upto value preset as desired.
- v) Balancing valves shall be provided, where specified, for AHU's to regulate the maximum flow rate upto a value preset as desired. A mercury manometer shall be supplied with every 10 nos. or part thereof of balancing valves, whether or not specifically indicated in the tender specifications.
- vi) Air valves shall be provided at all high points in the piping system for venting with a size of 25 mm for pipes upto 100 mm and 40 mm for larger pipes.
- vii) Plumbing drawings showing the sizes of valves, layout and other details shall be prepared and shall be got approved from the Engineer-in-Charge before the execution of the plumbing work.

11.2 PIPE MATERIALS

Pipes shall be of the following materials.

- 11.2.1 Mild steel medium class (Black steel) tube conforming to IS: 1239 for sizes upto 150mm.
- 11.2.2 Welded black steel pipe, class 2, conforming to IS: 3589, for sizes greater than 150 mm. These pipes shall be factory rolled & fabricated from minimum 6mm thick M.S. Sheet for pipes upto 350mm dia & from minimum 7mm thick M.S. sheet for pipes of 400mm dia & above.

11.3 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.

- 11.3.1 Screwed joints and union joints screwed to pipes, upto 25 mm size.
- 11.3.2 Butt welded joints for pipe sizes above 25mm. Electric welding shall be used for sizes 100mm and above.
- 11.3.3 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.

11.3.4 Flexible coupling V groove joints.

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

11.3.5.1 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.

11.3.5.2 The connections shall work for a temperature range of minus 10°C to 70°C.

11.3.5.3 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

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

11.3.5.5 These shall be capable to withstand torsional movement upto 3° without damage.

11.4 VALVES

- i) The material of butter fly valves shall be as under:
Body- Cast iron
*Disc- Cast Bronze or 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 upto 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 upto 65 mm, flanged ends shall be provided for larger sizes.
- iv) Air valves shall be of gunmetal body.

11.5 STRAINERS

- 11.5.1 Strainers shall be of 'Y' type or pot type as specified.
- 11.5.2 'Y' strainers shall be provided on the inlet side of each air-handling unit and pump in chilled water and condenser water circuit.
- 11.5.3 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.
- 11.5.4 The strainers shall be designed to the test pressure specified for the gate valves.
- 11.5.5 Filtration area of Y-strainer shall be minimum four times the connecting pipe size.
- 11.5.6 Strainers shall have a removable bronze/ stainless steel minimum 1mm thick screen with 3 mm perforations and permanent magnet.

- 11.5.7 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 mainpipe.
- 11.5.8 Strainers shall be provided with equal size isolating gate valves on either side so that the strainers may be cleaned without draining the system.
- 11.5.9 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

11.6 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 pumpsets.

The pressure gauge shall be duly calibrated before installation and shall be complete with shut offcocks.
- 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 separatewells.
- iii) Appropriate number of additional sockets shall be provided for the installation of pressure & temperature transducers forBMS.

11.7 EXPANSIONTANKS

- 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 atthe highest point of thesystem.
- iii) Valves, strainers and traps must be omitted from the expansion line since these may be accidentally turned off or becomeplugged.
- iv) Pressurized expansion tank with air separator, can be used where the conventional type expansion tank is not feasible to beprovided.

11.8 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:-

Nominal Pipe size (mm)	Spacing (Metres)
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.

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

11.9 PRESSURE TESTING

- 11.9.1 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 10 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.
- 11.9.2 Piping repaired subsequent to the above pressure test shall be re-tested in the same manner.
- 11.9.3 System may be tested in sections and such sections shall be securely capped.
- 11.9.4 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.
- 11.9.5 Insulation shall be applied to piping only after the completion of the pressure testing to the satisfaction of the Engineer-in-charge.
- 11.9.6 Pressure gauges may be capped off during pressure testing of the installation.
- 11.9.7 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.

11.10 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.

11.11 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 to complete 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 pipework.

SECTION 12:-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.

12.1 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 equipment's 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) All materials and components used shall conform to the relevant IS specifications amended to date.

12.2 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.

12.3 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-in-Charge, after taking into consideration the load, the length of cabling and the type of load.

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

12.4 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.

12.5 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:

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

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.

12.6 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.

12.7 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.

12.8 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.

12.9 MOTOR EFFICIENCY

1. All permanently wired poly-phase motors of 0.375 kW or more serving the building and expected to operate more than 1500 hours per year and all permanently wired poly phase motors of 50 kW or more serving the building and expected to operate more than 500 hours per year shall have a minimum acceptable nominal full load motor efficiency not less than IE3 class as per IS 12615 for Energy Efficient motors.

2. Motors of horsepower differing from those listed in the table shall have efficiency greater than that of the listed kW motor..

3. Motor horsepower ratings shall not exceed 20% of the calculated maximum load.

4. Motor nameplates shall list the nominal full load motor efficiencies and the full load power factor.

5. Motor users should insist on proper rewinding practices for rewound motors. If the proper rewinding practices cannot be assured, the damaged motor should be replaced with a new, efficient one rather than suffer the significant efficiency penalty associated with typical rewind practices.

6. Certificates shall be obtained and kept on record indicating the motor efficiency. Whenever a motor is rewound, appropriate measures shall be taken so that the core characteristics of the motor is not lost due to thermal and mechanical stress during removal of damaged parts. After rewinding, a new efficiency test shall be performed and similar records shall be maintained.

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

INSPECTION, TESTING AND COMMISSIONING GUIDELINES

1.1 SCOPE

This chapter covers initial inspection and testing of Chillers, Pumps, Expansion Tanks, Dirt Separator, Cooling Tower, BMS System and pre insulated pipe, valves 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.

1.2 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.

xiv) Hydraulic test at 10 Kg/sq.cm. for the Pre insulated chilled water pipe shall be carried out as per the Indian Standard.

xv) 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.

1.3 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 .

1.4 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.

1.5 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 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 . 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.*

1.6 TESTING REQUIREMENTS AND PROCEDURES

1.6.1 Balancing of all air and water systems and all tests as called for in the specification shall be carried out by the HVAC contractor in accordance with the specifications and relevant local codes if any. Performance tests of individual equipment and control shall be carried out as per manufacturer's recommendation. All tests and balancing shall be carried out in the presence of Engineer-in-charge or his authorized representative.

The whole system balancing shall be tested with microprocessor based hi-tech instruments with an accuracy + 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.

1.6.2 Air Systems:

Systems are to be balanced by first adjusting the total flow at the fan, then by adjusting main dampers and branch dampers. Only final minor adjustments are to be made with register and diffuser dampers. Balancing of

the air system shall be accomplished without causing objectionable air noise. Baffles and orifice plates required for proper air balance shall be furnished and installed by the contractor. Basically the following tests and adjustments are required.

- i) Test all fan systems to provide proper cfm/ cmh.*
- ii) Adjust fresh air, return air and exhaust dampers to provide proper air quantities in all modes of control.*
- iii) Test and record fresh air, return air and mixed air temperature at all air handling units. Test and record data at all coils after air and hydronic systems are balanced. Measure wet and dry bulb temperature on cooling coils.*
- iv) Make point tube transverse at all main supply and return ducts to set proper air quantities. Adjust all zone and branch dampers to proper cfm/cmh.*
- v) Test and adjust each register, grills, diffuser or other terminals equipment to within 5% of design air quantity. Each opening shall be defined on the test report by size, manufacturer's model, room location, design cfm and actual cfm. Outlets shall be adjusted to minimize objectionable drafts.*
- vi) Test and record static pressure drop across all filters and major coils.*
- vii) High velocity duct systems shall be tested for leakage. If excessive or audible leakage is detected, the defect shall be repaired by the contractor. Sufficient static pressure readings shall be taken from the air handling units to the terminal units to establish system static pressure.*

1.6.3 Water System:

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

- i) Test and adjust all pumps to deliver the proper gpm. Record rpm, motor amperage, discharge and suction pressure. Pumps shall operate without objectionable noise or cavitation. Plot actual pump and system performance points on manufacturer's pump curves.*
- ii) Check all expansion tanks for proper filling pressurization. Verify operation of automatic fill and relief valves.*
- iii) Check the operation of all automatic valves.*
- iv) Test and adjust correct water flow through chiller, major items of equipment and main water circuits. The balancing valves, provided on the equipment shall be used for adjustment.*
- v) Check capacity output of chillers and set water flow rate for proper data.*
- vi) Check and adjust each coil to provide proper gpm. Record water and air temperature changes and water pressure drop.*
- vii) Set pressure drops across coil by-pass to match coil full-flow pressure drop.*

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

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

1.6.5 Balancing Tolerance:

Systems shall be balanced within the following tolerances ;

i) Duct leakage Rates (at operating pressures) :

<i>Low pressure ducts</i>	<i>5% of full flow</i>
<i>(0 to 0.5 kPa)</i>	

<i>Medium Pressure Ducts</i>	<i>1% of full flow</i>
<i>(0.5 to 3 kPa)</i>	

<i>High Pressure Ducts</i>	<i>1% of full flow</i>
<i>(Greater than 3 kPa)</i>	

ii) Air flow rates :

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

iii) Water flow rates :

<i>Chilled Water</i>	<i>2% of flow</i>
<i>Other</i>	<i>5% of flow</i>

iv) Heat flow rates :

<i>Heat exchangers</i>	<i>5% of design capacity</i>
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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.

1.6.6 Reports

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

1.6.7 Final documentation

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

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

Notify the department of any areas marginal or unacceptable system performance. The above tests and procedures are mentioned herein, for general guidance and information only, but not by way of limitation 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.

1.7. Miscellaneous

1.7.1 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.

- 1.7.2 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.
- 1.7.3 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.
- 1.7.4 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.
- 1.7.5 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.

IDENTIFICATION OF SERVICES

1.1 SCOPE

The scope of this section comprises of identification of services for each piece of equipment

1.2 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 displayed in each plant room showing the plant layout with pipe work, valve diagram and valve schedule indicating size, service, duty, etc.

1.3 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.

1.3.1. Pipe work Services :-

For pipe work services and its insulation the colours of the bands shall comply with BS. 1710: 1971.

Basic colours for pipe line identification :

<u>Pipe Line Contents</u>	<u>BS. 4800 Colour Reference</u>	<u>Colour.</u>
Water	12 D 45	Green
Steam	10 A 03	Grey
Oils	06 C 39	Brown
Gas	08 C 35	Yellow / Brown

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<i>Air</i>	<i>20 E 51</i>	<i>Blue</i>
<i>Drainage</i>	<i>00 E 53</i>	<i>Black</i>
<i>Electrical</i>	<i>06 E 51</i>	<i>Orange</i>

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

<i>Pipe Line Contents</i>	<i>Colour Bands to BS. 4800</i>
<i>Water Services :</i>	
<i>Cooling</i>	<i>00 E 55</i>
<i>Fresh / drinking</i>	<i>18 E 53</i>
<i>Boiler feed</i>	<i>04 D 45/00 E 55 / 04 D 45</i>
<i>Condensate</i>	<i>04 D 45/14 E 53 / 04 D 45</i>
<i>Chilled</i>	<i>00 D 55/14 E 53 / 00 D 45</i>
<i>Central Heating Services :</i>	
<i>Below 100° C</i>	<i>18 E 55/04 D 45/18 E 53</i>
<i>Above 100° C</i>	<i>04 D 45/18 E 53 /04 D 45</i>
<i>Cold Water Storage</i>	
<i>Tanks:</i>	<i>00 E 55/18 E 53/00 E 55</i>
<i>Hot Water Supply</i>	<i>00 E 55/04 D 45/00 E 55</i>
<i>Hydraulic Power</i>	<i>04 C 33</i>
<i>Sea / River Untreated</i>	<i>Basic Colour only</i>
<i>Fire Extinguishing</i>	<i>04 E 53</i>
<i>Steam Services:</i>	<i>Basic Colour only</i>
<i>Air : Compressed</i>	<i>Basic Colour only</i>
<i>Vacuum</i>	<i>White.</i>
<i>Town Gas : Manufactured</i>	<i>14 E 53</i>
<i>Natural</i>	<i>10 E 53</i>
<i>Oils:</i>	
<i>Diesel</i>	<i>00 E 55</i>
<i>Lubricating</i>	<i>14 E 53</i>
<i>Hydraulic Power</i>	<i>04 C 53</i>
<i>Transformer</i>	<i>04 D 45</i>
<i>Drainage and other fluids :</i>	<i>Basic Colour only</i>
<i>Electrical Services :</i>	<i>Basic Colour only</i>

In addition to the colour bands specified above all pipe work shall be legibly marked with black or white letters to indicate the type of service and the direction of flow, identified as follows :-

<i>High Temperature Hot Water</i>	<i>HTHW</i>
<i>Medium Temperature Hot Water</i>	<i>MTHW</i>
<i>Low Temperature Hot Water</i>	<i>LTHW</i>
<i>Chilled Water</i>	<i>CHW</i>
<i>Condenser Water</i>	<i>CONDW</i>
<i>Steam</i>	<i>ST</i>
<i>Condensate</i>	<i>CN</i>

Pipe shall have the letters F and R added to indicate flow and return respectively as well as directional arrows.

1.3.2 Duct Work Services

For Duct work services and its insulation the colours of the triangles shall comply with BS.1710 : 1971. The size of the symbol will depend on the size of the duct and the viewing distance but the minimum size should not be less than 150 mm. length per side. One apex of the triangle shall point in the direction of airflow.

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

In addition to the colour triangles specified above all duct work shall be legibly marked with black or white letters to indicate the type of service, identified as follows:-

<i>Supply Air</i>	<i>S</i>
<i>Return Air</i>	<i>R</i>
<i>Fresh Air</i>	<i>F</i>
<i>Exhaust Air</i>	<i>E</i>

The colour banding and triangles shall be manufactured from self adhesive cellulose tape, laminated with a layer of transparent ethyl cellulose tape.

Specifications for Electrical Works

Specifications Medium Voltage Switchgear

1. STANDARDS AND CODES

The following Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition the relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

BIS certified equipment shall be used as a part of the Contract in line with Government regulations. Necessary test certificates in support of the certification shall be submitted prior

to supply of the equipment.

It is to be noted that updated and current Standards shall be applicable irrespective of those listed below.

Low voltage Switchgear and Control gear specifications IS 13947 : 1993 Part

I – General

Part 2 – Circuit Breakers Part 3

– Switch Fuse Units

Part 4 – Contactors and Motor Starters Part 5 –

Control Circuit Devices

Electrical Relays for power system protection IS 3231 : 1986

Low voltage Switchgear and Controlgear assemblies IS 8623 : 1993

Marking of Switchgear busbars IS 11353 : 1985

Degree of Protection of Enclosures for low

voltage switchgear IS 2147 : 1962

Code of Practice for selection, installation and

maintenance of Switchgear IS 10118 : 1982

2. SWITCH FUSE UNITS

2.1 Switch fuse units, incorporated in switchboards wherever required shall conform in all respects to IS 13947 : 1993. Switch fuse units shall be suitable for 415 Volts 3 Phase 50 HZ AC supply and shall be suitable for AC - 23 A duty.

Unit housing shall be of robust construction designed to withstand arduous conditions. Sheet steel used shall be given rigorous rust proofing treatment before fabrication and painting Units shall have double break per phase in order to isolate fuse links when the switch is in OFF position.

Operating mechanism of units shall be crisp and positive in action with quick- make and quick-break silver plated contacts. Operating handle shall be suitable for rotary operation unless otherwise specified. Position of handle such as ON and OFF shall be clearly indicated.

All live parts inside the switch fuse units shall be shrouded to prevent any accidental contact.

All the terminals shall be liberally designed. All units above 100 A shall be provided with integral cable sockets.

All switch units shall be provided with suitable interlocks such that the door of the switchboard panel shall not open unless the switch is in OFF position. Provision for padlocking the switch in OFF position shall also be provided.

Routine and type tests as per IS 13947: 1993 shall be conducted at works and test certificates furnished.

3. MOULDED CASE CIRCUIT BREAKERS

i) Moulded case circuit breakers (MCCB) or fuse free breakers, incorporated in switchboards wherever required, shall conform to IS 13947 : 1993 in all respects. MCCBs shall be suitable either for single phase 240 Volts or 3 Phase 415 Volts AC 50 HZ supply.

ii) MCCB cover and case shall be made of high strength heat resisting and flame retardant thermosetting insulating material. Operating handle shall be quick make/break, trip - free type. Operating handle shall have suitable ON, OFF and TRIPPED indicators. Three phase MCCBs shall have a common handle for simultaneous operation and tripping of all the three phases. Suitable arc extinguishing device shall be provided for each contact. Tripping unit shall be of thermal/magnetic type provided on each pole and connected by a common tripping bar such that tripping of any one pole causes three poles to open simultaneously. Thermal/magnetic tripping device shall have IDMT characteristics for sustained over loads and short circuits.

iii) Contact trips shall be made of suitable arc resistant sintered alloy. Terminals shall be of liberal design with adequate clearances.

iv) MCCBs shall be provided with following accessories, if specified in drawings/schedule of quantities :

- Under voltage trip
- Shunt trip
- Alarm switch
- Auxiliary switch
- v) MCCBs shall be provided with following interlocking devices for interlocking the door a switch board.
- Handle interlock to prevent unnecessary manipulations of the breaker.
- Door interlock to prevent door being opened when the breaker is in ON position
- Deinterlocking device to open the door even if the breaker is in ON position.

MCCBs shall have rupturing capacity as specified in drawings/schedule of quantities.

4. METERING, INSTRUMENTATION AND PROTECTION.

The switchboard shall have required current and potential transformers as per schedule of quantities for metering and protection. The transformers shall comply to relevant ISS and class of accuracy required for metering and protection. Separate sets of CTs shall be provided for metering and protection.

4.1 Current Transformers

C/Ts shall conform to IS 2705 (part -I, II and III) in all respects. All C/Ts used for medium voltage application shall be rated for 1 kV. C/Ts shall have rated primary current, rated burden and class of accuracy as specified in schedule of quantities/drawings. Rated secondary current shall be 5A unless otherwise stated. Minimum acceptable class for measurement shall be class 0.5 to 1 and for protection class SP 10. C/Ts shall be capable of withstanding magnetic and thermal stresses due to short circuit faults of 31 MVA on medium voltage. Terminals of C/Ts shall be paired permanently for easy identification of poles. C/Ts shall be provided with earthing terminals for earthing chassis, frame work and fixed part of metal casing (if any). Each C/T shall be provided with rating plate indicating:

- Name and make

- Serial number
- Transformation ratio
- Rated burden
- Rated voltage
- Accuracy class

CTs shall be mounded such that they are easily accessible for inspection, maintenance and replacement. Wiring for CT shall be with copper conductor PVC insulated wires with proper termination works and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

4.2 Potential Transformer

PTs shall conform to IS 3156 (Part-I,II and III) in all respects.

4.3 Measuring Instruments

Direct reading electrical instruments shall conform to IS 1248 or in all respects. Accuracy of direct reading shall be 1.0 of voltmeter and 1.5 for ammeters. Other instruments shall have accuracy of 1.5. Meters shall be suitable for continuous operation between -10°C and +50°C. Meters shall be flush mounting and shall be enclosed in dust tight housing. The housing shall be of steel or phenolic mould. Design and manufacture of meters shall ensure prevention of fogging of instrument glass. Pointer shall be black in colour and shall have Zero position adjustment device operable from outside. Direction of deflection shall be from left to right. Suitable selector switches shall be provided for ammeters and volt meters used in three phase system. The rating type and quantity of meters, instruments and protective device shall be as per Schedule of Quantities /drawings

4.3.1 Ammeters

Ammeters shall be of moving iron type. Moving part assembly shall be with jewel bearings. Jewel bearings shall be mounted on a spring to prevent damage to pivot due to vibrations and shocks. Ammeters shall be manufacture and calibrated as per IS 1248

Ammeters shall normally be suitable for 5 A secondary of current transformers. Ammeters shall be capable of carrying substantial over loads during fault conditions.

4.3.2 Voltmeters

Voltmeters shall be moving iron type range of 3 phase 415 volt voltmeters shall be 0-500. Volt meters shall be provided with protection fuse.

4.3.3 Watt meter

Wattmeter shall be of 3 phase electro dynamic type and shall be provided with a maximum demand indicator if required.

4.3.4 Power factor meters

3 phase power factor meters shall be of electro dynamic type with current and potential coils suitable for operation with current and potential transformers provided in the panel. Scale shall be calibrated for 50% lag - 100% - 50% readings. Phase angle accuracy shall be +40.

4.3.5 Energy and reactive power meters

Trivector meters shall be two element, integrating type, KWH, KVA, KVARH meters. Meters shall confirm to IEC 170 in all respects. Energy meters, KVA, and KVARH meters shall be provided with integrating registers. The registers shall be able to record energy conception of 500 hours corresponding to maximum current at rated voltage and unity power factor. Meters shall be suitable for operation with current and potential transformers available in the panel.

4.4 Relays

Protection relays shall be provided with flag type indicators to indicate cause of tripping. Flag indicators shall remain in position till they are reset by hand reset. Relays shall be designed to make or break the normal circuit current with which they are associated. Relay contacts shall be of silver or platinum alloy and shall be designed to withstand repeated operation without damage. Relays shall be of draw out type to facilitate testing and maintenance. Draw out case shall be dust tight. Relays shall be capable of disconnecting faulty section of network without causing interruption to remaining sections. Analysis of setting shall be made considering relay errors, pickup and overshoot errors and shall be submitted to Engineer-in-Charge for approval.

4.4.1 Over current relays

Over current relays shall be induction type with inverse definite minimum time lag characteristics. Relays shall be provided with adjustable current and time settings. Setting for current shall be 50 to 200 % insteps of 25%. The IDMT relay shall have time lag (delay) of 0 to 3 seconds. The time setting multiplier shall be adjustable from 0.1 to unity. Over current relays shall be fitted with suitable tripping device with trip coil being suitable for operation on 5 Amps.

4.4.2 Earth fault relay

Same as over current relay excepting the current setting shall be 10% to 40% in steps of 10%.

4.4.3 Under voltage relay

Under voltage relays shall be of induction type and shall have inverse limit operation characteristics with pickup voltage range of 50 to 90% of the rated voltage.

4.5 Power factor correction capacitors

Power factor correction capacitors shall conform to IS 2834 in all respects. Approval of insurance association of India shall be obtain if called for. Capacitors shall be suitable for 3 phase 415 volts 50 HZ supply and shall be available in single and three phase units of 5,10,15,20,25 and 50 kVAR sizes as per requirements. Capacitor shall be usable for indoor use, permissible overloads being as below.

- Voltage overloads shall be 10% for continuous operation and 15% for six hours in a 24 hours cycle.
- Current overloads shall be 15 % for continuous operations and 50% for six hours in a 24 hours cycle.
- Over load of 30% continuously and 45% for six hours in a 24 hours cycle.

Capacitors shall be hermetically sealed in sturdy corrosion proof sheet steel containers and impregnated with non inflammable synthetic liquid. Every element of each capacitory unit shall be provided with its own built in silvered fuse. Capacitors shall have suitable discharge device to reduce the residual voltage from crest value of the rated voltage to 50 volts or less within one minute after capacitor is disconnected from the source of supply. The loss factor of capacitor shall not exceed 0.005 for capacitors with synthetic impregnates The capacitors shall withstand power frequency test voltage of 2500 volts AC for one minute. Insulation resistance between capacitors

terminals and containers when a test voltage of 500 volts DC is applied shall not be less than 50 meg.ohms.

5. MEDIUM VOLTAGE SWITCH BOARDS

5.1 GENERAL

- All medium voltage switchboards shall be suitable for operation at three phase/three phase 4 wire, 415 volt, 50 Hz, neutral grounded at transformer system with a short circuit level withstand of 31 MVA at 415 volts or as per schedule of quantities.
- The Switch Boards shall comply with the latest edition with upto date amendments of relevant Indian Standards and Indian Electricity Rules and Regulations.

5.2 SWITCH BOARD CONFIGURATION

- The Switch Board shall be configured with Air Circuit Breakers, MCCB's, and other equipment as called for in the Schedule of Quantities.
- The MCCB's shall be arranged in multi-tier formation whereas the Air Circuit Breakers shall be arranged in Single or Double tier formation only to facilitate operation and maintenance.
- The Switch Boards shall be of adequate size with a provision of 25% spare space to accommodate possible future additional switch gear.

5.3 EQUIPMENT SPECIFICATIONS

All equipment used to configure the Switch Board shall comply to the relevant Standards and Codes of the Bureau of Indian Standards and to the detailed technical Specifications as included in this tender document.

5.4 CONSTRUCTIONAL FEATURES

- The Switch Boards shall be metal enclosed, sheet steel cubicle pattern, extensible, dead front, floor mounting type and suitable for indoor mounting.
- The Switch Boards shall be totally enclosed, completely dust and vermin proof. Synthetic rubber gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust and vermin proof to provide a degree of protection of IP 42. All doors and covers shall also be fully gasketed with synthetic rubber and shall be lockable.
- The Switch Board shall be fabricated with CRCA Sheet Steel of thickness not less than 2.0 mm and shall be folded and braced as necessary to provide a rigid support for all components. The doors and covers shall be constructed from CRCA sheet steel of thickness not less than 1.6 mm. Joints of any kind in sheet metal shall be seam welded and all welding slag ground off and welding pits wiped smooth with plumber metal.
- All panels and covers shall be properly fitted and square with the frame. The holes in the panel shall be correctly positioned.
- Fixing screws shall enter holes tapped into an adequate thickness of metal or provided with hank nuts. Self threading screws shall not be used in the construction of the Switch Boards.

5.5 SWITCHBOARD DIMENSIONAL LIMITATIONS

- A base channel 75 mm x 5 mm thick shall be provided at the bottom.
- A minimum of 200 mm blank space between the floor of switch board and bottom most unit shall be provided.

- The overall height of the Switch Board shall be limited to 2300 mm
- The height of the operating handle, push buttons etc shall be restricted between 300 mm and 1800 mm from finished floor level.

5.6 SWITCH BOARD COMPARTMENTALIZATION

The Switch Board shall be divided into distinct separate compartments comprising

- A completely enclosed ventilated dust and vermin proof bus bar compartment for the horizontal and vertical busbars.
- Each circuit breaker, and MCCB shall be housed in separate compartments enclosed on all sides.
- Sheet steel hinged lockable doors for each separate compartment shall be provided and duly interlocked with the breaker/switch fuse unit in "on" and "off" position.
- For all Circuit Breakers separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, control contactors and control fuses etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, busbars and connections.
- A horizontal wire way with screwed cover shall be provided at the top to take interconnecting control wiring between vertical sections.
- Separate cable compartments running the height of the Switch Board in the case of front access Boards shall be provided for incoming and outgoing cables.
- Cable compartments shall be of adequate size for easy termination of all incoming and outgoing cables entering from bottom or top.
- Adequate and proper support shall be provided in cable compartments to support cables.

Following minimum clearances to be maintained after taking into consideration connecting bolts, clamps etc.

- i) Between phases 32 mm
- ii) Between phases and neutral 26 mm
- iii) Between phases and earth 26 mm
- vi) Between neutral and earth 26 mm

5.7 SWITCH BOARD BUS BARS

- The Bus Bar and interconnections shall be of electrolytic Copper/Aluminium and of rectangular cross sections suitable for full load current for phase bus bars and half rated current for neutral bus bar. The maximum current density for copper shall be 1.2 amps per sq. mm. and for Aluminium shall be 0.8 amp per Sq. mm. and suitable to withstand the stresses of a 31 MVA fault level or at 415 volts for 1 second or as per schedule of quantities. .
- The bus bars and interconnections shall be insulated with insulation tape/ fiber glass.
- The bus bars shall be extensible on either side of the Switch Board.
- The bus bars shall be supported on non-breakable, non-hygroscopic insulated supports at regular intervals, to withstand the forces arising from a fault level of 31 MVA at 415 volts for 1 second.
- All bus bars shall be colour coded.
- All bus bar connections in Switch Boards shall be bolted with brass bolts, washers and nuts.

5.8 SWITCH BOARD INTERCONNECTIONS

- All connections between the bus bars/Breakers/ shall be through solid copper strips of adequate size to carry full rated current and PVC/fibre glass insulated.

5.9 DRAW-OUT FEATURES

Air Circuit Breakers shall be provided in fully drawout cubicles. These cubicles shall be such that drawout is possible without disconnection of the wires and cables. The power and control circuits shall have self aligning and self isolating contacts. The fixed and moving contacts shall be easily accessible for operation and maintenance. Mechanical interlocks shall be provided on the drawout cubicles to ensure safety and compliance to relevant Standards. The MCCB's shall be provided in fixed type cubicles.

5.10 INSTRUMENT ACCOMMODATION

- Instruments and indicating lamps shall not be mounted on the Circuit Breaker Com- partment door for which a separate and adequate compartment shall be provided and the instrumentation shall be accessible for testing and maintenance without danger of accidental contact with live parts of the Switch Board.
- For MCCB's instruments and indicating lamps can be provided on the compartment doors.
- The current transformers for metering and for protection shall be mounted on the solid copper/ aluminum bus bars with proper supports.

5.11 WIRING

All wiring for relays and meters shall be with PVC insulated copper conductor wires. The wiring shall be coded and labelled with approved ferrules for identification. The minimum size of copper conductor control wires shall be 1.5 sq. mm.

5.12 CABLE TERMINATIONS

- The cable terminations of the Circuit Breakers shall be brought out to terminal cable sockets suitably located at the rear of the panel.
- The cable terminations for the MCCB's shall be brought out to the rear in the case of rear access switchboards or in the cable compartment in the case of front access Switch Boards.
- The Switch Boards shall be complete with gland plates

5.13 SPACE HEATERS

The Switch Board shall have in each panel thermostatically controlled space heaters with a controlling 15 amp 230 volt switch socket outlet to eliminate condensation

5.14 EARTHING

A main earth bar of G.I shall be provided throughout the full length of the Switch Board with a provision to make connections to earth stations on both sides.

5.15 SHEET STEEL TREATMENT AND PAINTING

- Sheet Steel materials used in the construction of these units should have undergone a rigorous rust proofing process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognised phosphating process or by using sand blasting method. The steel work shall then receive two coats of oxide filler primer before final painting. Castings shall be scrupulously cleaned and fettled before receiving a similar oxide primer coat.

- All sheet steel shall after metal treatment be spray or powder painted with two coats of shade 692 to IS 5 on the outside and white on the inside. Each coat of paint shall be properly stoved and the paint thickness shall be adequate.

5.16 NAME PLATES AND LABELS

Suitable engraved white on black name plates and identification labels of metal for all Switch Boards and Circuits shall be provided. These shall indicate the feeder number and feeder designation.

6. INSTALLATION

The foundations prepared as per the manufacturers drawings shall be levelled, checked for accuracy and the Switch Board installed. All bus bar connections shall be checked with a feeler gauge after installation. The cable end boxes shall be sealed to prevent entry of moisture. The main earth bar shall be connected to the sub-station earths.

A 15 mm thick rubber matting of approved make on a 100 mm high timber platform shall be provided in front of and along the full length of the Switch Board. The width of the matting shall be 1000 mm. The rubber mat shall withstand 15 KV for 1 minute and leakage current shall not exceed 160 mA/sq. metre.

After installation the Switch Board shall be tested as required prior to commissioning.

7. OUTDOOR TYPE DISTRIBUTION FEEDER PILLARS

The feeder pillar shall be of the floor mounting type, totally enclosed, and weather proof, conforming to ISI IP 54 incorporating phenolic moulded fuse fittings with high rupturing capacity cartridge fuse links having a certified rupturing capacity of not less than 35 MVA at 433 volts. The feeder pillar shall be suitable for 440 volts 3 phase 4 wires, 50 cycles AC supply.

The cubicle should be fabricated out of heavy gauge sheet steel of thickness not less than 2 mm thick with suitable side frame and stiffeners. Hinged doors of not less than 1.6 mm thick should be provided at the front and rear of the cubicle to provide access for installation, operation, tests and inspection. The rear door is provided to facilitate cable termination and the front door for inspection of fuses, to switch 'ON' and 'OFF' the switch as and when required. All doors should be fitted with dust excluding neoprene gaskets. The doors should also be fitted with suitable locking arrangement with lock to prevent unauthorized opening. The cubicle should be designed for mounting over cement concrete plinths by the roadside, and should be of substantial construction capable of withstanding the vibrations normally experienced due to vehicular traffic. The top of the feeder pillar is of slanting construction in all directions to prevent any collection of water due to rain. A gland plate is provided at the bottom of the feeder pillar (removable) for mounting the cable glands. The feeder pillar shall be fitted on an angle iron pedestal at the bottom covered with sheet metal from all the four sides which facilitates cable bending etc specially with aluminium cables. Two lifting hooks shall be provided at the top. A door switch shall be provided in the feeder pillar so as to switch 'ON' and 'OFF' the lamp fixed in the brass batten holder below the top sheet of the pillar.

The sheet steel materials used in the construction of the cubicle should have undergone a rigorous rust proofing process comprising alkaline degreasing, descaling in dilute sulfuric acid solution and recognized phosphating process. After metal treatment, the interior of the cubicle should be painted with two coats of air-drying red lead primer followed by two coats of air drying anti-condensation paint. The exterior of the cubicle should be painted with two coats of staving red oxide primer followed by one coats of epoxy finishing paint. One final spray of epoxy paint shall be applied at the time of handing over the installation.

All the nuts, bolts shall be cadmium plated with spring washers. A minimum spacing from cable connection to the bottom of gland plate shall be 300mm.

The bus bars should be of electrical grade copper. They should be air insulated with adequate clearances between conductors and between conductors and earth. These should be colour coded to enable immediate identification of the phases and neutral. The current density for bus bars shall not be more than 1.0 amps per square mm. All bus bar joints and tapings should be of the clamped type as far as possible thereby avoiding drilling of holes on bus bars. The bus bars should be carried on supports made out of a suitable non-inflammable and non-hygroscopic material such as Hylam, Permali or Formics. Suitable insulating phase barriers should be provided to prevent accidental short-circuits during operation.

The fuse base contacts should be of copper comprising one top contact for bolting to the bus bar, one bottom contact for terminating the incoming or outgoing cable and a cable lug. The bottom contacts should be so designed that the cable tail from the cable gland to the cable lug is vertical and does not foul with any live parts in its run. The spacing between the respective fuse bases should not be less than 40mm.

The fuse carriers should be fitted as standard to all fuses to minimize accidental contact with live metal during inspection or maintenance. The carriers should be phenolic moulded, designed

to accommodate HRC fuse-links and should incorporate a wedge action device for tightening the fuse-link to the base contact. This wedge action should be operated externally by insulated thumb screws giving uniformly high pressure contact and ensuring cool running under full load conditions, with positive location of the fuse-link tags on the base contact. The fuse-link shall not work loose due to vibration occurring from vehicular traffic.

A viewing aperture should be provided on the carrier to facilitate location of a 'blown' fuse. The fuse carriers should also be easily withdrawable in service. The design of the carrier should be such that carrier components do not carry any current and the contact is decided between fuse-link tag and base contact.

When incoming links are called for it should be possible to fit the carriers with solid links in lieu of fuses.

Cable Trays, Racks, perforated and associated Material

Cable Trays / Support

1. All cable trays shall be ladder type and shall be supported and laid in accordance with the 'layout drawings'.
2. Cable trays shall be ladder type and dip galvanized after fabrication.
3. Cable tray supports shall be cantilever type for easy installation. All supports and hardware shall be hot dip galvanized.
4. Standard cable tray width shall be 600 mm. However reduced width of 300 mm shall be used in some place where specifically required.
5. Trays in general shall be supported at a distance of 1.5 m horizontal run.
6. All welds for cable trays shall have a minimum throat thickness of 60mm.

7. Jointing of cables trays shall be done by welding only.
8. Damaged galvanized surfaces shall be cleaned and coated with two (2) coats of red oxide primer followed by two (2) coats of cold galvanized paint.

Earthing of cable Trays.

Cable trays shall be electrically continuous and grounded. Earthing of cable trays shall be ensured by separate connection with the weld.

Cable Tray Installation

All relevant layout drawings enclosed shall be followed except where obvious interference occurs. In such case the coating shall be damaged as directed and / approved by the owner.

Twenty (20%) spare space shall be provided in cable tray.

Cabling

Adequate space will be provided to facilitate installation of cable system and to allow routine inspection and modification after installation.

Different voltage grade cable shall be laid in separate trays when the trays are run in tier formation. Generally power cable will be on bottom trays and control cables system with non-inflammable materials.

Cables for redundant equipment / system shall be run in separate trays.

All opening in the floor and wall for cable access shall be sealed after installation of the cable system with non-inflammable materials.

Grounding

All grounding work shall be carried out as per guidelines specified in 'Grounding notes and details along with the typical grounding drawings enclosed with this specification.

Main grounding grid shall be laid 1 M below ground level. This shall be comprising of 40mm dia MS rod and earth pit. This earthing system will also be interconnected to the existing system.

Tapped riser of 50 x 6 mm 6.5 mtr from main grounding grid running along tray, building structural steel shall be used as ground continuity conductor.

Building structural steel wherever available shall be directly connected with main ground grid. In no case runner angle of cable tray, building structural steel shall be used as ground continuity conductor.

All equipment under this package shall be directly connected to main grounding grid/ ground continuity conductor running along cable tray.

The riser shall be bolt connection at equipment end. In case the rise length is not adequate, separate equipment ground conductor shall be used which will be welded to the riser at one end and bolt connector to the equipment at other end.

All ground conductor shall be painted black after connection to guard against weathering and easy identification.

Equipment ground connection after checked and tested by the Authority shall be coated with anti-corrosive paint/ old compound.

All ground connection shall be made by electric arc welding unless otherwise specified.

Electrical equipment shall be provided with two separate and all sealed grounding pads, each complete with tapped hole galvanizing spring washer for connection to main ground grid.

Tests

Upon completion system and equipment shall be subjected to standard tests for checking the acceptability of the system with reference to relevant IS and IE rules.

Six (6) copies of Routine tests Certificate shall be submitted for approval prior to the dispatch of the concerned equipment from works.

GROUNDING NOTES

1. Grounding work shall conform to the requirements of the following latest standard, statutory provision is amended upto date:

IS : 3043 – 1987 –Code of practice for earthing.
Indian Electricity act, 1910
Indian Electricity Rules – 1956

Contract Specifications
Enclosed grounding drawings

2. The ground shall be connected with main grid available in the yard.
3. The earth pit shall be as per enclosed drawing and connected to the ground grid conductor.
4. Riser / pig tail from the ground grid conductor shall be as per typical details shown in the enclosed drawing .
5. All ground connection below the grade shall be made by Electric arc welding with low hydrogen content electrode Bonding of the conductor where necessary shall be done by gas heating.
6. The ground conductors shall be interconnected between them and top the main ground grids through risers.
7. All electrical equipments and associated non-current carrying metal works, supporting structures, building columns, fence, and system neutrals lightening mast / arrestors shall be connected to the ground grid system.
8. Two separate and distinct ground connections shall be provided for earthing of electrical equipment frame work in compliance with I.E. rules.
9. Misc. devices such as push button stations, lockout switches and cable end boxes etc. shall be grounded effectively whether specifically shown or not.

10. For ground connections, the conductor sizes shall be as listed below:

Equipment	G.I. Steel flats / wires
a. Structures, cable trays etc	1 No. 50 x 6mm
b. LT/HT panels	1 No. 50 x 6 mm

11. Ground conductor connection above the grade shall be generally made by electric arc welding.
12. Bolted connections shall be made only for grouting equipment devices and removable structures. The contact surface shall be thoroughly cleaned before connection to ensure good electrical contact.
13. A continuous 50x6mm GI flats ground c conductor shall be installed on one bank of vertical/horizontal trays and securely attached to such tray section, forming a solidly grounded trays system.

Before installing 50x6mm GI flats ground conductor along the cable tray run the cable trays welding joints in cable to ground tray supports shall be painted as specified.
14. Where two or more trays run together in one bank either vertically/ horizontally provide a continuous conductor on the top tray only on taps to each section of to other tray at 10M interval.
15. Fence within the ground grid shall be bounded the palmily at regular interval not exceeding ten (10) Meters. Fence generally separately grounded with flexible connection before type
16. Earth pit shall be provided at connection
17. All welding joints in ground conductor above the ground shall be coated with two coats of cold galvanizing anti-cursive paint after welding.
18. For typical detail of grounding refer drawing enclosed.

9. SPECIFICATION FOR POWER AND CONTROL CABLES

1.00.00 DESIGN CRITERIA

- 1.01.00 The cable will be used for connection of power and control circuits of the owner's electrical system.
- 1.02.00 Cable will be either laid on ladder type trays or directly buried in ground.
- 1.03.00 For continuous operation at specified rating, maximum conductor temperature shall be limited to the permissible value as per relevant standard and/or this specification.
- 1.04.00 The insulation and sheath materials shall be resistant to oil, acid and alkali and shall be enough to withstand mechanical stresses during handling.
- 1.05.00 Armoring shall be single round wire of galvanized steel for multicore cables and aluminium for single core cable.
- 1.06.00 Core identification for multicore cable shall be provided by colour coding.

2.00.00 SPECIFIC REQUIREMENTS

2.01.00 L.V. Power cables

1100 Volt grade, heavy duty armoured power cables with stranded aluminium conductors, XLPE insulation and extruded PVC overall sheath.

2.02.00 Control Cables

1100 Volt grade, 70°C rating, control cables with standard copper conductor, PVC insulation, round wire armour and extruded PVC overall sheath.

2.03.00 Drum Length & Tolerance

Each size of the control cable shall be supplied in one length.

2.04.00 Cable Identification

Cable identification shall be provided by embossing on the outer sheath the following :

- a. Manufacture's name or trade mark
- b. Voltage grade
- c. Year of manufacture
- d. Type of insulation e.g. PVC etc.

3.00.00 Joints and Termination

Material of construction for joints / termination shall perfectly match with the dielectric chemical and physical characteristics of the associated cables. The material and design concept shall incorporate a high degree of operating compatibility between the cable and the joints. The protective outer covering (jacket) used on the joints / terminations shall have the same qualities as that of the cable oversheath in terms of ambient / operating temperature and fire retardant properties withstand capability and

resistance of hazardous environment and corrosive elements.

4.00.00 TESTS

4.01.00 Shop tests

The cables shall be subject to shop tests in accordance relevant standards to prove the design and general qualities of the cables as below:-

4.01.01 Routine tests on each drum of cables

4.01.02 Acceptance tests on each drum s chosen at random for acceptance of the lot.

4.01.03 Type tests on each type of cable, inclusive of measurement of armour D.C resistance of power cables.

4.02.00 Test witness

Tests shall be performed in presence of engineer-in-charge if so desired by the Institute. The contractor shall give at least thirty (30) days advance notice of the date when the tests are to be carried out.

4.03.00 Test Certificates

4.03.01 Certified reports of all the tests carried out at the works shall be furnished in six (6) copies for approval of the owner

4.03.02 Test reports shall be completed with all details and shall also contain IS specified limit values, wherever applicable to facilities review.

4.03.03 The cable shall be dispatched from works only after receipt of owner's written approval of the test reports.

5.00.00 SPECIAL TOOLS & TACKLES

5.01.00 A set of special tools and tackles which are necessary or convenient for splicing, jointing and termination of different types of cables.

5.02.00 These special tools and tackles shall includes but not limited to:-

- | | |
|---|------|
| a. Splice-cum-insulation remover for control cable | 1 No |
| b. Hand operated compression tools with a set of dies for different cable sizes | 1 No |
| c. Hydraulically operated compression tools with a set of dies for different cable sizes. | 1 No |

5.03.00 The tools shall be shipped in separate containers, clearly marked with the service for which they are intended.

6.00.00 SPARES

The bidder shall submit a list of recommended spare parts for three (3) years satisfactory and trouble free operation, indicating the itemized price of each item of the spare.

7.00.00 DRAWING, DATA & MANUALS

- 7.01.00 Drawing data manuals shall be submitted and in quantities and procedures as specified in general conditions of contract and / or else where in this specification on approval & subsequent distribution after the issue of letter of intent.
- 7.02.00 To be submitted with the bid:
- a. Manufacture's catalogues giving cable construction details and characteristics.
 - b. Cable current rating for different type of installation inclusive of operating factors for ambient temperature, grouping etc.
 - c. Write-up on manufacture's recommended method of splicing, jointing, termination etc. of the cables.
 - d. Type test report on H.V power cable.
- 7.03.00 To be furnished for Approval and distribution:
- a. Confirmed cable data.
 - b. Shop test reports.

9 SPECIFICATION FOR ELECTRICAL ERECTION

1.00.00 GENERAL

- 1.01.00 The tenderer shall furnish & install all materials & equipment which are obviously a part of the completed installation but have not been specifically mentioned in this specification without any additional charge to the Authority.
- 1.02.00 All ladders, platforms, scaffolding, temporary supports, any other facility required for erection at site shall also be provided.
- 1.03.00 The tenderer shall at all times work in close coordination with Engineer-in-charge supervisory personnel & afford them every facility to become familiar with the erection & maintenance of the equipment.
- 1.04.00 The tenderer shall arrange his schedule of work & method of operation to minimize inconvenience to other contractors at the project site. In case of any difference between contractors. The decision of the Owner shall be final & binding on all parties concerned.
- 1.05.00 In case of any hold up due to fault of other contractors or for any other reason, the tenderer shall bring it to the notice of the engineering-in-charge in writing without any delay. Otherwise any delay in completion of his work will be accounted for.
- 1.06.00 In case of any contradiction/ confusion with any other section/ sub-section of this specification, the same shall be referred to the Engineer-in-charge in this respect shall be final & binding.

2.00.00 REGULATIONS

The complete installation shall meet the requirements of the latest edition of the relevant Indian Standard & I.E. Rules.

3.00.00 DRAWINGS

The tenderer shall inform himself fully with the relevant Electrical layout single line diagram & schematic drawings enclosed with the package specification.

The tenderer shall furnish all erection drawings, catalogue data sheets, etc as required to cover specific information for all items.

4.00.00 TRANSPORTATION

The contractor shall be responsible for the transportation to the site of all equipment, materials & supplies to be provided by him according to terms of the contract. The contractor shall be responsible for arranging transportation as advised by Owner depending on requirement & to meet the completion schedule. In the event of the schedule requiring change in the mode of transportation the same shall be arranged by the contractor without any extra cost.

5.00.00 UNLOADING

The contractor shall arrange to unload equipment received at site & also arrange to transport the material from the unloading point to site.

The contractor shall make all necessary arrangement for tools & tackles, men & machinery for unloading of equipment at site & its transportation to site or storage. It is clearly understood that demurrage, whereas & other expenses incurred by the contractor due to delayed clearance of the material or for any other reason, shall be to the contractor's account.

6.00.00 STORAGE AT SITE

The contractor shall provide coverage of the equipment & material, security arrangement & all other facilities required for proper & safe storage till completion of the work.

7.00.00 PROTECTION OF WORK

7.01.00 The contractor shall effectively protect his work at his own expense, equipment & material under his custody from theft, damage or tampering.

7.02.00 Finished work where required shall be suitably covered to keep it clean & free from defacement or injury.

7.03.000 For protection of his work contractor shall provide fencing & lighting arrangement connect up space heaters & provide heating arrangement as necessary or directed by Engineer-in-charge.

7.04.00 Contractor shall be responsible for any loss or damage to equipment & material until his work is fully & finally accepted.

8.00.00 OPENING OF CASE, CHECKING AND CLEANING OF PART

8.01.00 All packing cases or package shall be opened in presence of Owner's representative.

8.02.00 All equipment, accessories & materials i.e. Switchgear, transformer, bus duct, power & control cables etc after receipt at site shall be jointly inspected & checked with packing list & identified with erection drawings.

8.03.00 All claims against loss or damage in transit shall be lodged by the contractor under intimation to Owner. The contractor shall be responsible for processing and settlement of claim including furnishing any information that may be required in this connection.

8.04.00 The contractor shall ensure that insurance formalities are observed & any loss of claim due to the fault of the contractor shall be to the contractor's account.

8.05.00 All parts shall be thoroughly cleaned all rust removed & surface polished as required.

8.06.00 Cleaned & polished parts shall be coated with anti-corrosive paints where necessary & stored with care, ready for erection.

9.00.00 TESTING EQUIPMENT

The major testing equipment that are required to be arranged by the contractor are listed below :

a.) Insulation Tests :

i) Power operated Meggar - 1 kV & 2.5 kV grade

- ii) Hand operated Meggar - 500 Volt/ 1100 Volt grade
- b.) Hand driven earth Resistance Meggar, range 0-1/3/30 Ohms.
- c.) High potential testing set- roller mounted type
- d.) Tong testers of suitable ranges
- e.) Contact resistance measuring set for micro-ohms
- f.) Torque wrench of various sizes.
- g.) Multimeters, test lamp, field telephone with buzzer set, different gauges etc.

10.00.00 PAINTING

After completion of the erection, all equipment & materials supplied under this specification shall be given necessary protective painting. The colour of the final coat shall be approved by the Owner.

11.00.00 ERECTION

11.01.00 Method & materials

- 11.01.01 All work shall be installed in a first class, neat & workman like manner by mechanics skilled in the trade involve. All details on the installation shall be mechanically & electrically correct.
- 11.01.02 All materials shall be brand new & of best available quality without having imperfections & blemishes. Where two or more units of the same manufacture.
- 11.01.03 All conduits & equipment shall be installed in such a manner as to preserve access to any other equipment installed.

12.00.00 DETAILED REQUIREMENT OF INSTALLATION:

- 12.01.01 All alignment, leveling, grouting, base channel fixing & anchoring adjustments shall be carried out in accordance with manufacturer's instructions and install necessary floor steel for supporting the panels.
- 12.01.02 All connections, in switchgear shall be completed, checked and adjusted to ensure safety & satisfactory operation of the equipment.
- 12.01.03 In some cases minor modifications may have to be carried out at site in the wiring & mounting of the equipment to meet the requirement of desired control scheme & the contractor shall have to do the same at no extra cost.

12.02.00 Transformer

- 12.02.01 The contractor shall place the transformer on its foundation, assemble parts, fabricate & erect & supporting structure for detachable type cable chamber.
- 12.02.02 H.V. test of transformer oil shall be carried out taking a sample from individual transformer. If the result is not in satisfaction of the purchaser, oil conditioning of that particular transformer shall have to be carried out.
- 12.03.00 L.T. Bus duct shall be erected duly supported on the soffit on the building by structural member

supplied along with the bus duct. The bus duct will pass through separate wall between transformer & switchgear & will rest on two flanges one each at the switchgear & The transformer end. The grounding of the bus duct shall be carried as per the relevant standard. The flanges supplied along with the bus duct shall be erected & terminals end equipment namely transformer & switchgear will be connected to the bus duct. The bus duct shall be erected in straight, vertical or horizontal formation as per the site requirement. The test like milli volt drop on the contacts, insulation resistance value & proper tightness shall be ensured by the contractor.

12.03.01 For draining out of oil a oil soak pit for transformer is to be erected of the suitable capacity.

12.04.00 Miscellaneous items :

12.04.01 The tenderer shall install miscellaneous minor items to complete the installation of equipment.

12.04.02 These equipment will be generally floor or wall mounted. The exact location will be as decided by the Owner at site or as shown in Final drawings.

12.04.03 All support & bracket needed for installation shall be fabricated & painted by the tenderer.

12.04.04 All welding, cutting, chipping & grouting as & when necessary shall be carried out by the contractor.

12.05.00 Handling of cable drum and cable

12.05.01 Rolling of drum shall be avoided as far practicable. For short distance, the drums may be rolled they are rolled slowly and in proper direction as marked on the drum. In absence of any identification, the drums may be rolled in the same direction as it was rolled during taking up the cable.

12.05.02 For unreeling the cable, the drum shall be mounted on jacks or on cable wheel. The spindle shall be strong enough to carry the weight without bending. The drum shall be rolled on the spindle slowly, so that cable should come out over the drum & not below the drum.

12.05.03 While laying cable, cable shall be used at an interval of 2 meters. The cable shall be pushed over the roller by a gang of people positioned in between rollers. The cable shall not be pulled from the end without laying intermediate pushing arrangement. Bending radius shall not be less than what is specified by manufacturer.

12.06.00 Cable laying :

Cables shall generally be installed in cable trays except for some short runs in buried formation or in conduit / pipe for protection or crossing. Multi core power cables laid on trays & riser shall be neatly dressed & clamped with fabricated 25 x 3 mm G.S. flat or cable tray at an interval of maximum 1 meter for vertical / inclined run & 1.50 meter for horizontal run. Control cables may be laid in single layer with touching formation. Power & control cables shall be claimed in separate group. Power & control cables shall not be laid in a common tray excepting in very special case where a gap of 150 mm shall be maintained between power & control cables.

12.06.01 H.T. & L.T. power cables shall be laid in cable tray in single layer & with spacing equal to the diameter of cable.

12.06.02 Control cables can be laid upto a maximum of three layers in each tray.

12.06.03 Both power & control cables shall be clamped to the tray rungs by means of clamp made up of 25 x 3 mm fabricated G.S. flat at an interval of 1500 mm for horizontal run & 1000 mm for vertical / inclined

cable run.

- 12.06.04 The cable trays shall be run with a vertical spacing of 300 mm cable trenches. A minimum of 300 mm clearance shall be provided between the top of tray & beams, cold piping, 500 mm clearance for hot piping/ object to facilitate installation of cables in tray.
- 12.06.05 Adequate pull boxes shall be provided in conduit run to facilitate. Cable pulling in long runs & also to ensure that there will be no more than 270 degree bend between the pull points.
- 12.06.06 Cable tray shall be installed to accommodate cable manufacturer's recommended maximum pulling tension & minimum bending radius.
- 12.06.07 All openings in the floor & wall for cable access shall be sealed after installation of the cable system with non-inflammable materials.
- 12.06.08 All floor / wall openings for cable entry to the electrical equipment & accessories shall be sealed with non-inflammable material, after completion of cable installation. Thickness of such materials shall be equal to the thickness of floor / wall.

12.07.00 Cables-power & control :

- 12.07.01 The tenderer shall install & connect all power & control cable required for complete installation within his scope of work. Type & size of power & control cable shall be as specified & as supplied under a separate sub section for power & control cable.
- 12.07.02 In general all power & control cable shall be run in cable trays in cable trenches. Isolated runs of control cables shall be run in rigid conduit.
- 12.07.03 Jointing of power cable should be avoided as far as possible. However, if any splicing of control cable is required to carry out interlock it will be done in junction boxes not in the conduit or in the trays. Such junction boxes shall be in the scope of tenderer.
- 12.07.04 The contractor shall not install cables with different voltage grade in the same cable tray.
- 12.07.05 During cable installation care shall be taken so that the actual bending radius of each cable is not less than the one recommended by the cable manufacturer.
- 12.07.06 For cables buried directly underground there shall be a stone free sand cushion both above & below the cable run being held by brick wall supports on two (2) sides. The excavated portion above the top sand cushion shall be covered by concrete precast slab supported on the side walls & finally filled up with standard back fill.
- 12.07.07 Cables shall be pulled into the trenches in strict accordance with the cable manufacture's instruction.
- 12.07.08 Tenderer shall furnish & install suitable solderless crimping type cable lugs at the termination of all wires & cables if not already furnished with the equipment.
- 12.07.09 All exposed conduits & armoured cables shall be tagged with the numbers that appear in the conduit & cable schedules as prepared by the tenderer. All conduits & armoured cables shall be tagged at their entrance and/ or exist from any piece of apparatus, junction box or pull box. Aluminium tags shall be used with the number engraved/ punched on the tag. Tag shall be suitable secured to the conduit or armoured cable.

The cable tags shall also be provided at all bends and at interval of 30 M on straight run of cable in

order to facilitate the identification.

- 12.07.00 Laying termination & connection of all control cables for interlock, protection, indication & annunciation.

The tenderer shall prepare cable schedule & interconnection diagram & submit the same for approval of the Authority. Cable laying shall be started with the approval cable schedule & interconnection diagrams. Separate cables for each type of following services/ functions as applicable shall be used & laid along the run for each feeder.

- a.) Power - designate as 'P'
- b.) Control protection interlock, metering, indication & annunciation designate as 'C'.

13.00.00 FIELD TESTING:

- 13.01.00 Field Testing shall be required for all the equipment & accessories furnished, installed or connected by the tenderer to ensure proper installation, setting, connection & in accordance with the plans, specifications & manufacturer's recommendations.

Testing shall be conducted in presence of Owner's engineers with prior notice at least 2 weeks before commencement of any test.

- 13.02.00 Field testing work shall be done as per the latest edition of the relevant standards. All tests recommended by the equipment manufacturer shall be conducted. The tenderer shall submit the list of all field tests to be conducted for all equipment & accessories for review / approval by the Owner.
- 13.03.00 Testing shall include any additional tests suggested by the Owner that he deems necessary because of field conditions to determine that equipment, materials & system meet requirements of the specification.
- 13.04.00 The tenderer shall depute qualified personal to conduit all testing & shall provide all labour & testing equipment required for & incidental to testing.
- 13.05.00 The tenderer shall be responsible for any damage to equipment & material due to improper test procedure or test apparatus & shall replace or restore to original condition of any damaged equipment or material.
- 13.06.00 The tenderer shall maintain in quadruplicate a written record of all tests showing date, personal making the tests, equipment or material tested, test performed & result. Two copies of test records shall be given to the Authority.

14.00.00 COMMISSIONING :

After the satisfactory test are performed the equipment & material shall be put on trial operation by the tenderer. After successful trial operation, the equipment shall be put on performance tests. Initially at no load condition & finally with different loading conditions.

10 Specifications for LT Panel/ Switchgear

(a) CONSTRUCTION:-

- Switchgear enclosure shall conform to the degree of protection IP4x minimum thickness of sheet metal used shall be 2 mm.
- The switchgear shall comprise a continuous line up of single / Multi-tire cubicles. The installations of circuit breakers however shall be limited to the bottom two tires only.
- The design shall be of fully compartmentalized execution with metal/ insulating portions. Working height shall be limited between 750 mm to 1800 mm from the floor level.
- Each breaker shall be housed in a separate cubicle, complete with an individual front access door; each vertical section shall have a removable back cover. All doors & covers shall be gasketed.
- Switchgear cubicle shall be so sized as to permit closing of the front access door when the breaker is pulled out to ISOLATED position.
- All switchgear, lamps & indicating instruments shall be flush mounted on the respective cubicle door whereas relays & other auxiliary devices of any may be mounted on a separate cubical.

(b) BUS AND BUS TAPS

- The main buses & connections shall be of high conductivity aluminium alloy, as per IS : 5082 sized for specification current rating with maximum temperature limited to 85 degree C (i.e., 35 degree C rise over 50 degree C ambient). Bus bars shall be designed for a maximum current density of 0.8A/ sq.mm.
- All bus connections shall have adequate contact pressure which should be ensure by means of two bolt connections with plain & spring washers locknuts. Bimetallic connections between dissimilar metals.
- Bus connections shall be fully insulated for working voltage with adequate phase / ground clearances.
 - Insulating sleeves for bus bars & surrounds for joints shall be provided.
 - Bus insulator shall be flame-retardant, track resistant type with high creep age surface.
- All buses & connections shall be supported & braced to with stand the stresses due to maximum short circuit current & also to take care of any thermal expansion.
- Bus-bars shall be sleeved in colour coded manner for easy identification & so located that the sequence RYB shall be from left to right, top to bottom of front to rear, when viewed from the front of switchgear assembly.
- Bolted disconnected links shall be provided from all incoming & outgoing feeders for isolation of neutral, if necessary.

(c) CIRCUIT BREAKER

- Circuit breaker shall be three poles, single throw, air breaker type with stored energy, trip free mechanism & shunt trip. The circuit breaker of the outgoing feeder shall have an in built microprocessor base release, short circuit, over current & earth fault protection release.
- Circuit breakers shall be draw out type, having SERVICE, TEST & ISOLATED position with positive indication for each position along with in built relay unit.

- Circuit breaker of identical rating shall be physically & electrically interchangeable.
- Circuit breaker shall be motor wound spring charged mechanism, motor voltage should be 240 V AC. For motor wound mechanism, spring charging shall take place automatically after each breaker closing operation. One open close-open operation of the circuit breaker shall be possible after failure of power supply to the motor. Power supply for this motor shall be taken from the output of auto changeover.
- Mechanical safety interlocking shall be provided to prevent the circuit breaker from being racked in or out of the service position when the breaker is closed.
- Automatic safety shutters shall be provided to fully cover the female primary disconnects when the breaker is withdrawn.
- Each breaker shall be provided with an emergency manual trip, mechanical ON-OFF indicator, an operation counter & mechanism charge/ discharge indicator.
- In addition to the auxiliary contacts required for normal breaker operation & indication, each breaker shall be provided with following for interlocking purpose:-
 - a) Position/ cell switch with 4 NO. + 4 NC contacts. These shall be available as spare for automation work.

Control Supply:- 230V AC for closing,

Tripping & indication lamps.

a. Auxiliary switch, with 6 NO+ NC contact, mounted on the stationary portion of the switchgear & operated mechanically by a sliding level from the breaker, in SERVICE position. These shall be available as spare for automation work.

- Limit / auxiliary switches shall be convertible type, that is, suitable for changing NO contact to NC & Vice-Versa.

(d) Moulded Case Circuit Breakers

- Moulded case circuit breakers (MCCB) or fuse free breakers, incorporated in switchboards wherever required, shall conform to IS 13947 : 1993 in all respects. MCCBs shall be suitable either for single phase 240 Volts or 3 Phase 415 Volts AC 50 HZ supply.

MCCB cover and case shall be made of high strength heat resisting and flame retardant thermosetting insulating material. Operating handle shall be quick make/break, trip - free type. Operating handle shall have suitable ON, OFF and TRIPPED indicators. Three phase MCCBs shall have a common handle for simultaneous operation and tripping of all the three phases. Suitable arc extinguishing device shall be provided for each contact. Tripping unit shall be of microprocessor based electronic type provided on each pole and connected by a common tripe bar such that tripping of any one pole causes three poles to open simultaneously. Electronic tripping device shall have IDMT characteristics for sustained over loads and short circuits.

Contact trips shall be made of suitable arc resistant sintered alloy. Terminals shall be of liberal design with adequate clearances.

MCCBs shall be provided with following accessories, if specified in drawings/schedule of quantities:

- Shunt trip
- Alarm switch
- Auxiliary switch

MCCBs shall be provided with following interlocking devices for interlocking the door a switch board.

- Handle interlock to prevent unnecessary manipulations of the breaker.
- Door interlock to prevent door being opened when the breaker is in ON position
- De interlocking device to open the door even if the breaker is in ON position.

MCCBs shall have rupturing capacity as specified in drawings/schedule of quantities.

- i) MCCB shall be triple pole air break.
- ii) The MCCB shall have a quick - make, quick - break mechanism operated by a suitable external rotary handle, complete with position indicator this handle shall have provision for pad locking in ON & OFF position.
- iii) MCCB should have microprocessor base electronic release with over current, earth fault & short circuit protection equivalent to L&T 'D' since with RC-10 release.

(e) CONTROL & INDICATION :-

The circuit breaker shall be wired up for both local & remote operation. A local-remote selector switch shall be provided for this purpose. Each breaking cubicle shall be equipped with following:-

- One (1) Test- neutral - service selector switch stay put type with test/ service position pistol grip handle & key interlock for breaker marked 'E'.
- Two (2) heavy duty, oil tight push buttons for TRIP & CLOSE.
- Three (7) LED indicating lights on front of compartment:- GREEN : Breaker open & spring charged

RED : Breaker close

AMBER : Trip / circuit healthy condition

WHITE : Control supply failure

Phase indication : One Red, One Blue & One Yellow

O & 1 NC should be provided for status monitoring of the remote / local position.

- Lamps shall be low watt, LED type lamp & lens shall be replaceable from the front.
- The general scheme of connections for control, interlock & protection shall got approved before fabrication of panel.

(f) FUSES :-

- Fuses shall be HRC, preferably link type with a minimum interrupting capacity equal to the short circuit current.
- Fuses shall be furnished complete with fuse base & fittings of such as to permit easy & safe replacement of fuse element. Visible indicated indication shall be provided on blowing of the fuse.

(g) CURRENT TRANSFORMER :-

Current transformer shall be cast- resin type. All secondary connections shall be brought out to terminal blocks where or delta connection will be made.

- Ratings :
- for incomers and bus coupler

1500-750/5+5 : 3 sets

- For out goings :

800-400/5+5 : 4 sets

600-300/5+5 : 4 sets

400-200/ 5+5 : 2 sets

- Accuracy class of the current transformers shall be :-
 - a. Class 5P10 for other relaying (protection).
 - b. Class 1.0, ISF < 5 for metering.

(h) RELAYS :-

- Relays shall be of draw out design with built in testing facilities. Small auxiliary relays may be in non-draw out execution.
- Relay shall be rated for operation on 5 Amp secondary current & 110 / 220 V secondary voltage; number & rating of relay contacts shall suit the job requirements.
- The contractor shall furnish, install & co-ordinate all relays to suit the requirements of protection & interlock & as broadly indicated in the annexure & drawings.

(i) METERS (digital display):-

- Indicating instruments shall be switch board type & accuracy class of 2% .
- All Digital Watt-hour meter shall be provided, alternatively, they may have test block to facilitate testing of meter without disturbing C.T. or V.T. secondary connections.
- Each breaker shall be with volt meter, amp meter with selector switches & KWH meters. Only outgoing feeders will be relaxed from voltmeters.

(j) SECONDARY WIRING :-

- i. The switchgear shall be fully wired at the factory to ensure proper functioning of control, protection, & interlocking schemes.
- ii. Fuses & links shall be provided to permit individual circuit isolation from bus wires without disturbing other circuits. All spare contacts of relays, switches & other devices shall be wired upto terminal blocks.

- iii. Wiring shall be done with FRLS PVC flexible, 650V grade, PVC insulated switchboard wires with solid copper conductors of 2.5 sq.mm for voltage circuits along with numbered ferrules.
- iv. Each wire shall be identified, at both ends, with permanent markers bearing wire numbers as per contractors wiring diagrams.
- v. Wire terminations shall be made with crimping type connectors with insulating sleeves. Wire shall not be spliced between terminals.

11 TERMINAL BLOCKS

- i) Terminal blocks shall be 660V grade box clamp type with marking strips, similar to ELMEX 10 sq.mm of equal. Terminals for C.T. secondary leads shall have provision for shorting.
- ii) Not more than two wires shall be connected to any terminals equal in number to 20% active terminals shall be furnished.
- iii) Terminal blocks shall be located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.

12 CABLE TERMINATION :-

- i) Switchgear shall be designed for cable entry from the bottom. Sufficient space shall be provided for each of termination & connection.
- ii) All provision & accessories shall be furnished for termination & connection of cables, including removable gland plates, cable supports, crimp type tinned copper/ aluminum lugs, brass compression gland with tapered washer (power cable only) & terminal block.
- iii) Gland plate shall be minimum 4 mm thick.

13 BUS DUCT CONNECTION :-

- i) Bus duct connections, where specified shall be furnished along with transportation of panel. Bus duct connections shall be generally from the top.
- ii) All connecting bus work shall have the same continuous rating as associated switchgear bus & shall be fully braced for the listed short circuit current.
- iii) All provision such as matching flange & other accessories shall be furnished for connection to bus duct if any, being supplied by this purpose will be furnished by contractor.

14 GROUND BUS :-

- i) A ground bus, rated to carry maximum fault current, shall extend full length of the switchgear.
- ii) The ground bus shall be provided with two bolt drilling with GI bolts & nuts at each to receive 50 x 6mm GI flat.
- iii) Each stationary unit shall be connected directly to the ground bus. The frame of each circuit breaker & draw out VT unit shall be grounded through heavy multiple contacts at all times except when the primary disconnecting devices are separated by a safe distance.
- iv) Whenever the schematic diagrams indicate a definite ground at the switchgear, a single wire for each circuit thus grounded shall be run independently to the ground bus & connected thereto.
- v) C.T. & V.T. secondary neutrals shall be earthed through removable links so removed

without disturbing others.

15. NAME PLATES :-

- i) Nameplates of approved design shall be furnished at each cubicle & at each instrument & device mounted on or inside the cubicle.
- ii) The material shall be lamicaid or approved equal, 3mm thick with white letter on black background.
- iii) The name plate shall be held self-tapping screws. Nameplate size shall be minimum 20 x 75 mm for instrument device & 40 x 150mm for panels.
- iv) Caution notice suitable metal plate shall be affixed at the back of each vertical panel.

16. SPACE HEATERS PLUG SOCKETS :-

- i) Each vertical section shall be provided with thermostat controlled space heater & 5A, 3 pin plug socket.
- ii) Cubical heater, plug-socket circuit shall have individual switch fuse units.

17. A.C. / D.C. POWER SUPPLY :-

- i) The following power supplied will be made available to the switchgear :

240 A.C. Supply : Two Feeders From these two single-phase feeders a reliable 240V, 1 Ph. AC bus shall be obtained using auto changeover scheme. The necessary equipment's for this scheme should be indicated.

The DC supply required for control purposes is to be obtained in each module through a rectifier arrangement, which will convert the 250V AC supply to 110V DC. The equipment necessary for this rectification including protective relaying as per the approved drawing are also to be included.

- ii) Isolating switch fuse units shall be provided at each switchgear for the incoming supplies, 2-pole, single throw for A.C. & 2-pole, double throw for D.C. Bus-wires of adequate capacity shall be provided to distribute the incoming supplies to different cubicles. Isolating switch- fuse units shall be provided at each cubicle for AC/DC supplies.
- iii) AC load shall be so distributed as to present a balance loading on three-phase supply system.

18. PAINTING :-

- i) All surfaces shall be sand blasted, pickled & grounded as required to produce a smooth, clean surface free of scale, grease & rust.
- ii) After cleaning, the surface shall be given a phosphate coating followed by 2 coats of high quality prime & stove after each coat.
- iii) The switchgear shall be finished in light gray (IS shade # 631) with two coats of synthetic enamel paint.
- iv) Sufficient quantity of touch- up paint shall be furnished for application at site.

19. SPECIAL TOOLS & TACKLES :-

- i) A set of special tools & tackle (manual charging handle & operating handle trolley for lifting outside breaker for maintenance) which are necessary or convenient for erection, commissioning, maintenance & overhauling of the equipment shall be supplied.

- ii) The tools shall be shipped in separate containers (Tool Box) clearly marked with the name of the equipment for which they are intended.

20 PARES:-

- i) The bidder shall submit list of recommended spare parts for three (3) years satisfactory & trouble free operation indicating the itemized price of each item of the spares.

21. DRAWINGS, DATA & MANUALS :-

- i) To be furnished for approval after award of work.
- a. General arrangement drawing showing constructional features, space required in front for withdrawals, power & control cable entry points etc.
 - b. Details of materials with specifications.
 - c. Typical foundation plan & loading.
 - d. Typical breaker control schematic.
 - e. Matching flanges & terminals for the bus termination.
 - f. Type test reports on circuit breaker.
 - g. Technical leaflet on
 - h. Circuit breaker
 - i. Instrument transformer
 - j. Relays, meters, switches etc.
 - k. Single line diagram
 - l. Control schematic
 - m. Wiring diagram

22 Instruction manuals of switchgear & individual equipment:-

The manual shall clearly indicate the installation method, checkup & tests to be carried out before commissioning of the equipment.

23 The bidder may note that the drawings, data & manuals listed here in are minimum requirements only the bidder shall ensure that the other necessary write-ups, curves & information required to fully describe the equipment are submitted with his bid.

CIRCUIT BREAKER

Make - As per approved make. Type -

Microprocessor release air

- circuit breaker

Rated voltage - 415 Volts

Rated frequency - 50 Hz

Rated current - 1600/($I_{cu}=I_{cf}=1\text{sec}$ 50 kA)

800A($I_{cu}=I_{cf}=1\text{sec}$ 50 kA)

No. of pole - 3

Aux. Voltage for trip/close coil - 110 V DC Motor for

spring charging Voltage- 240 V AC Protection unit -

Equivalent to SR-18G with fault indication & thermal masonry.

Interlocking arrangement electrically & mechanically with bus coupler & incomer.

PROTECTION (FOR LT SUPPLY 415V PANEL)

The minimum protections to provided for different type of circuit are listed below:-

INCOMING FEEDER:-

2 over current +E/F relay microprocessor based along with the element of instantaneous o/c & E/F protection.

BUS COUPLER:-

3 O/C relay microprocessor based

All inverse time O/C relay shall be 3 sec. Version.

All definite time O/C relay shall have adjustable time range of 0-6 Sec.

Apart from protection relays each breaker shall be provided with auxi. Contact multiplier relay, anti-pumping relay, trip supervision relay, lockout relay test terminal block. These relay shall be hand reset.

2. Specifications for LT Bus Duct

(a)Design Criteria

- The LT non phase segregated bus duct serve as a interconnection between the LT switchgear and outdoor LT transformer.
- The LT bus ducts will be installed partially indoor and partially outdoor in a hot, humid and tropical atmosphere. All panels associated.
- Bus duct associated equipment and wiring shall be provided with tropical finish to prevent fungus growth. All ventilation openings shall be screened and drains shall be filtered to prevent entrance of dust and insects.
- For continuous operation at specified ratings, temperature rise of the bus duct and auxiliary equipment shall be limited to the site permissible values stipulated in relevant standards and / or this specification.
- Bus duct and auxiliary equipment shall be capable of withstanding the mechanical forces and thermal stresses of the short circuit currents listed in the annexure without any damage or deterioration of material.
- The bus ducts shall be self-cooled and shall not be equipped with blower or any other type of forced ventilation.
- Bus duct enclosure shall be of sheet steel.

1. Specific Requirements.

- **General**

- The LT bus duct shall be non-phase segregated enclosure type.
- The layout of the bus ducts shall be generally in accordance with enclosed drawings. The details shown however are only typical. Bidder may propose changes to suit his particular design.
- All parts and accessories shall have appropriate match mark and part numbers for easy identification and installation at site.

- 1. **Enclosure**

- Phase shall be enclosed in weather proof, dust-tight, enclosure of sheet steel fabricated type conforming to degree of protection of IP 55.
- Circumferential neoprene rubber gaskets shall be provided for dust tight joints with adjacent enclosure section.
- The bus enclosure shall have extended bellows or equivalent means to allow for temperature changes and vibrations. Flexible joints shall be provided in enclosures at all points where the bus duct terminates at equipment to withstand vibration, expansion/ contraction and at suitable intervals in any straight run of the bus duct where expansion and contraction would otherwise result in stress in the supporting structures.
- All outdoor bus enclosures shall be so designed & constructed as to prevent accumulation of rain water on top sheet. Similarly all gasketed flanged joints shall be suitably protected against direct splashing of rain water in case of outdoor runs.
- Suitable inspection openings shall be provided for access to support insulators, bus joints, transformer terminals, switchgear terminals etc. All inspection openings shall have reliable sealing arrangement with neoprene gaskets.
- Seal-off bushings complete with wall frame and support plates shall be provided where the bus duct penetrates the building wall. The seal is to prevent free exchange of air between indoor and outdoor portions of the bus duct.
- Silica-gel breather shall be provided on both indoor and outdoor portions of the bus duct.
- Filtered drains for drainage of condensate shall be provided at the lowest points and at such locations where accumulation of condensate can be expected.
- Shipping length of the bus duct shall be not more than three (3) meters in length.

- 4. **Bus Conductor**

- The bus conductor shall be of high conductivity, aluminium alloy, supported on wet process porcelain insulators.
- The bus conductor shall be designed for bolted connections throughout the run.
- Flexible connections shall be provided between bus sections to allow for expansion and contraction of the conductor. Flexible connections shall also be provide at all equipment terminations.
- All contact surfaces shall be silver plated to ensure an efficient and trouble-free connection. All connection hardware shall be non-magnetic and shall have high corrosion resistance.

5. Disconnect Link

- Removable bolted disconnect link shall be provided in the bus where shown on the drawing for the purpose of isolation.
- Disconnect link shall consist of a removable section of conductor and shall be so constructed as to permit easy removal or reinsertion without alignment difficulties.
- The bus on both sides of the link shall be rigidly supported so that the disconnect link is equal in mechanical strength to any other section of the bus.
- A minimum clearance of 300mm (12") shall be provided between the disconnected bus sections with the link removed.

6. Insulators

- Bus support insulators shall be interchangeable, high creep, high strength, wet process, fine glazed porcelain. Alternatively good quality cast resin insulators.
- Insulator shall be mounted in such a way so as to permit easy removal or replacement without disassembly of the bus. The insulator mounting plate shall be designed for cantilever loading to withstand the short circuit.
- The conductor shall be fastened on the insulator through fixed and slip joints so as to allow conductor expansion or contraction without straining the insulator.
- Space heater shall be provided preferably located near to each insulator to avoid moisture condensation within bus-duct. No and wattage rating of space heater shall be decided by the tenderer.

7. Connections & Terminations

- All matching flanges seal off bushings, gaskets, fittings, hardware and supports required for termination of the bus duct at the switchgears, transformers shall be furnished.
- In this connection the contractor is required to coordinate through the Engineer in Charge with the suppliers of the switchgear, transformers with regard to connection details, mechanical and thermal stresses.
- Flexible connections both for conductor and enclosure shall be furnished.
- At all equipment termination to provide for misalignment upto 25mm (1") in all directions.

8. Between bus duct supported from building steel to prevent transmission of vibration.

- The equipment terminal connections shall be readily accessible and shall provide sufficient air gap for safe isolation of equipment during testing.
- If the material of bus conductor and that of the equipment terminal connectors are different then suitable bi-metallic connectors shall be furnished.

9. Grounding

- A separately run 50x6mm GI flat suitably clamped along the enclosure shall be used as the ground bus. All parts of the bus enclosure supporting structures and equipment frames shall be bonded to above ground bus.
- Ground pad shall be bolted type to accommodate 50x6mm galvanized steel flats. Complete with suitable tapped holes, bolts and washers.

10. Supporting Structures

- All supporting structures required for hanging and/or supporting the complete bus duct shall be furnished. These include all members, indoor/outdoor posts, bolts, shims, base plate, beams, hangers, brackets, bracings and hardware.
- All buses shall be adequately supported and braced to successfully withstand normal operation, vibration, thermal expansion, short circuit forces and all specified design loads.
- Supports shall be designed to provide tolerance of plus/minus 12mm (1/2") in the horizontal and vertical directions.
- All steel members shall be hot dip galvanized after fabrication. All hardware shall be of high strength steel with weather resistant finish.
- Concrete foundation, building steel, concrete, inserts/plates will be provided by the owner.
- The contractor shall co-ordinate with the owner for this purpose giving well in advance the details of his requirements so as to enable the owner to arrange for the same in time.

11. Wiring

- All wiring for space heaters shall be done with insulated stranded copper conductor of not less than 2.5 sqmm cross section. Each wire shall be identified at both ends with wire designation as per contractor's wiring diagram and shall be brought out to a terminal box outside the bus duct.
- Terminal blocks shall be box-clamp type Elemex 10 sq.mm with marking strips or approved equal.
- At least 20% spare terminals shall be furnished in the terminal block.

3. Name Plate

- Suitable name plate shall be furnished with each piece of equipment.
- Materials for name plate shall be plastic/lamicoid, 3mm thick, using white letters on black background.

1. Finish

- Except for supporting steel structures which shall be galvanized, all equipment shall be finished with an undercoat of high quality primer followed by two coats of synthetic enamel paints.
- The interior surface finish shall be as per manufacturer's standard. The shade of exterior surface finish will be battle ship gray shade 632 as per IS-5.
- Pre-treatment consisting of degreasing, derusting etc. shall be done on all fabricated parts before painting or galvanizing.
- Paints shall be carefully selected to withstand heat and weather conditions. The paint shall not scale-off or crinkle or get removed by abrasion due to normal handling.
- Sufficient quantities of all paints and preservatives required for touching up at sites shall be furnished.

4. Handling of cable drum and cable:

- Rolling of drum shall be avoided as far practicable. For short distance, the drums may be rolled they are rolled slowly and in proper direction as marked on the drum. In absence of any identification. The drums may be rolled in the same direction as it was rolled during taking up the cable.

- For unreeling the cable, the drum shall be mounted on jacks or on cable well. The spindle shall be strong enough to carry the weight without bending. The drum shall be rolled on the spindle slowly, so that cable should come out over the drum & not below the drum.
- While laying cable, cable shall be used at an interval of 2 meters. The cable shall be pushed over the roller by a gang of people positioned in between rollers. The cable shall not be pulled from the end without laying intermediate pushing arrangement. Bending radius shall not be less than what is specified by manufacturer.

15. Cable laying:

- Cables shall generally be installed in cable trays except for some short runs in buried formation or in conduit / pipe for protection or crossing. Multi core power cable laid on trays & riser shall be neatly dressed & clamped with fabricated 25 x 3 mm G.S flat or cable tray at an interval of maximum 1 meter for vertical / inclined run & 1.50 meter for horizontal run. Control cables may be laid in single layer with touching formation. Power & control cables shall be claimed in separate group. Power & control cables shall not be laid in a common tray excepting in very special case where a gap of 150 mm shall be maintained between power & control cables.
- H.T & L.T power cables shall be laid in cable trays in single layer & with spacing equal to the diameter of cable.
- Control cable can be laid up to a maximum of three layers in each tray.
- Both power & control cables shall be clamped to the trays rungs by means of clamp made up to 25 x 3 mm fabricated G.S flat at an interval of 1500 mm for horizontal run & 1000 mm for vertical / inclined cable run.
- The cable trays shall be run with a vertical spacing of 300 mm cable trenches. A minimum of 300 mm clearance shall be provided between the top of tray & beams, cold piping, 500 mm clearance for hot piping / object to facilitate installation of cables in tray.
- Adequate pull boxes shall be provided in conduit run to facilitate. Cable pulling in long runs & also to ensure that there will be no more than 270 degree bend between the pull points.
- Cable tray shall be installed to accommodate cable manufacture's recommended maximum pulling tension & minimum bending radius.
- All opening in the floor & wall for cable access shall be sealed after installation of the cable system with non-inflammable materials.
- All floor/ wall for cable entry to the electrical equipment & accessories shall be sealed with non-inflammable material, after completion of cable installation. Thickness of such materials shall be equal to the thickness of floor / wall.

16. Cable power & control:

- The tender shall install & connect all power & control cable required for complete installation within his scope of work. Type and size of power & control cable shall be as specified & as supplied under a separate sub section for power and control cable.
- In general all power and control cable shall be run in cable trays in cable trenches. Isolated runs of control cables shall be run in rigid conduit. Jointing of power cable should be avoided as far as possible. However, if any splicing of control cable is required to carry out interlock it will be done in junction boxes not in the conduit or in the trays. Such junction boxes shall be in scope of tenderer.
- The contractor shall not install cables with different voltage in the same cable tray.

- During cable installation care shall be taken so that actually binding radius of each cable is not less than the one recommended by the cable manufacturer.
- For cable buried directly underground there shall be a stone free sand cushion both above and below the cable run being held by brick wall support on two (2) sides. The excavated portion above the top sand cushion shall be covered by concrete precast slab supported on the side walls & finally filled up with standard back fill.
- Cables shall be pulled into the trenches in strict accordance with the cable manufacture's instruction.
- Tender shall furnish & install suitable solder less crimping type cable lugs at the termination of all wires & cables if not already furnished with the equipment.
- All exposed conduits & armoured cables shall be tagged with numbers that appear in the conduit & cable schedules as prepared by the tenderer. All conduits & armoured cable shall be tagged at their entrance and / or exist from any piece of apparatus, junction box or pull box. Aluminum tags shall be used with the number engraved / punched on the tag. Tag shall suitably be secured to the conduit or armoured cable.
- The cable tags shall also be provided at all bends and at interval of 30 M on straight run of cable in order to facilitate the identification.
- Laying termination & connection of all control cables for interlock, protection, indication & annunciation.

The tender shall prepare cable schedule & interconnection diagram & submit the same for approval of the Authority. Cable laying shall be started with the approval cable schedule & interconnection diagrams. Separate cables for each type of following services/ functions as applicable shall be used & laid along the run for each feeders.

- a) Power - designate as 'P'
- b) Control protection interlock, meeting, indication & annunciation designate as "C".

17. Filed Testing:

- Filed testing shall be required for all the equipment & accessories furnished, installed or connected by the tenderer to ensure proper installation, setting, connection & in accordance with the plans, specification and manufacturer's recommendations.
- Testing shall be conducted in presence of Owner's Engineer (i.e., Engineer in Charge) with prior notice at least 2 weeks before commencement of any test.
- Filed testing work shall be done as per the latest edition of the relevant standards. All tests recommended by the equipment manufacturer shall be conducted. The tenderer shall submit the list of all filed tests to be conducted for all equipment & accessories for review / approval by the owner.
- Testing shall include any additional tests suggested by the owner that the deems necessary because of filed condition to determine that equipment, materials & system meet requirements of the specification.
- The tender shall depute qualified personal to conduct all testing & shall provide all labour and testing equipment required for & incidental to testing.
- The tender shall be responsible for any damage to equipment & material due to improper test procedure or test apparatus & shall replace to original condition of any damaged equipment or

material.

- The tender shall maintain in quadruplicate a written record of all tests showing date, personal making the tests, equipment or material tested performed & result. Two copies of test records shall be given to the authority.

18. Commissioning:

After the satisfactory test is performed the equipment & material shall be put on trial operation by the tenderer. After successful trial operation, the equipment shall be put on performance tests initially at no load condition & finally with different loading conditions

Figure 2: Modified provisions in CPWD works manual 2019 regarding testing charges to be borne by contractor.

11 SPECIFICATION FOR THE ELECTRICAL INSTALLATION WORK

The following specifications will apply under all circumstances to the equipment to be installed against this contract and it is to be ensured that the contractor shall obtain for himself at his own expense and on his own responsibility all the information which may be necessary for purpose of making the tender and for entering into a contract keeping in view the specification and inspection of site etc.

The tendered rates shall include for the cost of material erection, connection, commissioning, labour, supervision, tools, transport all taxes, contingencies, breakage, wastage, sundries, scaffolding, maintenance of installations for defect liability period i.e. they should be for an item complete in all respects.

The general specifications of electrical works for internal and general specifications for Sub-station works- of CPWD shall be followed.

1. SITE CONDITIONS: the equipment to be erected and commissioned should be suitable for the site conditions, it is estimated that the maximum temperature at site will be 50°C.

2. L.S.SPECIFICATIONS:

The following Indian standard specifications will apply to the equipment and the contract unless specified otherwise.

a) Transformer	IS 2026-1977 & 1981
b) Low tension air-circuit breakers and MCCB	IS 2516-1965
c) Switch fuse unit on cubicle switch boards etc.	IS 4047-1967
d) Switch fuse unit on industrial boards etc	IS 4064-1967
e) Switch gear bus bars	IS 375-1963
f) HRC fuse links	IS 2208-1962
g) Distribution fuse boards	IS 2675-1966
h) Degree of protection provided by enclosure For low voltage switchgear	IS 2147-1962
i) PVC cables.	IS 1954-1962
j) 11,000 volt paper insulated lead sheathed cables	IS 692-1965
k) Tubular fluorescent lamps for general lighting	

Service.	IS 2418-1965
l) Tungsten filament lamps for general service.	IS 418-1963
m) Ceiling fans	IS 374-1966
n) Flood light	IS 1947-1961
o) Well glass flame proof electric light fitting	IS 2206-1962 Part-I
p) XLPE cables	IS 7098-Part-II
q) Industrial light fittings with metal reflectors.	IS 1971-1961
r) Water tight electric light fittings	IS 3533-1966
s) Fittings for rigid steel conduits	IS 2667-1964
t) Rigid steel conduits for electrical wiring	IS 1958-1964
u) Accessories for rigid steel conduit for electrical Wiring.	IS 3873-1966
v) Switch socket outlets.	IS 4615-1963
w) Three pin pug and socket outlets`	IS 1233-1967
x) Switches for domestic and similar purpose	IS 3858-1966
y) AC electricity meters	IS 722-1977/1980+86

CODE FOR PRACTICE

Earthing	IS 3043-1966
Electrical wiring installations	IS 732-1963
Lighting protection	IS 2309-1969

Technical Submittals

The successful tenderer after award of work shall furnish technical submittals 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:

<i>a.</i>	<i>CHILLER WITH CHILLER PLANT MANAGER</i>
<i>b.</i>	<i>CHILLED WATER PRIMARY VARIABLE PUMPS</i>
<i>c.</i>	<i>PRESSURISATION SYSTEM</i>
<i>d.</i>	<i>CONDENSER WATER PUMP</i>
<i>e.</i>	<i>CHILLED WATER PIPING</i>
<i>f.</i>	<i>AIR SEPARATOR</i>
<i>g.</i>	<i>COOLING TOWER</i>
<i>h.</i>	<i>DIRT SEPARATOR</i>
<i>i.</i>	<i>PLUMBING WATER PUMPING SYSTEM</i>
<i>j.</i>	<i>WATER TREATMENT SYSTEM</i>
<i>k.</i>	<i>ELECTRICAL PANELS & COMPONENTS.</i>
<i>L</i>	<i>VALVES, PIPES AND ASSOCIATED CONTROL</i>
<i>m</i>	<i>CHILLER INSULATION MATERIAL</i>
<i>n</i>	<i>AIR HANDLING UNITS/FCU/CSU/HEAT RECOVERY WHEELS</i>
<i>o</i>	<i>PRECISION AIR CONDITIONING SYSTEM</i>
<i>p</i>	<i>COLD ROOM</i>
<i>q</i>	<i>ANY OTHER ITEM AS MENTIONED IN THE BOQ</i>

Test certificates for various items shall also be submitted by the contractor required by Engineer In Charge/PMC..

12 List of Approved Makes

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/Bhutoria
8	Duct (factory fabricated)	Rola Star / Techno Fabri-duct/Zeco/Ductofab
9	Water strainers (Y- strainer/pot strainer)	Emerald/Sant/ Audco/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 connection	Air flow / Twiga/ATCO/GP spira/caryaire
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	Chiller/Heatpump	Trane/Carrier/York/Daikin
28	Polyurethane Foam (PUF)	Malanpur/ Lloyd /Best Opuf

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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/Bhutoria
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/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 / Crane/Kitz/Kirloskar
56	Check Valve (Non return valve)	Audco/Advance/Kirloskar/Crane/Kitz
57	Balancing valve	Advance /Audco/ Oventrop/Danfoss
58	Centrifugal pump / Monobloc Pump	Grundfoss/Armstrong/Willo/Xylem
59	Water Treatment Plant	Thermax/ Ion Exchange Ltd. / Gradient/Veolia/Nalco Water
60	Pressure switch	Indfoss / HonewellIndfoss / Honey- well
61	Bronze ball valve	Emerald/ Zoloto / Leader/ Sant
62	Bronze ball valve with Y strainer	Emerald / Rapid control/ BAP
63	Suction guide	Anergy instrument Pvt.Ltd./Johnson/Pump OEM

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		make
64	Water cooled screw chilling unit/Heat Pumps	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/Tecumsseh/Bohn/Danfoss
68	Cold room/Deep freezer	Voltas/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/Grandlay
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	XLPE Class-O tubular insulation with specification as per BOQ.	Supreme / K-Flex/ A-Flex/Aerolam
79	PAC Unit with specification as per BOQ	Schneider (Uniflair)/StulzChspl (In- dia) Pvt.Ltd /Emerson Climate Technologies/ Bluebox
80	Electrical LT Panels or MCC Panels with specification as per BOQ.	<i>(Main LT panel / MCC Panel board should be IEC 61439 part-I and II manufacturer has to produces the relevant test certificate as per IEC code for the same failing which panel shall be rejected). L&T /Siemens / Schneider/ ABB/ Legrand/ Neptune /Milestone switchgear/ Excel/Adlec</i>
81	Portable type dehumidifier with Specification as per BOQ.	White Westinghouse/Power Pye Electronics/Bryair /Munter
82	GI volume control duct damper with specification as per BOQ.	Airmaste Equipment Emirates/Omega/Airflow
83	Soft duct (Fabric Duct)	Duct Sox/Prihoda
84	Smoke cum fire damper (Bare Damper)	Dynacraft/Mapro/Servex/Ruskin
85	Smoke cum fire damper (Actuator)	Belimo/Joventa/Honeywell/Siemens

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86	Automatic Pressurization cum expansion tank	Flamco/Reflex/ IMI Hydronics/Ballandgosset
87	Dirt separator	Flamco/Reflex/ IMI Hydronics/Spirotech
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 LT Panels or MCC Panels with specification as per BOQ.	(Main LT panel / MCC Panel board should be IEC 61439 part-1 and II manufacturer has to produces the relevant test certificate as per IEC code for the same failing which panel shall be rejected). L&T /Siemens / Schneider/ ABB/ Legrand/ Neptune /Milestone switchgear/ Excel/Adlec
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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
89.	<i>MS Conduit (ISI marked)with heavy duty accessories</i>	<i>BEC/AKG/ RM CON /Steel Kraits</i>
90.	<i>PVC/ XLPE insulated aluminium / copper conductor armouredunarmoured MV cables upto 1100 V(ISI Marked)</i>	<i>Havells / Finolex/ KEI/ Grandlay/ Polycab/Gloster</i>
91.	<i>FRLS PVC insulated copper conductor stranded flexible wire i/c control cables(ISI Marked)</i>	<i>Havells/Finolex/KEI/ Grandlay/Polycab/Gloster</i>
92.	<i>Cable Raceway floor/wall mounted and accessories</i>	<i>Legrand / MK (Honeywell) / OBO/Excel</i>
93.	<i>Cable Tray & Accessories</i>	<i>Venus / MEM / BEC / RM CON/ Indiana/Excel</i>
94.	<i>Modular Switch & Socket & Accessories</i>	<i>Legrand(Myrus)/M.K. (Element) /Schneider (Zencelo) / legrand (Arteor)/ ABB</i>
95.	<i>Metal clad Industrial Socket outlet and sheet steel Enclosure for MCCB/ MCB</i>	<i>Legrand/Siemens/Schneider/Hager</i>
96.	<i>Cable Glands</i>	<i>Dowells/Commet/Gripwell/Raychem</i>
97.	<i>Lugs and end termination</i>	<i>Dowells/Commet/Braco</i>
	<i>Change over switch</i>	<i>L&T / Socomac / ABB / Schneider</i>

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98.	<i>Distribution Boards</i>	<i>Siemens (Betagard), / Hager / Schneider (Acti9) / Legrand (Ekinox3³/ L&T (Exora / ABB (Elegence)</i>
99.	<i>Protection Device (MCB/RCCB/RCBO/ELCB)</i>	<i>Siemens (5SL), Hager / Schneider (Acti9) / Legrand (DX 3) / ABB (S200M) / L&T</i>
100	<i>Current transformer / potential transformer</i>	<i>AEL / Gilbert & Maxwell / Pragati / Precise / L&T/ Kappa/Kalpa</i>
101	<i>Indicating Lamps LED type, Push Button</i>	<i>Siemens / L&T / Schneider / Legrand</i>
102	<i>Electronic Digital Meters</i>	<i>Schneider (conzerv) / L&T / Secure / Siemens / ABB / Legrand</i>
103	<i>MCCBs</i>	<i>Siemens (3VL) / L&T (D sine) / Schneider (CVS) / Legrand (DPX3) ABB (T max)</i>
104	<i>Power Contactor</i>	<i>L&T (MNX)/ Schneider (Tsys) / Legrand (CTX³) ABB (Ax)</i>
105	<i>Surge Protection Devices</i>	<i>Siemens/L&T/Schneider / Legrand/ OBO/DEHN</i>
106	<i>Selector Switch</i>	<i>Salzer/Seimens /BCH/ Kaycee / L&T</i>
107	<i>Auxiliary Relays</i>	<i>Siemens/L&T/Schneider/Legrand/ABB</i>
108	<i>LED Lighting Fixture</i>	<i>Philips/ Wipro/Havells/Crompton</i>
109	<i>Emergency Lighting/ Exit Sign boards</i>	<i>Bajaj / Prolite / Glo-Line</i>
110	<i>Ceiling Fan, Fresh Air Fan, Exhaust Fan</i>	<i>Havells/Crompton/ Usha / Orient/ Atomberg</i>
111.	<i>Paint</i>	<i>Nerolac/Asian/Berger/ICI</i>
112	<i>Lighting Protech System</i>	<i>OBO/ Cape Electric/ Infinite / APS/ Jeff Techno/ Axis/DEHN</i>
113	<i>G.I Pipe</i>	<i>Tata, Jindal-Hissar, Prakash Surya</i>
114	<i>Rubber Mat (ISI Marked)</i>	<i>Jyoti / Deep Jyoti/ Premier</i>
115	<i>Fire Extinguisher</i>	<i>Minimax/ Life Guard / Cease Fire / Newage</i>
116	<i>CU/ GI Strip & GI wire for earthing</i>	<i>Jeff Techno/ Axis / OBO</i>
117	<i>MS Conduit (ISI marked)</i>	<i>BEC/AKG/NIC/ Steel craft/ M-Key, SK (E.R.W)</i>
118	<i>PVC Conduit and accessories</i>	<i>Polycab/ AKG / Asian</i>
119	<i>1.1 KV aluminium/Copperarmoured XLPE insulated and PVC sheathed cable (LT cable)</i>	<i>Havells /KEI/ Finolex/ Grandlay/ Gloster/Polycab</i>
120	<i>Modular Switch & Socket</i>	<i>Legrand (Myrus) MK (Element) Schneider (Zencelo India) / Havells/ ABB</i>
121	<i>Metal Clad Industrial Socket</i>	<i>Legrand / Siemens/Schneider/ C&S/ ABB</i>
122	<i>Cat-6 cable</i>	<i>Beldon/Siemon/Legrand/Penduit (Pannet)</i>

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123	<i>Crimp Patch Cord</i>	<i>Beldon/Siemon/Legrand/Penuit (Pannet)</i>
124	<i>Panel Accessories</i>	<i>Siemenss/ L&T/ Schneider / Legrand / Tecnic/ ABB/ C&S/ Neptune</i>
125	<i>LED/ Metal Halide / Fluorescent Internal Lighting Fixtures</i>	<i>Philips/ Wipro/Havells/Crompton</i>
126	<i>External Lighting Fixture</i>	<i>Philips/ Wipro/Havells/Crompton</i>
127	<i>Ceiling Fan (ISI marked & BEE rated 5 star)</i>	<i>Havells / Almonard/ Orient/ Usha/ Bajaj</i>
128	<i>Advance lighting protections System (Early Streamer Emission Type)</i>	<i>LPI (Australia)-by allied power/ SGI (Duval Messien/ Satellite(France) by SGI/ Bradlay (USA) - by JMV/ Erico (USA) by security shoppe/ ABB/DEHN</i>
129	<i>Main LT Panels/ MCC Panel</i>	<i>(Main LT panel / MCC Panel board should be IEC 61439 part-I and II manufacturer has to produces the relevant test certificate as per IEC code for the same failing which panel shall be rejected). L&T /Siemens / Schneider/ ABB/ Legrand/ Neptune /Milestone switchgear/ Excel/Adlec</i>
130	<i>Air Circuit Breaker</i>	<i>Siemens / Schneider/ L&T/ Legrand/ ABB/CGL</i>
131	<i>Surge Voltage Protection</i>	<i>Siemens/L&T/Schneider / ABB</i>
132	<i>Earth fault module</i>	<i>Siemens/Schneider/L&T/Legrand</i>
133	<i>Protection relays</i>	<i>Siemens/ Areva/ L&T/ Legrand</i>
134	<i>C.Ts and PTs</i>	<i>Kappa / AE/ Matrix/KALPA</i>
135	<i>Digital Meters</i>	<i>Siemens (PAC)/ Schneider/ (conzerv) / Secure Enersol / L&T/ Neptune</i>
136	<i>Indicating lamps</i>	<i>ESBEE/Schneider/Siemens/Vaishno/Neptune</i>
137	<i>Power capacitors</i>	<i>Epcos/ Neptune / Legrand /ABB/ L&T</i>
138	<i>Automatic Power factor correction relay/controller</i>	<i>Epcos/Siemens (PAC) /Schneider (Conzerv)/L&T/Neptune</i>
139	<i>Sealed Maintenance Free Batteries</i>	<i>Exide/Panasonic/Amara Raja/HBL</i>
140	<i>Battery charger</i>	<i>Caldyne/Chhabi Electricals/Statcon/Max Power</i>
141	<i>Cable Trays (Factory Fabricated/ Overhead & Floor Raceways</i>	<i>Legrand/MEM/OBO/ Milestone/ Neptune/Excel</i>
142	<i>HDPE underground cable duct</i>	<i>Rex Polyextrusion/ Tirpura/ Plasomatics/ Duraline</i>
143	<i>Insulation Mats</i>	<i>DL Miller & Co. Ltd.?PremierPolyfilm Ltd./RMG Polyvinyl India Ltd/Jyoti</i>
144	<i>Smoke/Heat detectors</i>	<i>Apollo/ System Sensor/ Agni</i>
145	<i>Manual Call point</i>	<i>PRD/System-Tek/ Simplex/ System Sensor/ Agni</i>

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146	<i>Response indicators</i>	<i>PRD/System-Tek/ Simplex/ System Sensor /Agni</i>
147	<i>Fire Exit Signs</i>	<i>System-Tek/ Simplex/ Agni</i>
148	<i>Fire Control Panel</i>	<i>System-Tek/ Morley /Agni</i>
149	<i>Speaker / Hooter</i>	<i>System-Tek/ Philips /Agni</i>
150	<i>Occupancy Sensors/ Movement Sensor</i>	<i>Legrand/ Philips/ Wipro</i>
151	<i>Flush type switch /socket</i>	<i>Anchor/ Kinjal/ SSK/ Havells Reo</i>
152	<i>Fuse switches unit / switch fuse unit /HRC fuse</i>	<i>L&T / Siemens/ Havells/ C&S</i>
153	<i>Exhaust fan</i>	<i>Almonard/ Alstom/ Crompton/ Havells</i>
154	<i>XLPE insulated HT cables</i>	<i>KEI/Havells/Grandlay/Gloster/Polycab</i>
155	<i>Cable lug</i>	<i>Ascon (Heavy gauge) JainsonDowells</i>
156	<i>Telephone wires/Telephone Cable / jelly filled telephone cables</i>	<i>Finolex /Delton/Havell's</i>
157	<i>Telephone tag blocks</i>	<i>Krone/ Pouyet</i>
158	<i>Telephone outlet</i>	<i>MK Electric /Legrand (Mosaic)/Crabtree (Piccadilly)</i>
159	<i>GI raceways</i>	<i>Milestone Engineering /Legrand/ MDS/ Neptune Systems Pvt. Ltd./MK /Excel</i>
160	<i>PVC raceways</i>	<i>Legrand/ MK</i>
161	<i>Electronic ballast</i>	<i>Philips / Wipro/ Bajaj/ Decon/Crompton/Havells</i>
162	<i>DLP plastic trunking</i>	<i>Legrand/MK</i>
163	<i>Geysers</i>	<i>Recold /Venus /Usha Lexus /Sphere hot</i>
164	<i>Tower Light</i>	<i>Ligman/Simes/Bega</i>
165	<i>HT/LT transformers</i>	<i>ABB/Schneider /CGL (Crompton Greaves Ltd.)/Siemens</i>
166	<i>HT SF-6 circuit breakers / VCB</i>	<i>Siemens/ ABB/ CGL / Schneider</i>
167	<i>Programmable Logic Controller (PLC)</i>	<i>Siemens /Allen-Bradley/ Schneider/ CGL</i>
168	<i>Earthing (Chemical Earthing Plate Earthing)</i>	<i>JMV/ As per CPWD Norms</i>
169	<i>Octagonal Pole</i>	<i>Bajaj / Crompton / Phillips</i>
170	<i>11 kV HT panel Incoming relay(IEC 61850)</i>	<i>CGL/Schneider/ABB/ Siemens</i>
171	<i>Control Relay Panel</i>	<i>CGL/Schneider/ABB/Siemens</i>
172	<i>Lightning Arrestor</i>	<i>ABB/Alltec/JMV/DEHN</i>
173	<i>Temp. Gauge</i>	<i>Guru</i>
174	<i>Gate Valve</i>	<i>Leader/Sant</i>
175	<i>Electrical Backup</i>	<i>Spare hot/ Racold</i>
176	<i>PVC Tank</i>	<i>Syntex/ Polycon</i>

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177	<i>Thermostat</i>	<i>ISI Marked</i>
178	<i>Flat Collector Plate</i>	<i>Solocrome/ Tata BP/ Racold</i>
179	<i>S.S Sheet</i>	<i>Jindal / National</i>
180	<i>HT/LT cable joints (Straight through/outdoor/indoor)</i>	<i>3M/ Denson/ M Seal/Raychem/ Cabseal</i>
181	<i>Alternator</i>	<i>STAMFORD/Crompton Greaves/Kirlosker/Leroy Somer</i>
182	<i>DG set engine</i>	<i>Kirlosker/ Cummins/ Greaves Cotton/Baudouin/Caterpillar/Perkins</i>
183	<i>DG Set (Preferred makes)</i>	<i>Sterling Generator/ Kirlosker /Caterpillar/Cummins Power / Greaves Cotton/Jackson</i>
184	<i>Makes of accessories of HT / LT Panel</i>	<i>As per standard practice of manufacturer/ L&K /Siemens / Schneider/ ABB/Legrand/Crompton Greaves</i>
185	<i>Bus Trunking</i>	<i>C&S / CGL/ L&T/ Schneider as per standard practice of OEM manufacturer</i>
186	<i>HT panel 11 KV</i>	<i>Siemens/ABB/ Schneider/ CGL (Crompton Greaves Ltd.)</i>
187	<i>Bus Duct</i>	<i>Neptune / Milestone/ Tricolite</i>
188	<i>Lamp Holder (Brass)</i>	<i>Kay/ SSK/ Kinjal</i>
189	<i>UPS</i>	<i>APC(Schneider)/Vertiv/Numeric/Delta/Eaton</i>
190	<i>AMF Panel</i>	<i>L&T/ Siemens/ ABB/ Excel Control</i>
191	<i>RTU panel</i>	<i>Synergy/ Siemens/ Schneider/GE</i>
192	<i>Li-Ion battery Storage System</i>	<i>Exide nextcharge /Panasonic/Samsung/LG</i>

Note: Any other material not listed shall be approved by Engineer In Charge.

15. List of Drawings

. No.	Name of drawing	Drawing No.
A	HVAC Drawings	
1	Schematic layout- HVAC Piping System (Chilled water, Hot water, VRF, DX piping) SUPER SPECIALITY BLOCK (SHAFT-1)	SSH-ME-1003-1 OF 6
2	Schematic layout- HVAC Piping System (Chilled water, Hot water, VRF, DX piping) SUPER SPECIALITY BLOCK (SHAFT-2)	SSH-ME-1003 2 OF 6
3	Schematic layout- HVAC Piping System (Chilled water, Hot water, VRF, DX piping) SUPER SPECIALITY BLOCK (SHAFT-3)	SSH-ME-1003-3 OF 6
4	Schematic layout- HVAC Piping System (Chilled water, Hot water, VRF, DX piping) SUPER SPECIALITY BLOCK (SHAFT-4)	SSH-ME-1003-4 OF 6
5	Schematic layout- HVAC Piping System (Chilled water, Hot water, VRF, DX piping) ANCILLARY BLOCK (SHAFT-5)	SSH-ME-1003-5 OF 6
6	Schematic layout- HVAC Piping System (Chilled water, Hot water, VRF, DX piping) ENGINEERING YARD	SSH-ME-1003-6 OF 6
7	HVAC-DUCTING LAYOUT Ground Floor Plan	ANC-ENGG-ME-401
8	HVAC - PIPING LAYOUT Ground Floor Plan	ANC-ENGG-ME-501
9	HVAC-DUCTING LAYOUT First Floor Plan	ANC-ENGG-402
10	HVAC - PIPING LAYOUT First Floor Plan	ANC-ENGG-502
11	HVAC-DUCTING LAYOUT Second Floor Plan	ANC-ENGG-ME-403
12	HVAC - PIPING LAYOUT Second Floor Plan	ANC-ENGG-503
13	HVAC-DUCTING LAYOUT Third Floor Plan	ANC-ENGG-ME-404
14	HVAC - PIPING LAYOUT Third Floor Plan	ANC-ENGG-ME-504
15	HVAC-DUCTING LAYOUT Fourth Floor Plan	ANC-ENGG-ME-405
16	HVAC - PIPING LAYOUT Fourth Floor Plan	ANC-ENGG-ME-505
17	GENERAL DETAIL- HVAC NOTES & LEGENDS	SSH-ME-003
18	GENERAL DETAIL- HVAC TYPICAL DETAILS1	SSH-ME-003-1 OF 2
19	GENERAL DETAIL- HVAC TYPICAL DETAILS2	SSH-ME-003-2 OF 2
20	CHILLED WATER FLOW DIAGRAM (HVAC SYSTEM)	SSH-ME-1003B-1 OF 3
21	HOT WATER FLOW DIAGRAM (HVAC SYSTEM)	SSH-ME-1003B-2 OF 3
B	Electrical Drawings	
1	Legends of Electricals	SSH-EL-001
2	Electrical earthing Schematic Diagram	SSH-EL-905
3	Earth PIT location layout for SITE plan	TGS-EL-401
4	Electrical Single Line Diagram (SLD)	SSH-EL-906-SHEET 01 to 30
C	PHE Drawings	
1	DOMESTIC WATER SYSTEM WTP SCHEMATIC FOR ENGINEERING BLOCK.	383-IITK-ENYRD-PL-DWTP-SC-001
2	FLUSHING WATER SYSTEM WTP SCHEMATIC FOR ENGINEERING BLOCK.	383-IITK-ENYRD-PL-FWTP-SC-002
3	HOT WATER SUPPLY AND RETURN SYSTEM SCHEMATICFOR ENGINEERING BLOCK.	383-IITK-ENYRD-PL-HWS-SC-003
4	SSH-Under Ground Water Tank DETAILS LAYOUT	383-IITK-ENYRD-PL-UGT-001.R1
5	Schematic Water Supply Layout	SSH-ME-1002
6	PLUMBING - WATER SUPPLY - SECOND FLOOR PLAN	ANC-ENGG-PL-203

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	(ANCILLARY BLOCK+ENGINEERING YARD)	
	Link for all above drawings https://drive.google.com/drive/folders/1wmJDIfsvyRP9kRmInB00qcONDcObpt0?usp=sharing	

APPENDIX I

Undertaking from major equipment OEM's (Original Equipment Manufacturer)

The lowest tenderer shall submit along with the performance guarantee after the acceptance of tender, an undertaking from OEM's as at Annexure-1 to 6 regarding major equipment's as mentioned below:

- In Annexure 1 to for the 3 years defect liability period & 2 years non comprehensive warranty of the Chillers, Pumps, Cooling Tower and all major items as mentioned in the BOQ in favor of IIT Kanpur. The OEM shall unconditionally support the lowest tenderer technically throughout the execution of the contract as well during DLP, comprehensive warranty & non comprehensive maintenance contract period for the useful life of the equipment.
- The OEM shall provide list of all the necessary spares required for healthy functioning of the transformer till the useful life of the equipment.

ANNEXURE – 1

Original Equipment Manufacturers (OEM) undertaking for providing 3 years of Defect Liability Period & additional 2 years of non-comprehensive warranty of the chiller to the lowest tenderer for 1050 TR Centrifugal Chiller including its integrated VFD & Chiller plant manager (CPM) proposed to be supplied to IIT Kanpur under the above tender No..... by M/s.....

1. We, OEM for 1050 TR Centrifugal Chiller including its integrated VFD & Chiller plant manager (CPM) do hereby give undertaking to IIT Kanpur for the 3 years of Defect liability period & 2 years of non-comprehensive warranty support through M/s....., lowest tenderer for the work, **“Supply, Installation, Testing & Commissioning of Water Cooled Central AC Plant of Capacity 4600 TR (4x1050 TR +1X400 TR) with Electrical (remaining) & Plumbing (Highside) works (Package - 4) of GSMST at IIT Kanpur”**.

1. We also give undertaking to provide maintenance support and all the spares to IIT Kanpur throughout the useful life of the equipment for the hardware, software, integrated VFD, CPM and any other accessories for running the equipment.

M/s.....

Authorized signatory with stamp.

ANNEXURE – 2

Original Equipment Manufacturers (OEM) undertaking for providing 3 years of Defect Liability Period & additional 2 years of non-comprehensive warranty of the chiller to the lowest tenderer for 400 TR Screw Chiller including its integrated VFD& Chiller plant manager (CPM) proposed to be supplied to IIT Kanpur under the above tender No..... by M/s.....

1. We, OEM for 400 TR Screw Chiller including its integrated VFD& Chiller plant manager (CPM) do hereby give undertaking to IIT Kanpur for the 3 years of Defect liability period & 2 years of non-comprehensive warranty support through M/s....., lowest tenderer for the work, **“Supply, Installation, Testing & Commissioning of Water Cooled Central AC Plant of Capacity 4600 TR (4x1050 TR +1X400 TR) with Electrical (remaining) & Plumbing (Highside) works (Package - 4) of GSMST at IIT Kanpur”.**

1. We also give undertaking to provide maintenance support and all the spares to IIT Kanpur throughout the useful life of the equipment for the hardware, software, integrated VFD and any other accessories for running the equipment.

M/s.....

Authorized signatory with stamp.

ANNEXURE – 3

Original Equipment Manufacturers (OEM) undertaking for providing 3 years of Defect Liability Period & additional 2 years of non-comprehensive warranty of the heat pump to the lowest tenderer for water to water heat pump of 350KW capacity proposed to be supplied to IIT Kanpur under the above tender No..... by M/s.....

1. We, OEM for water to water heat pump of 350KW capacity do hereby give undertaking to IIT Kanpur for the 3 years of Defect liability period & 2 years of non-comprehensive warranty support through M/s....., lowest tenderer for the work, **“Supply, Installation, Testing & Commissioning of Water Cooled Central AC Plant of Capacity 4600 TR (4x1050 TR +1X400 TR) with Electrical (remaining) & Plumbing (Highside) works (Package - 4) of GSMST at IIT Kanpur”.**

1. We also give undertaking to provide maintenance support and all the spares to IIT Kanpur throughout the useful life of the equipment for the hardware, software, integrated VFD and any other accessories for running the equipment.

M/s.....

Authorized signatory with stamp.

ANNEXURE – 4

Original Equipment Manufacturers (OEM) undertaking for providing 3 years of Defect Liability Period & additional 2 years of non-comprehensive warranty of the heat pump to the lowest tenderer for air to water heat pump of 350KW capacity proposed to be supplied to IIT Kanpur under the above tender No..... by M/s.....

1. We, OEM for air to water heat pump of 350KW capacity do hereby give undertaking to IIT Kanpur for the 3 years of Defect liability period & 2 years of non-comprehensive warranty support through M/s....., lowest tenderer for the work, **“Supply, Installation, Testing & Commissioning of Water Cooled Central AC Plant of Capacity 4600 TR (4x1050 TR +1X400 TR) with Electrical (remaining) & Plumbing (Highside) works (Package - 4) of GSMST at IIT Kanpur”**.

1. We also give undertaking to provide maintenance support and all the spares to IIT Kanpur throughout the useful life of the equipment for the hardware, software, integrated VFD and any other accessories for running the equipment.

M/s.....

Authorized signatory with stamp.

ANNEXURE – 5

Original Equipment Manufacturer (OEM) undertaking for ensuring availability of the refrigerant throughout the useful life of Centrifugal Chiller, Screw Chiller & heat pumps proposed to be supplied to IIT Kanpur under the above tender No..... by M/s.....

1. We, OEM for Centrifugal Chiller, Screw Chiller & heat pumps do hereby give undertaking to IIT Kanpur for the providing refrigerant throughout the life of the chillers & heat pumps through M/s....., lowest tenderer for the work, **“Supply, Installation, Testing & Commissioning of Water Cooled Central AC Plant of Capacity 4600 TR (4x1050 TR +1X400 TR) with Electrical (remaining) & Plumbing (Highside) works (Package - 4) of GSMST at IIT Kanpur”**.

2. We also give undertaking to provide un-conditional support to the lowest tenderer technically throughout the execution of the contract as well during DLP, comprehensive warranty & non comprehensive maintenance contract period for the useful life of the equipment.

M/s.....

Authorized signatory with stamp.

ANNEXURE – 6

Original Equipment Manufacturers (OEM) undertaking for providing 3 years of Defect Liability Period & additional 2 years of non-comprehensive warranty of the cooling tower to the lowest tenderer for Cooling towers proposed to be supplied to IIT Kanpur under the above tender No..... by M/s.....

1. We, OEM for Cooling tower do hereby give undertaking to IIT Kanpur for the 3 years of Defect liability period & 2 years of non-comprehensive warranty support through M/s....., lowest tenderer for the work, **“Supply, Installation, Testing & Commissioning of Water Cooled Central AC Plant of Capacity 4600 TR (4x1050 TR +1X400 TR) with Electrical (remaining) & Plumbing (Highside) works (Package - 4) of GSMST at IIT Kanpur”**.

1. We also give undertaking to provide maintenance support and all the spares to IIT Kanpur throughout the useful life of the equipment for all hardware and any other accessories for running the equipment.

M/s.....

Authorized signatory with stamp.

ANNEXURE – 7

Original Equipment Manufacturers (OEM) undertaking for providing 3 years of Defect Liability Period & additional 2 years of non-comprehensive warranty of the Pumping system to the lowest tenderer for Pumping System proposed to be supplied to IIT Kanpur under the above tender No..... by M/s.....

1. We, OEM for Pumping system do hereby give undertaking to IIT Kanpur for the 3 years of Defect liability period & 2 years of non-comprehensive warranty support through M/s....., lowest tenderer for the work, **“Supply, Installation, Testing & Commissioning of Water Cooled Central AC Plant of Capacity 4600 TR (4x1050 TR +1X400 TR) with Electrical (remaining) & Plumbing (Highside) works (Package - 4) of GSMST at IIT Kanpur”**.

1. We also give undertaking to provide maintenance support and all the spares to IIT Kanpur throughout the useful life of the equipment for all hardware and any other accessories for running the equipment.

M/s.....

Authorized signatory with stamp.

ANNEXURE – 8

Original Equipment Manufacturers (OEM) undertaking for providing 3 years of Defect Liability Period & additional 2 years of non-comprehensive warranty of the Expansion Tank to the lowest tenderer for Expansion tanks proposed to be supplied to IIT Kanpur under the above tender No..... by M/s.....

1. We, OEM for expansion tanks do hereby give undertaking to IIT Kanpur for the 3 years of Defect liability period & 2 years of non-comprehensive warranty support through M/s....., lowest tenderer for the work, **“Supply, Installation, Testing & Commissioning of Water Cooled Central AC Plant of Capacity 4600 TR (4x1050 TR +1X400 TR) with Electrical (remaining) & Plumbing (High side) works (Package - 4) of GSMST at IIT Kanpur”**.

1. We also give undertaking to provide maintenance support and all the spares to IIT Kanpur throughout the useful life of the equipment for all hardware, software and any other accessories for running the equipment.

M/s.....

Authorized signatory with stamp.

APPENDIX II

(Refer Para 5.20 (2) of CPWD Works Manual 2024)

FORM OF SUPPLEMENTARY AGREEMENT

*This Agreement made this day the 20..... between herei
nafter called the First Party which expression shall include his heirs, executors and
administrators/their successors and assigns and the Director, IIT Kanpur , hereinafter called the
Second Party or IIT Kanpur authorized third party(GSMST), which expression shall include his
successors and assigns, shown as under :*

1. That this Agreement shall be called as Supplementary Agreement to the Agreement No. relating to the Name of work entered into by the parties to this Agreement.
2. That WHEREAS the First Party has substantially completed the execution of the work described in and covered by the Agreement No.except the items mentioned in the Schedule annexed to this Agreement and whereas the items of the work mentioned in the Schedule annexed to this agreement cannot now be executed on account of non completion of the sanitary work, electric installation and some other work; and whereas both the parties are desirous that the items mentioned in the Schedule annexed to this Agreement should be executed by the First Party after the completion of the sanitary work, electric installation and some other work, it is hereby further agreed as under :
 - (a) That First Party shall and will execute the work covered by the items mentioned in the Schedule annexed to this Agreement at the rates and as per the terms and conditions of the original Agreement No.whatsoever called upon to do so by the Engineer-in-Charge, within a period of one year from the date hereof.
 - (b) That the First Party shall have absolutely no claim of whatsoever nature against the Second Party for doing the work mentioned in the Schedule annexed to this Agreement as required under clause (a) above, except that which he would be entitled to under the original Agreement No.
 - (c) That the First Party shall have to execute all the items which the Engineer-in-charge consider necessary.
 - (d) That the First Party shall start with the work of the remaining items mentioned in the Schedule annexed to this Agreement within days from..... on the receipt of a letter to the effect from the Engineer-in-Charge or from any date fixed in the said letter and shall complete the said work within the time fixed by the Engineer-in-Charge or as extended by him from time to time.
 - (e) That on the due execution and completion of this Agreement by the parties, the bill of the First Party in relation to the work already done by him under the Original Agreement No. shall be provisionally finalized by the Second Party and payment on account, if any amount due, shall be made to the First Party provided that the Second Party shall have a right to retain such amount as is considered reasonable by him as a security for the execution of the work mentioned in the Schedule annexed to this Agreement and the Second Party shall have right to deal with the said amount of security as he thinks proper under the terms and conditions of the Original Agreement. Further, on the due execution and original completion of this Agreement, the First Party shall be entitled to claim back his security deposit relating to the work in question, subject to the right of the Second Party to retain such amount as he thinks reasonable as mentioned above soon after the maintenance period of three months or six months, as the case may be mentioned in clause of the Original Agreement, is over.

- (f) That the final bill relating to the entire work under the two agreements shall be prepared after the completion of the entire work covered by Agreement No. and this Agreement.
- (3) Except as modified by this Agreement the said Agreement No. shall remain in full force and effect.

*IN WITNESS WHEREOF THE ABOVE MENTIONED PARTIES HAVE PUT THEIR
SIGNATURE ON THIS DAY THE.....*

20 Special Conditions of Contract

20.1 Special 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 as 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.
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 precisely 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.

20.2 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.

20.3 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, testing charges 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 multistoried 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, earthing's 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.

20.4 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 contractor 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.

20.5 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.

20.6 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. **Contractor Safety Policy:- The contractor needs to comply with institute contractor safety policy as uploaded in envelope -1 of technical bid, which will be the part of the contract agreement.**

20.7 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.

20.8 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.

20.9 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.

20.10 TERMS & CONDITIONS OF ANNUAL OPERATION OF AC PLANT FOR 5 YEARS AND MAINTENANCE OF 5 YEARS (i/c 3 YEARS DEFECT LIABILITY & 2 YEARS NON COMPREHENSIVE ANNUAL MAINTENANCE AFTER 3 YEARS OF DLP OF THE ENTIRE SYSTEM)

Scope of Work & Conditions

Note:-The defect liability Period (DLP), shall be of 3 years for the entire system i.e. a) HVAC Works, B) Electrical & UPS works, C) Plumbing Works, D) Water treatment plant and all the works covered under the contract from the date of completion, cover all equipment installed in this project

1. For the Annual Operation and Non Comprehensive Maintenance (after 3 years of defect liability period) Contract (AOMC) of entire high side of HVAC system i.e. 4x1050 TR Centrifugal chillers, 400 TR screw Chiller, chiller plant manager (CPM), automatic and online tube cleaning system, Cooling towers, Expansion tanks, air separators, all primary variable and condenser pumps, all water to water & air to water heat pumps, primary variable hot water pumps, pumping control system, chilled water transfer pump, all the electrical & isolator panel for HVAC i.e. panel for chillers, pumps, heat pumps, cooling tower including VFDs and pump control systems, valve and all other accessories installed for HVAC system, the following are the scope of works and special conditions of contract.

The under mentioned equipment are covered in the scope of Annual Operation and Non Comprehensive Maintenance Contract;

2. 4 Nos. Centrifugal Chiller of 1050 TR capacity with Refrigerant gas complete with VFD, AHF, compressor, Motors, Condensers, Chillers, CPM with Microprocessor Controllers, Power & Control Cabling, Pipe Lines, and Valves etc. are covered under the scope of work.
3. 1 No Screw chiller of 400 TR capacity with Refrigerant gas complete with VFD, AHF, compressor, Motors, Condensers, Chillers, CPM with Microprocessor Controllers, Power & Control Cabling, Pipe Lines, and Valves etc. covered under the scope of work.
4. 9 Nos. Condenser Water Pumps along with motor.
5. 9 Nos variable primary Chilled Water Pumps along with motor, drives and Pump logic controller.
6. 4 Nos. induced draft Cooling Towers complete with direct drive fan motor assembly, pipes, strainer, makeup water tank supporting structures (overhead & underground and its pumps) etc.
7. Automatic Pressurization cum expansion tank for both chiller and heat pump pipeline.
8. Air Separator for both chiller and heat pump pipeline.
9. 2 Nos. 350 KW water to water and 1 No 350 KW air to water heat pump with Refrigerant gas complete with VFD, compressor, Motors, Condensers, Chillers, Microprocessor Controllers, Power & Control Cabling, Pipe Lines, and Valves also covered under the scope of work.
10. 3 Nos Primary variable hot water pump and its control system
11. 3 Nos. constant speed chilled water transfer pump
12. Electrical Panels for HVAC system including drives for pumps and cooling towers and its PLC

13. All other HVAC items installed in the AC plant room associated with the above mentioned system

The following works are covered in the Scope of work of Annual Operation (5 Years) and Maintenance Contract (3 year DLP and 2 year Non-comprehensive AMC, total 5 years)

1. To keep all the equipment's of central ac plant in operation as per Institute's requirement ,maintain neat, clean& healthy conditions.
 2. Operation of the entire Central AC plant 24X7 hrs. throughout year. including holiday and Sunday).
 3. The quarterly visit of the OEM of chiller & heat pump for monitoring the health of chillers & heat pumps and will generate the reports accordingly, guidance/instructions/ maintenance advisory to the contractor for smooth and trouble free running of the system. OEM shall produce the reports and submit to the Engineer In Charge through the contractor. The OEM shall depute an Engineer at site whenever called by IIT Kanpur or if nay need arises for their presence at site without any extra charges till the defect liability period and non-comprehensive warranty of the system.
 4. The half yearly visit of the OEM of pumps, expansion tank, CPM System, Air-seperator & Cooling tower for monitoring the health of pumps, expansion tank, CPM System & Cooling tower and will generate the reports accordingly, guidance/instructions/ maintenance advisory to the contractor for smooth and trouble free running of the system. OEM shall produce the reports and submit to the Engineer In Charge through the contractor.
 5. Recording the readings of pressure gauges and temperatures both at inlet and outlet, current voltage etc. all other relevant parameters in the logbook. Maintain a maintenance register for day to day maintenance of AC plant.
 6. Generation of MIS reports on daily, weekly, fortnightly, monthly, yearly basis through BMS system and reporting to the site engineer.
 7. Checking and recording of water level in cooling towers and make up water tank.
 8. Checking, tightening of various connections for electrical, mechanical and air-conditioning items of HVAC system and lubrication of bearings.
 9. Checking/attending the water level system for make-up water tank and cooling tower so that the overflow of water/wastage of water can be stopped.
 10. Attending routine day to day maintenance and informing the Institute for civil work if required.
 11. Checking & tightening all connection, remaining vibration, noise in equipments.
 12. Tightening of nuts & bolts, coupling etc. of various equipments including greasing and oiling.
 13. The operation and day to day maintenance shall have to be carried out as per manufacturer's procedures/instructions for all measure equipment's.
 14. The contractor should submit the shift duty chart of staff deputed on AC plant to the site engineer on regular basis.
 15. The contractor should submit maintenance detail carried out during the month at the end of each month.
 16. The HVAC plant after commissioning , shall be handed over on "as is where is" basis for O&M.
- Note: For any future expansion of the Central AC Plant in the same building, no any extra operation charges shall be admissible, whereas for non-comprehensive maintenance extra charges shall be paid to the contractor proportional to the capacity enhancement in the tonnage of the AC plant.**

Scope of the non comprehensive maintenance contract (2 Years) after 3 Year of DLP

1. During Non- comprehensive AMC, any refrigerating gas and lubricating oil required for topping up shall be provided by contractor free of cost. During breakdown of all HVAC chillers and heat pumps required refrigerant gas/oil/sensors/spare parts shall be supplied by the OEM through contractor on chargeable basis or arranged by the institute. However, all labour, and technical staff (Equipment OEM technical staff) and equipment's for maintenance shall be in the scope of contractor.
2. The contractor has to supply compressor oil (as per requirement for 1 no. 1050 TR centrifugal chiller, 1 No. 400 TR screw Chiller and 1No. 350 KW heat pump machine) per annum, refrigerant, temperature sensors & oil filter's required by 1 no. machine as spare for Chiller machine of Central AC plant always in stock as inventory till the completion of annual operation of the entire Plant. The above spares have to be supplied by the contractor within 1st quarter of commissioning of the AC plant, and the charges towards the same are to be included in the SITC of chiller.
3. All minor indigenous spare parts of motors (Pump and cooling tower motor) and pumps i.e. machining part of shaft, housing, impeller, end cover etc. and bearing, coupling, cooling fan, terminal box and labour cost required in routine maintenance are included in the scope of contract. However if any major spare parts are to be changed or repaired of the main motor for the compressors, Pump and cooling tower requires rewinding and replacement and any major indigenous component shall be arranged by contractor on chargeable basis or the Institute may also procure directly whereas the fixing, testing & commissioning charges shall be covered under AOMC.
4. For cooling tower parts like PVC filling of cooling tower, cooling tower gear box, fan assembly, MS base frame, electric motor and other modification works etc. because of normal wear & tear these shall be arranged by the AOMC agency and the cost shall be borne by the Institute or the Institute may also procure directly whereas the fixing, testing & commissioning charges shall be covered under AOMC.
5. For Electrical Panels, routine maintenance i.e. checking all parameter, cleaning, tightening including replacement of connector, contactor kits, lugs and thimbles, control cable, indicator, push buttons, etc. are in the scope of the contractor, all major component i.e. contactor, starter, relay, meters etc. shall be arranged by the AOMC agency and cost shall be borne by the Institute or the Institute may by the procure directly and pay only the installation charges.
6. Repair of all condenser, chilled water refrigerant, pipes and valve etc. is included in the scope of work. The re-insulation and cement plaster over the insulation and painting etc. of the AC plant are also included. However replacement of pipe lines/ valve of required shall be arranged by the AOMC agency and cost shall be borne by the Institute or the Institute may by the procure directly and pay only the installation charges.
7. All temperature gauges, pressure gauges, siphon with ball valve, all drain valve, nipple, socket, air-purge installed in the plant are in the scope of the contractor.
8. The scope also covers the painting of the complete piping of AC plant once a year.
9. The preventative maintenance schedule shall be prepared and submitted in advance and the necessary shutdowns may be taken with prior permission of the Institute. The list of preventive maintenance of various equipment's are listed as mentioned below:
10. Descaling of condenser from time to time to maintain the efficiency of the plant, as per direction of the engineer-in-charge.
11. List of preventive maintenance activities alongwith the schedule have to be provided by the lowest

tenderer at the time of specification approvals of the individual items through OEM.

12. A list of all components and consumable items replaced shall be maintained along with other records of plant maintenance and operation. Proper log sheets of running the plant and record for preventative maintenance of the plant shall be maintained. These recorded shall be put up to the engineers – in – charge on regular basis.
13. The standard Operating Procedures and Preventive Maintenance schedule shall be pasted on well designed ACP Board, inside the central AC plant along with the safety procedures, refrigerant leakage preparedness.
14. A suitable shutdown shall be given in winter for the annual preventative maintenance of the plant. All the equipment's should be thoroughly checked and maintained for proper functioning of all the systems. All the major equipment, pipeline, supports & cooling towers etc. in the plant room shall be painted once in a year with approved color. All relays installed in electrical panel shall be checked and tested once in a year. Which shall be duly checked by engineers-in-charge Changing of oil & oil filter also shall be done during the annual maintenance. Decaling of condensers & chillers shall be done during winter shutdown once in a year also shall be done as & when required.
15. It shall be responsibility of the contractor to supply adequately trained manpower necessary for the operation and maintenance of AC Plant as follows
Total manpower for operation shall be as mentioned in BOQ i.e. (Highly Skilled-1No, Skilled-4Nos, Semi-Skilled-7 Nos and Un-skilled-1No),
There shall be 3 Nos. operators (2s nos. semi-skilled, 1 no. skilled) in all shift on round the clock for seven days a week. 1 No. electrician (Highly skilled) in day shift (6 Days in a week)
16. The current minimum wages as per central Government lab our commissioner as considered in the tender as on last date of the tender submission.
Unskilled : Rs. 805/day
Semi-skilled : RS.893/day
Skilled : RS.981/day
Highly -skilled: Rs. 1065/day
17. In addition to above 1 No. Electrical supervisor (8-10 year experienced diploma or 4-5 years experienced graduate engineer Electrical/mechanical) shall be available in day shift.
18. Graduate and Diploma Engineers shall be deployed at the plant and will be responsible for maintaining all required parameters in coordination with the equipment OEM. Their duties also include coordinating all operation staff (plant operators), managing preventive maintenance through the OEM, overseeing preventive shutdowns, and handling routine equipment maintenance, all in liaison with the engineer in-charge
19. The contractor shall be responsible for all the requirement of labour laws governing such deployment. If any violation is noticed any time the contractor shall be solely responsible. Subletting of work in any manner shall not be allowed and if found at any later stage, the contract shall be terminated.

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20. There shall be a penalty in case of short supply of manpower as specified & poor quality of maintenance and also for the not attending breakdowns within reasonable time. A penalty of Rs. 150/- per man shift shall be per month and this penalty shall increase to Rs. 300/- per man shifts if the shortage in more than 30 man shifts a month . For poor quality of maintenance and for not attending breakdowns within reasonable time. The contract may be rescinded as per contract agreement.
21. Only the quality and experienced staff for operation and maintenance of the Ac plant shall be engaged. The qualifications and experience of the staff shall be as under:-

Category	Qualifications and experience
1. Engineer	Degree(Electrical/Mechanical) with 4-5 years experience or diploma with 8-10 years experience in similar fields.
2. Supervisor/Operator	ITI in refrigeration & Air conditioning/electrical or 4-5 years experience in similar fields.
3. Electrician	ITI in electrician trade with 4-5 years experience in similar filed.

22. The proof of qualification & experience of staff has to be submitted to Institute and which shall be verified by the engineer- in charge.
23. Contactor shall abide by all the necessary requirement of labour laws while engaging the operating staff in the AC plant.
24. The contractor shall have to maintain proper log book on the prescribed from and shall make the record available for inspection by the Institute. The log book format will be given by the Institute.
25. The contractor shall be responsible to maintain proper discipline of the operating staff in the AC plant in discharge of their duties. However the Institute shall have the right to ask any of the operating staff to leave the premises if in the opinion of the institute the conduct/ behavior and activities of the individual concerned is subversive and not in the interest of Institute.
26. The schedule of preventative maintenance of the plant and its equipment shall have to be prepared and submitted to the engineer-in-charge well in advance so that shutdown program can be issued for maintenance works.
27. Any other piece of work not specifically mentioned above but essential for the normal operation and maintenance is also covered in the scope of work.
28. The payment against operation and non-comprehensive maintenance during the contract period of one year shall be made against monthly running bills equivalents to 1/12 of the accepted amount for AOMC.
29. The contribution of EPF & ESI by the contractor shall be reimbursed on actual basis and production of the receipt of deposit of the same in office of competent authority's. Administrative expenses deposited by the contractor shall not be reimbursed.
30. The minimum wages to be paid to the operators shall be as per Central Government , revised by the Labour Commissioner (Central) from time to time.
31. If the prescribed minimum wages are revised by the labour commissioner (Central), the contractor shall revise the wages of the workers accordingly. The difference in minimum wages, with respect to the wages applicable from the month of start of operation + 7.5% shall be reimbursed to the contractor, in addition to the contract amount against worker deputed for operation of the AC

plant (round the clock).

32. Recoveries or additional charges shall be made, calculated at the minimum wage rate as of last date of bid submission (as mentioned above) plus 10% contractor's profit, for any man days that fall short of or exceed the standard 26 man days per month per worker.
33. All the workers shall be paid for the 3 national holidays in addition to the above daily wages.
34. No contractor, to whom the provision of the BOCW Act apply, shall be allowed to commence the work on the campus unless he has produced the registration certificate, issued by the office of Dy. CLC(Central)
35. The contractor shall engage only such workers, who are registered as beneficiaries with UP BOCW and in case of engagement of new workers: he shall ensure the submission of applications for registration of such work men within appropriate time.
36. A certificate for administration convenience shall be obtained from the contractor covered under the BOCW Act whether he has engaged 10 or more workmen while working in the Institute and only thereafter Cess @ 1% from bills raised by him shall be deducted at source for all running works. Cess, so deducted shall be deposited with the BOCW welfare board.

20.11 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 breach 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.

20.12 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.

20.13 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.

20.14 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.

20.15 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.

20.16 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.

20.17 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
 - (a) Approved Drawing (If any)
 - (b) Technical specifications of the NIT
 - (c) CPWD General specification Part – I (Internal) 2014, BIS Codes amended up to date, practices
 - (d) CPWD General Specifications for Electrical Works–Part-II(External), 2014 amended up to date.
 - (e) Relevant IS or other international code in case IS code is not available.
 - (f) Indian Electricity Act 2003 and Indian Electricity Rules 1956 amended up to date.
 - (g) Local Fire Regulations applicable at the place of installation. Relevant and applicable foreign standards and specifications amended up to date.
 - (h) 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. Other than electricians no one is allowed to carry out electrical connections, repairs on electrical equipment or other jobs related thereto.
14. All electrical connections shall be made using 3 or 5 core cables, having a earth wire.
15. Inserting of bare wires for tapping the power from electrical sockets is completely prohibited.
16. A tools and tackles inspection register must be maintained and updated regularly.
17. 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.
18. All the unsafe conditions, unsafe acts identified by contractors, reported by site supervisors and / or safety personnel to be corrected on priority basis.
19. No children shall be allowed to enter the workplace.
20. All the lifting tools and tackles shall be stored properly when not in use.
21. Clamps shall be used on Return cables to ensure proper earthing for welding works.
22. Return cables shall be used for earthing.
23. All the pressure gauges used in gas cutting apparatus shall be in good working condition.
24. Proper eye washing facilities shall be made in areas where chemicals are handled.
25. Connectors and hose clamps are used for making welding hose connections.
26. All underground cables for supplying construction power shall be routed using conduit pipes.
27. Spill trays shall be used to contain the oil spills while transferring / storing them.
28. Tapping of power by cutting electric cables in between must be avoided. Proper junction boxes must be used.
29. All the E&M works shall be carried out as per direction and to the satisfaction of the Engineer-in-charge.
30. 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.
31. 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.
32. All materials should conform to relevant BIS specifications wherever the same exists in absence of stipulation in this tender document.
33. Where manufacturers furnish specific instructions / recommendations relating to the materials 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.

34. 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.
35. The structural and architectural drawings shall at all times be properly co-related before executing any work.
36. 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.
37. The following drawings must be submitted to Executive Engineer within 30 days of award of work.
 - (a) Completely filled-in Technical Parameters of all equipment's i.e. Chiller, Pumps, Heat pumps, Cooling Tower, water Treatment Plant System, CPM, VFD, AHF, AHU, Piping, Valves, gauges, Water treatment plant, Expansion tank, Pressurization system, ATC, Insulation, switchgears, electrical panels, and cables etc. and any other item as required by Engineer In charge
 - (b) Design and drawing of the AC Plant Layout, SLD, chilled water SLD,.
 - (c) G.A and schematic drawings of Chiller Plant, AHU, Piping, Plumbing System, Water Treatment Plant, Electrical panel, cable, wiring drawing, control cabling, i/c details of protection, metering, indicating and inter lock etc.
 - (d) Control Cable schedule, Cable Tray layout for 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.
 - (d) Cable/chilled water routing drawings showing details of size, type and no. of pipes/cables and mode of installation.
 - (e) Foundation drawings of all equipment's of the AC Plant, water treatment plant.
38. 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) All the as built drawings as mentioned above at sr.no. 39
 - (b) Testing and commissioning reports of AC Plant with all equipment's and Water Treatment Plant, Electrical panels
 - (c) Technical literature, test certificates and operation and maintenance manuals of all equipment's.

39. 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/testing, 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.

40. Pre-commissioning test: All routine and site tests shall be carried out on the electrical equipment as per the Indian Standard. Protective & metering devices should be checked for calibration of relays, C&R panel & cable meggar, 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:

- By the contractor, if the result shows that material does not conform to the relevant codes/ specification.
- 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 Preparation of NIT
4.10.2 No Provision	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.)

e-file 9116587

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

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