



**GOVERNMENT OF INDIA CENTRAL
PUBLIC WORKS DEPARTMENT**



Office of the Executive Engineer & SM (E)

IISER Project Electrical Division, CPWD, Plot No 185/789

Defence colony, Utkal Nagar, Jagannathpur, Berhampur, Ganjam, Odisha-760007

NOTICE INVITING TENDER

NIT No: 05/NIT/EE & SM (E)/IPED/CPWD/2026-27

Name of Work: Construction of Academic cum Administrative Building (G+6), Residential Buildings Type-II&III, 2 Blocks, 72 Nos, (S+9), Type-IV&IV(s), 1 block, 28 nos, (S+7), Type-V, 4 Blocks, 80 Nos, (S+10) with **Monolithic Concrete Construction technology**, Type-VI, 1 Block, 14 Nos, (S+7), Director's Residence (G+1), 3 nos 656 bedded Hostel Buildings (S+8) with **Monolithic Concrete Construction technology**, Kitchen cum Dining (G+2), Guest House (G+2), 500 seated Auditorium (GF), Health Centre (G+1), Community Centre (G), Commercial facility Centre (S+1), Sports Complex (GF) including all internal & external services of Civil, Electrical, Mechanical including STP, WTP, Roads, Footpaths, Landscaping & Horticulture etc Fire, GRIHA & IGBC compliant building for a Functional Permanent Campus of IISER, at Berhampur, Odisha. (SH: Carrying out balance E&M Works in auditorium Building under clause 14 of the main work at risk & cost of the contractor.)

Estimated Cost: Rs. 71,65,035/-

EMD Amount: Rs. 1,43,301/-

Last date & time online submission of bid: 01/09/2026 upto 15:00

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Executive Engineer & SM (E)
IPED, CPWD, Berhampur

Notice Inviting e –Tender

CENTRAL PUBLIC WORKS DEPARTMENT NIT No: - 05/NIT/EE & SM (E)/IPED/CPWD/2026-27

The Executive Engineer & SM (E), IISER Project Electrical Division, CPWD, Plot no. B-16 Defence Colony, Utkal Nagar, Jagannathpur, Berhampur, Dist.-Ganjam, Pin-760007, Odisha email id: eeiiserelectricaldivision@gmail.com) on behalf of the President of India invites online Percentage rate e-tender in single bid system from CPWD registered contractors of composite category in appropriate class for the following work: -

Name of work: - Construction of Academic cum Administrative Building (G+6), Residential Buildings Type-II&III, 2 Blocks, 72 Nos, (S+9), Type-IV&IV(s), 1 block, 28 nos, (S+7), Type-V, 4 Blocks, 80 Nos, (S+10) with **Monolithic Concrete Construction technology**, Type-VI, 1 Block, 14 Nos, (S+7), Director's Residence (G+1), 3 nos 656 bedded Hostel Buildings (S+8) with **Monolithic Concrete Construction technology**, Kitchen cum Dining (G+2), Guest House (G+2), 500 seated Auditorium (GF), Health Centre (G+1), Community Centre (G), Commercial facility Centre (S+1), Sports Complex (GF) including all internal & external services of Civil, Electrical, Mechanical including STP, WTP, Roads, Footpaths, Landscaping & Horticulture etc Fire, GRIHA & IGBC compliant building for a Functional Permanent Campus of IISER, at Berhampur, Odisha. (SH: Carrying out balance E&M Works in auditorium Building under clause 14 of the main work at risk & cost of the contractor.)

Estimated Cost of E & M component put to Tender

Rs 71,65,035.00

Earnest Money

Rs 1,43,301.00

Period of Completion

01 (One) Month

Last date & time of submission of Technical cum

Eligibility & Financial Bids up to

15:00 Hrs on Dt-01/09/2026.

Time and Date of Opening of Technical cum Eligibility Bid & Financial Bid

15:30 hrs. on Dt-01/09/2026.

The Bid forms and other details can be obtained from the website <https://etender.cpwd.gov.in> or www.eprocure.gov.in. All corrigendum/addendum shall only be available on these websites and shall not be published anywhere else.

Bank Details:-

In favour of : Executive Engineer & SM (C)-II, BPD, CPWD, Berhampur

Executive Engineer & SM (E)
IPED, CPWD, Berhampur

INFORMATION AND INSTRUCTIONS FOR BIDDERS FOR e- TENDERING

INFORMATION AND INSTRUCTIONS FOR BIDDERS FOR e-TENDERING

(FORMING PART OF BID DOCUMENT AND TO BE POSTED ON THE WEBSITE)

The **EE & SM (E), IISER Project Electrical Division CPWD**, Berhampur, email ID: eeiserelectricaldivision@gmail.com) on behalf of the President of India invites online percentage rate bids in single bid system from CPWD enlisted contractor of appropriate class and above in composite category **for the following work: -**

Sl.No.	Description	Details
1	NIT No.	05/NIT/EE & SM (E)/IPED/CPWD/2026-27
2	Name of Work	Construction of Academic cum Administrative Building (G+6), Residential Buildings Type-II&III, 2 Blocks, 72 Nos,(S+9), Type-IV&IV(s), 1 block, 28 nos, (S+7), Type-V, 4 Blocks, 80 Nos,(S+10) with Monolithic Concrete Construction technology , Type-VI,1Block,14 Nos,(S+7), Director's Residence (G+1), 3nos 656 bedded Hostel Buildings (S+8) with Monolithic Concrete Construction technology , Kitchen cum Dining (G+2), Guest House (G+2), 500 seated Auditorium (GF), Health Centre (G+1), Community Centre (G) , Commercial facility Centre (S+1), Sports Complex (GF) including all internal & external services of Civil, Electrical, Mechanical including STP, WTP, Roads, Footpaths, Landscaping & Horticulture etc Fire, GRIHA & IGBC compliant building for a Functional Permanent Campus of IISER, at Berhampur, Odisha. (SH: Carrying out balance E&M Works in auditorium Building under clause 14 of the main work at risk & cost of the contractor.)
3	Estimated Cost Put to Tender (Composite)	Rs. 71,65,035.00
4	Earnest Money	Rs 1,43,301.00
4	Period of Completion	01 Month
5	Last date& time of online submission of bid and other documents as specified in the press notice.	Up to 15:00 Hours on 01/09/2026
6	Time & date of online opening of documents. (Mandatory documents)	At 15:30 Hours on 01/09/2026

7	Time & date of online opening of financial bids.	At 15:30 Hours on 01/09/2026
8	Last date & time of submission of hard copies of Experience Certificates if any, Registration Certificates, Affidavit if any, Undertaking and other Documents as specified in the press notice to Division Office by the Lowest Tenderer Only .	To be submitted during office hours within a week from the date of opening of Bid. In case the last day happens to be a closed holiday, these documents shall be submitted on the next working day.

2. List of documents to be scanned and uploaded within the period of bid submission: -

I	Treasury Challan or Demand Draft or Pay order or Banker`s Cheque or Deposit at Call Receipt or FDR or Bank Guarantee of any Scheduled Bank against EMD.
II	The copy of receipt of deposition of original EMD from Executive Engineer/ Assistant Engineer/ Assistant Accounts Officer of any Division office of CPWD in the prescribed proforma attached Form at Page-16 .
III	GST registration Certificate of the state in which the work is to be taken up, if already obtained by the bidder. If the bidder has not obtained GST registration in the state in which the work is to be taken up, or as required by GST authorities, then in such a case the bidder shall scan and upload following undertaking along with other bid documents. “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 CPWD, 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 CPWD or GST department in this regard”. As per Form attached at page-34.
IV	Valid PAN Card issued by Income Tax Department.
V	Valid Enlistment order of appropriate class.
VI	Valid Electrical License of appropriate category Or Undertaking “If work is awarded to me, i/we shall either obtain valid electrical license at the time of execution of electrical work or associate contractor having valid electrical license of eligible class”.
VII	Upload scan copy of ERP training certificate issued by the Competent Authority.
VIII	Any other document as specified in the NIT.

**Executive Engineer & SM (E),
IISER Project Electrical Division
CPWD, Berhampur.**

CPWD-6 for E-Tendering

Percentage rate bids are invited on behalf of President of India from approved and eligible contractors of CPWD for the work of “Construction of Academic cum Administrative Building (G+6), Residential Buildings Type-II&III, 2 Blocks, 72 Nos,(S+9), Type-IV&IV(s), 1 block, 28 nos, (S+7), Type-V, 4 Blocks, 80 Nos,(S+10) with **Monolithic Concrete Construction technology**, Type-VI,1Block,14 Nos,(S+7), Director’s Residence (G+1), 3nos 656 bedded Hostel Buildings (S+8) with **Monolithic Concrete Construction technology**, Kitchen cum Dining (G+2), Guest House (G+2), 500 seated Auditorium (GF), Health Centre (G+1), Community Centre (G) , Commercial facility Centre (S+1), Sports Complex (GF) including all internal & external services of Civil, Electrical, Mechanical including STP, WTP, Roads, Footpaths, Landscaping & Horticulture etc Fire, GRIHA & IGBC compliant building for a Functional Permanent Campus of IISER, at Berhampur, Odisha. (SH: Carrying out balance E&M Works in auditorium Building under clause 14 of the main work at risk & cost of the contractor.)”

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

1. The work is estimated to cost **₹ 71,65,035.00**. The estimate however is given merely as a rough guide.
2. Agreement shall be drawn with the successful bidder 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 their rates as per various terms and conditions of the said form which will form part of the agreement.
3. The time allowed for carrying out of the work will be **01 Month** 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, if any, indicated in the bid documents.
The site for the work is available.
4. The bid document consisting of plans, specifications, 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 except Standard General Conditions of Contract Form can be seen on website <https://etender.cpwd.gov.in> free of cost.
5. After submission of the bid the contractor can re-submit revised rate. While submitting the revised bid, contractor can revise the rate of one or more item(s) 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.
6. Earnest money in the form of insurance Surety Bonds, Account Payee Demand Draft, Fixed Deposit Receipt, Banker's Cheque or Bank Guarantee (For balance amount as prescribed) issued by a Commercial Bank against EMD. The original EMD should be deposited either in the office of Executive Engineer inviting bids or division office of any Executive Engineer, CPWD within the period of bid submission. The EMD receiving Executive Engineer (including NIT issuing EE / AE) shall issue a receipt of deposition of earnest money deposit to the bidder in a prescribed format (enclosed) uploaded by the tender inviting EE in the NIT.

This receipt shall also be uploaded to the e-tendering website by the intending bidder upto the specified bid submission date and time.

A part of earnest money is acceptable in the form of bank guarantee also. In such case, minimum 50% of earnest money of Rs. 20 Lac, whichever is less, shall have to be deposited in shape prescribed above, and balance may be deposited in shape of Bank Guarantee of any scheduled bank having validity for six months or more from the last date of receipt of bids which is to be scanned and uploaded by the intending bidders.

Copy of Enlistment Order and certificate of work experience and other documents as specified in the press notice shall be scanned and uploaded to the e-tendering website within the period of bid submission.

7. Online bid documents submitted by intending bidders shall be opened only of those bidders, **whose original EMD deposited with any division of CPWD and other documents scanned and uploaded are found in order.**
8. Those contractors, who are not registered or have not updated their profile on the website mentioned above, are required to get registered / update their profile beforehand. The necessary training materials including the videos with step to step process are available on download section of <https://etender.cpwd.gov.in>.
9. The intending bidder must have valid Class-III digital signature certificate with encryption key (combo type) to perform any operations / transactions on the e-tendering portal / website and the bidder should download and install the eMsigner on their system as per instructions available on download section of <https://etender.cpwd.gov.in>.
10. Contractor can upload documents in the form of JPG format and PDF format.
11. The department reserves the right to reject any prospective application without assigning any reason and to restrict the list of qualified contractors to any number deemed suitable by it, if too many bids are received satisfying the laid down criterion.
12. The contractor submitting the bid should read the schedule of quantities, Special conditions, additional conditions, particular specifications and other terms and conditions given in the NIT and drawings. The bidder should also read the General Conditions of Contract for CPWD Works 2020 with all correction slips issued up to the last date for submission of bid, which is available as Government of India Publication. However, provisions included in the bid document shall prevail over the provisions contained in the standard form. The set of drawings and NIT will be available with the Executive Engineer & Senior manager (E), IISER Project Electrical Division, CPWD, Berhampur. The contractor should also visit the site of work and acquaint himself with the site conditions before tendering. The following conditions, which already form part of the tender conditions, are specially brought to his notice for compliance while filling the tender. They are requested to comply with the following instructions.
13. Tenders with any condition including that of conditional rebates shall be rejected. Such tenders shall not be entered in the tender opening register at the time of opening of tender.
14. GST on all materials as well as GST on Work Contract etc., or any other taxes applicable in respect of this contract shall be payable by the Contractor. Percentage rate quoted by him shall be inclusive of such taxes, levies etc. and all charges for items contingent to the work, such as packing, forwarding, insurance, preparation and design of drawing, freight and delivery, installation, testing, commissioning etc., at site

i/c temporary constructional storage, water and electricity requirement for construction ,testing and commissioning, safe custody, risk, watch and ward, overhead charges, general liabilities/ obligations etc. and Government will not entertain any claim for reimbursement whatsoever in respect of the same. The percentage rates of the contract shall be inclusive of all taxes and levies and nothing extra shall be paid. Further the percentage rate quoted by the contractor shall be inclusive of labour welfare cess and the same shall be recovered from the contractors' bills and will be remitted by the department.

15. No foreign exchange shall be made available by the department for importing (purchase) of equipment's, plants, machinery, materials of any kind. No delay and no claim of any kind shall be entertained from the Contractor on account of variation in the foreign exchange rate and/or any Custom duties / charges or any other levies. The Contractor shall assume all liability, financial or otherwise in connection with his contract and shall protect and indemnify the Department from any and all damages and claims that may arise on any account. The Contractor shall indemnify the Department against all claims in respect of patent rights, royalties, design, trademarks of name or other protected rights, damages to adjacent buildings, roads or members of public in course of execution of work or any other reason whatsoever and shall himself defend all actions arising from such claims and shall keep the department saved harmless and indemnified in all respect from such actions, costs and expenses. Nothing extra shall be payable on this account.
16. The bid submitted shall be opened at **03:30 PM on 01/09/2026.**
17. The bid submitted shall become invalid and e-Tendering processing shall not be refunded if :
 - i. The bidder is found ineligible.
 - ii. The bidder does not deposit original EMD with division office of any Executive Engineer, CPWD.
 - iii. The bidder does not upload all the documents as per the list in information and instructions for contractors for e-tendering
 - iv. Valid Electrical License. However the contractor shall be allowed to participate in tender with an undertaking that "They will either obtain valid electrical license at the time of execution of electrical work or associates contractor having valid electrical license of eligible class"
 - v. If any discrepancy is noticed between the documents as uploaded at the time of submission of bid and hard copies as submitted physically by the lowest bidder in the office of bid opening authority
 - vi. If a tenderer quotes nil rates against each item in item rate tender or 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.
18. The contractor, whose bid is accepted, will be required to furnish performance guarantee of 5% of the tendered value or Estimate Cost Put to Tender (ECPT) (whichever is higher) and additional PG as per schedule-F within the period specified in schedule F. This guarantee shall be in the form of cash (in case guarantee amount is less than s 10000/-) or form of insurance Surety Bonds, Account Payee Demand Draft, Fixed Deposit Receipt, Banker's Cheque or Bank Guarantee (as prescribed) issued by a Commercial Bank against performance guarantee. 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 Earnest Money deposited by the contractor shall be forfeited automatically without any notice to the contractor. The Earnest Money deposited along with tender shall be returned after receiving the aforesaid performance guarantee. The contractor whose bid is accepted will be required to furnish either copy of applicable licenses/registrations or proof of applying for obtaining labour licenses, registration with EPFO,ESIC and BOCW Welfare Board and Programme Chart (Time and Progress) within 15 Days from the date of issue of letter of acceptance as specified in Schedule F.

19. The description of the work is as follows :

“Construction of Academic cum Administrative Building (G+6), Residential Buildings Type-II&III, 2 Blocks, 72 Nos,(S+9), Type-IV&IV(s), 1 block, 28 nos, (S+7), Type-V, 4 Blocks, 80 Nos,(S+10) with **Monolithic Concrete Construction technology**, Type-VI,1Block,14 Nos,(S+7), Director’s Residence (G+1), 3nos 656 bedded Hostel Buildings (S+8) with **Monolithic Concrete Construction technology**, Kitchen cum Dining (G+2), Guest House (G+2), 500 seated Auditorium (GF), Health Centre (G+1), Community Centre (G) , Commercial facility Centre (S+1), Sports Complex (GF) including all internal & external services of Civil, Electrical, Mechanical including STP, WTP, Roads, Footpaths, Landscaping & Horticulture etc Fire, GRIHA & IGBC compliant building for a Functional Permanent Campus of IISER, at Berhampur, Odisha. (SH: Carrying out balance E&M Works in auditorium Building under clause 14 of the main work at risk & cost of the contractor.)”

20. Intending bidders are advised to inspect and examine the site 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, the accommodation they may require and in general shall themselves obtain all necessary information as to risks, contingencies and other circumstances, status of balance work, working at heights which may influence or affect their bid. A bidder shall be deemed to have full knowledge of the site whether he inspects it or not and no extra charges consequent on any misunderstanding or otherwise shall be allowed. The bidders 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 rated at which stores, tools and plant etc.

21. The competent authority on behalf of the President of India 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 the assignment of any reason. All bids in which any of the prescribed condition is not fulfilled or any condition including that of conditional rebate is put forth by the bidders shall be summarily rejected.

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

23. The competent authority on behalf of President of India 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.

24. The contractor shall not be permitted to bid for works in the CPWD Circle (Division in case of contractors of Horticulture / Nursery Category) responsible for award and execution of contracts, in which his near relative is posted a Divisional Accountant or as an office in any capacity between the grades of Superintending Engineer and Junior Engineer (Both inclusive). 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 gazette officer in the Central Public Works Department or in the Ministry of Urban Development. Any breach of this condition by the contractor would render him liable to be removed from the approved list of contractors of this Department.

25. 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 cancelled 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.

26. The bid for the work shall remain open for acceptance for a period of thirty (30) days from the date of opening of bids in case of single bid system; if any bidder withdraws his bid before the said period or issued 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 Government shall, without prejudice to any other right or remedy, be at liberty to forfeit 50% of the said earnest money as aforesaid. Further the bidders shall not be allowed to participate in the rebidding process of the work.
27. The notice inviting bid shall form a part of the contract document. The successful bidder / contractor, on acceptance of his bid by the accepting authority shall within 15 days from the stipulated date of start of the work, sign the contract consisting of: -
 - a. 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 incitation of bid and the rated quoted online at the time of submission of bid and acceptance thereof together with any correspondence leading thereto.
 - b. Standard C.P.W.D Form 7/8 or other Standard C.P.W.D Form as applicable.
28. In case any discrepancy is noticed between the documents as uploaded at the time of submission of the bid online and hard copies as submitted physically in the office of Executive Engineer, then the bid submitted shall become invalid and the Government shall, without prejudice to any other right or remedy, be at liberty to forfeit 50% of the said earnest money as aforesaid. Further the tenderer shall not be allowed to participate in the retendering process of the work.
29. The Contractor/Agency shall not execute any Extra and deviated item as specified in BOQ without prior approval of Engineer-in-charge.
30. Water and electricity to be used in the work will be in the scope of agency. No extra payment will be done for it.
31. Contractor shall submit the drawing before execution of work for all E&M services to the respective Engineer in charge for approval without any cost/claims.
32. Small civil work e.g core cutting or making any hole or after installation of items making it good again will be in the scope of agency without any cost/claims.
33. The bidder must bid the price for equipment including the price of foundation if required without any cost/claims.

Assistant Engineer (E)-II

IPED, CPWD, Berhampur

Executive Engineer &SM (E)

IPED, CPWD, Berhampur

THE MINIMUM ELIGIBILITY CRITERIA FOR E&M COMPONENTS AND SPECIALIZED WORKS**WHEREVER APPLICABLE**

No of Packages	Components of E&M works	Estimated cost in Rupees	Minimum eligibility Criteria
SH: I	IEI & Fans i/c power wiring & plugs, lightning conductor, rising main, Telephone /computer/TV conduiting, etc.	2742158/-	The main contractor shall associate with contractor registered in composite category appropriate class and above in CPWD for execution of this Sub head of work, possessing valid Electrical Contractor License of appropriate Voltage issued by competent authority.
SH: II	Fire Fighting system	999451/-	The main contractor shall have to associate with agency fulfilling the following eligibility criteria having successfully completed during last seven years ending up to previous day of last date of submission of tender as given below with completion certificate issued by an officer not below the rank of Executive Engineer or Equivalent duly attested. Three similar completed works each of value not less Rs. 399780/- (40%) or Two similar completed works each of value not less than Rs. 599671/- (60%) or One similar completed work of value not less Rs. 799561/- (80%) Similar work shall mean "SITC of Fire Fighting System (Water based) and Addressable fire alarm system& PA system". However, the Composite.

SH: III	CCTV	510175/-	The main contractor shall have to associate with agency fulfilling the following eligibility criteria having successfully completed during last seven years ending up to previous day of last date of submission of tender as given below with completion certificate issued by an officer not below the rank of Executive Engineer or Equivalent duly attested. Three similar completed works each of value not less than Rs. 204070/- (40% of ECPT) or Two similar completed works each of value not less than Rs. 306105/- (60% of ECPT) or One similar completed work of value not less than Rs. 408140/- (80% of ECPT) Similar work shall mean "SITC of CCTV System". However, the Composite category contractor shall also be eligible to carry out himself without associating a specialized agency provided: (c) He fully fills the prescribed eligibility criteria respectively for this work or (b) He directly procures the equipment of approved make from manufacturer and gets it installed from authorized agency/service provider of manufacturer/specialized agency, all as per eligibility criteria mentioned as above.
SH: V	HVAC System	737572/-	The main contractor shall have to associate with agency fulfilling the following eligibility criteria having successfully completed during last seven years ending up to previous day of last date of submission of tender as given below with completion certificate issued by an officer not below the rank of Executive Engineer or Equivalent duly attested. Three similar completed works each of value not less than Rs. 295029/- (40% of ECPT) or Two similar completed works each of value not less than Rs. 442543/- (60% of ECPT) or One similar completed work of value not less than Rs. 590058/- (80% of ECPT)

			Similar work shall mean "SITC of HVAC system." However, the Composite category contractor shall also be eligible to carry out himself without associating any specialized agency provided: (f) He full fills the prescribed eligibility criteria respectively for this work or (b) He directly procures the equipment of approved make from manufacturer and gets it installed from authorized agency/ service provider of the manufacturer/specialized agency, all as per the eligibility criteria mentioned as above.
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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 last date of submission of tender. For other conditions, refer special conditions specified in the NIT.

The applicant shall either himself meet the eligibility conditions for the respective E&M packages or otherwise, he will have to associate an agency meeting the eligibility requirements as given in this tender document and submit the details as per Form given in this tender document within 30 days of award of work OR before start of minor component of work whichever is earlier.

The applicant/ main contractor has to submit consent letters as per Form given in this tender document from at least one eligible associate agency of the respective component of E&M work for each of the component of E& M works by clearly indicating the component of work within 30 days of award of work OR before start of minor component of work whichever is earlier.

The main contractor will have to submit an affidavit of MOU signed with eligible associated contractor. The MOU in the enclosed in the document shall be signed by both contractors, Main contractor as 1st party and associated contractor as 2nd party, independently for (i) IEI &

Fans, & water supply pump sets, (iv) Fire Fighting, Fire Alarm System and PA system (v) (vii) CCTV (xi) HVAC System etc., specified as above.

If the main contractor fails to associate agency for execution of minor components of work within 15 days of award of work OR before start of minor component of work whichever is earlier or furnishes incomplete details or furnishes details of ineligible agencies even after the tenderer is given due opportunity, the entire scope of such component of work shall be withdrawn from the tender and the same shall be got executed by the Engineer-in-Charge at the risk and cost of the main contractor.

1) Verifiable completion certificates of the work, registration/approval documents as the case may be, duly attested by the applicant shall be submitted within 15 days of award of work OR before start of minor component of work whichever is earlier. Valid Electrical license, as the case may be, duly attested by the applicant shall also be submitted within 30 days of award of work OR before start of minor component of work whichever is earlier

2) Self attested GST registration documents in respect of the associated agencies shall be submitted within 30 days of award of work OR before start of minor component of work whichever is earlier.

Executive Engineer (E)

SECTION - I
BRIEF PARTICULARS OF THE WORK SITE

The Indian Institute of Science Education and Research under the Ministry of Human Resource Development, Govt. of India envisages to set up a Permanent campus at Berhampur, Ganjam Dist.- Odisha.

The proposed Campus is to be set up on a plot area of about 200.43 Acres near to village Laudigam, Tahsil Konisi, Berhampur, Dist.- Ganjam, Odisha.

The site is situated at sea coast (Bay of Bengal). It is very much prone to cyclones. In the recent past it has been subjected to very strong cyclone namely Philine and Hud-hud with a high wind speed about 230 km/hr.

The site is about 15 km away from NH-16. It is connected with village road about 3.5 meter wide carriage way passing through number of villages. Therefore, transportation of men and materials in long body vehicles may be difficult. There is no source of water and electricity connection to the site. Therefore, bidders are advised to properly access the situation before the submission of the bid. At present there is no source of water & electric current at site.

The interim soil report given in the bid is just indicative. However, the Agency shall check the soil condition during actual execution & if there is any discrepancy, the same shall be brought to notice of Engineer-in-Charge. Work is being carried out at risk and cost of the main agency therefore bidders are advised to inspect the site and works are to be completed from as is where basis to the final testing commissioning with 1 year defect liability period. Auditorium building having height more than 16.5 metres and various fitting fixtures and works to be carried out at height and nothing extra shall be paid on this account. Bidders are advised to quote their rates after visiting the site of work.

EMD RECEIPT FORMAT

Receipt of Deposition of Original Bank Guarantee as EMD

(Receipt no..... / date.....)

Name of Work:- “Construction of Academic cum Administrative Building (G+6), Residential Buildings Type-II&III, 2 Blocks, 72 Nos, (S+9), Type-IV&IV(s), 1 block, 28 nos, (S+7), Type-V, 4 Blocks, 80 Nos, (S+10) with **Monolithic Concrete Construction technology**, Type-VI, 1 Block, 14 Nos, (S+7), Director’s Residence (G+1), 3 nos 656 bedded Hostel Buildings (S+8) with **Monolithic Concrete Construction technology**, Kitchen cum Dining (G+2), Guest House (G+2), 500 seated Auditorium (GF), Health Centre (G+1), Community Centre (G), Commercial facility Centre (S+1), Sports Complex (GF) including all internal & external services of Civil, Electrical, Mechanical including STP, WTP, Roads, Footpaths, Landscaping & Horticulture etc Fire, GRIHA & IGBC compliant building for a Functional Permanent Campus of IISER, at Berhampur, Odisha. (SH: Carrying out balance E&M Works in auditorium Building under clause 14 of the main work at risk & cost of the contractor.)”

- 1) NIT No.:- 05/NIT/EE & SM (E)/IPED/CPWD/2026-27
- 2) Estimated Cost: **Rs. 71,65,035/-**
- 3) Amount of Earnest money deposit: **Rs. 1,43,301/-**

- i) 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 of

Rs..... vide..... date.....

- ii) In the form of Bank Guarantee Rs..... issued by date (As per Form – G)

- iii) Last date of submission of bid:

- 1) Name of Bidder:
- 2) Total EMD Deposited:
- 3) Amount of Earnest Money Deposit:

- i) 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 of

Rs..... vide..... date.....

- ii) In the form of Bank Guarantee Rs..... issued by date (As per Form – G).

- 4) Date of Submission of EMD :

Signature, Name & Designation of EMD receiving officer
(EE/AE(P)/AE/AAO) along with office stamp

Form of Bank Guarantee for EMD/Performance Guarantee / Security Deposit

1. Whereas the EE & SM (E), IISER Project Electrical Division, CPWD, Berhampur on behalf of the President of India (hereinafter called "The Government,) has invited bids under NIT No:-**05/NIT/EE & SM (E)/IPED/CPWD/2026-27** for the work “Construction of Academic cum Administrative Building (G+6), Residential Buildings Type-II&III,2Blocks,72 Nos,(S+9), Type-IV&IV(s),1block,28nos, (S+7), Type-V, 4 Blocks, 80 Nos,(S+10) with **Monolithic Concrete Construction technology**, Type-VI,1Block,14 Nos,(S+7), Director’s Residence (G+1), 3nos 656 bedded Hostel Buildings (S+8) with **Monolithic Concrete Construction technology**, Kitchen cum Dining (G+2), Guest House (G+2), 500 seated Auditorium (GF), Health Centre (G+1), Community Centre (G) , Commercial facility Centre (S+1), Sports Complex (GF) including all internal & external services of Civil, Electrical, Mechanical including STP, WTP, Roads, Footpaths, Landscaping & Horticulture etc Fire, GRIHA & IGBC compliant building for a Functional Permanent Campus of IISER, at Berhampur, Odisha. (SH: Carrying out balance E&M Works in auditorium Building under clause 14 of the main work at risk & cost of the contractor.)”

The Government has further agreed to accept irrevocable Bank Guarantee for Rs. valid upto (date)*..... as Earnest Money Deposit from (name and address of contractor)(hereinafter called "the contractor") for compliance of his obligations in accordance with the terms and conditions of the said NIT.

OR**

Whereas the EE & SM (E), IISER Project Electrical Division, CPWD, Berhampur on behalf of the President of India (hereinafter called “The Government”) has entered into an agreement bearing number

..... With..... (Name and address of the contractor) (hereinafter called “the contractor”) for execution of work :-“ Construction of Academic cum Administrative Building (G+6), Residential Buildings Type-II&III,2Blocks,72 Nos,(S+9), Type-IV&IV(s),1block,28nos, (S+7), Type-V, 4 Blocks, 80 Nos,(S+10) with **Monolithic Concrete Construction technology**, Type-VI,1Block,14 Nos,(S+7), Director’s Residence (G+1), 3nos 656 bedded Hostel Buildings (S+8) with **Monolithic Concrete Construction technology**, Kitchen cum Dining (G+2), Guest House (G+2), 500 seated Auditorium (GF), Health Centre (G+1), Community Centre (G) , Commercial facility Centre (S+1), Sports Complex (GF) including all internal & external services of Civil, Electrical, Mechanical including STP, WTP, Roads, Footpaths, Landscaping & Horticulture etc Fire, GRIHA & IGBC compliant building for a Functional Permanent Campus of IISER, at Berhampur, Odisha. (SH: Carrying out balance E&M Works in auditorium Building under clause 14 of the main work at risk & cost of the contractor.)”

The Government has further agreed to accept irrevocable Bank Guarantee for Rs..... (Rupees Only) valid upto..... (date) *..... As **Performance Guarantee / Security Deposit** from the said contractor for compliance of his obligations in accordance with the terms and conditions of the agreement.

2. We, (Indicate the name of the Bank)..... (Herein after referred to as “the Bank”) hereby undertake to pay to the Government an amount not exceeding Rs..... (Rupees..... Only) on demand by the Government within 10 days of the demand.
3. We,..... (indicate the name of the Bank), do here by undertake to pay the amount due and payable under this guarantee without any demur, merely on a demand from the Government stating that the amount claimed is required to meet the recoveries due or likely to be due from the said contractor. Any such demand made on the Bank shall be conclusive as regards the amount due and payable by the Bank under this Guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs. (RupeesOnly).
4. We, (indicate the name of the Bank), further undertake to pay the Government any money so demanded not withstanding any dispute of disputes raised by the contractor in any suit or proceeding

pending before any Court or Tribunal, our liability under this Bank Guarantee being absolute and unequivocal. The payment so made by us under this Bank Guarantee shall be a valid discharge of our liability for payment there under and the Contractor shall have no claim against us for making such payment.

5. We, (indicate the name of the Bank)..... , further agree that the Government shall have the fullest liberty without our consent and without affecting in any manner our obligation here under to vary any of the terms and conditions of the said agreement or to extend time of performance by the said contractor from time to time or to postpone for any time or from time to time any of the powers exercisable by the Government against the said contractor and to forbear

or enforce any of the terms and conditions relating to the said agreement and we shall not be relieved from our liability by reason of any such variation or extension being granted to the said contractor or for any forbearance act of omission on the part of the Government or any indulgence by the Government to the said contractor or by any such matter or thing whatsoever which under the law relating to sureties would, but for this provision, have effect of so relieving us.

6. We, (indicate the name of the Bank)..... , further agree that the Government as its option shall be entitled to enforce this Guarantee against the Bank as a Principal debtor at the first instance without proceeding against the contractor and notwithstanding any security or other guarantee the Government may have in relation to the Contractor's liabilities.

7. This guarantee will not be discharged due to the change in the constitution of the Bank or the Contractor.

8. We, (indicate the name of the Bank) , undertake not to revoke this guarantee except with the consent of the Government in writing.

9. This Bank Guarantee shall be valid upto Unless extended on demand by the Government. Notwithstanding anything mentioned above, our liability against this guarantee is restricted to Rs. (Rupees Only) and unless a claim in writing is lodged with us within the date of expiry or extended date of expiry of this guarantee, all our liabilities under this guarantee shall stand discharged.

Date:

Witnesses:

1. Signature.....
Name and address

Authorized Signatory
Name

Designation

Staff code No.

2. Signature
Name and address

Bank seal

*Date to be minimum 90 days from the date of acceptance of tender in case of performance guarantee.

** In paragraph 1, strike out the portion not applicable. Bank Guarantee will be made either for Earnest money or for performance guarantee/security deposit/mobilization advance, as the case may be.

Note:

Bank Guarantee must be on non-judicial stamp paper of minimum Rs. 100.

UNDERTAKING FOR ASSOCIATION OF SPECIALISED AGENCY FOR E & M

We undertake that we shall submit within 15 days after award of work an undertaking from the OEMs for specialised E&M works of that “they shall unconditionally support the lowest tenderer technically throughout the execution of contract as well as for defect liability period of the Contract and warranty period for the useful life of the system, and they shall also provide all the spares required for healthy functioning of the equipment for the defect liability period and warranty period from the date of supply of equipment”.

Signature of bidder(s) with stamp

CONSENT LETTER FROM ELIGIBLE ASSOCIATE AGENCY OF MINOR COMPONENT OF WORK

I / We hereby give my consent to associate with M/s, for executing the minor component of work of (Mention category).

3) I / We will execute the work as per specifications and conditions of the agreement and as per directions of the Engineer –in-Charge for the corresponding minor work till the completion of the work.

4) I / We will be responsible for necessary action to handover the installations and for rectification of defects and repair during the maintenance / warranty period.

5) Also I / We will employ full time technically qualified Engineer / supervisor for the minor component of the work as required for the work. I / We will attend inspection of officers of the department as and when required.

Date:

Signature with date of Major component

Contractor

Address

Witness with address

(From major component contractor side) Signature
with date of Associate/

MinorComponentContractor Address

Witness with address

(From minor component contractor side)

AFFIDAVIT OF MEMORANDUM OF UNDERSTANDING (MOU)

(to be submitted for each and every E&M component)

- 1) M/s. (Name of the firm with full address)
- 2) Enlistment Status Valid Upto:
(Henceforth called the main Contractor)
- 3) M/s. (Name of the firm with full address)
- 4) Enlistment Status Valid Upto:
(Henceforth called Associated Contractor)

For the execution of E & M Component Works -

We state that M.O.U between us will be treated as an agreement and has legality as per Indian Contract Act (amended up to date) and the department (CPWD) can enforce all the terms and conditions of the agreement for execution of the above work. Both of us shall be responsible for the execution of work as per the agreement to the extent this MOU allows. Both the parties shall be paid consequent to the execution as per agreement to the extent this MOU permits. In case of any dispute, either of us will go for mediation by the Engineer In charge. Any of us may appeal against the mediation to the Chief Engineer, EZ-V, CPWD, Bhubaneswar. His decision shall be final and binding on both of us. We have agreed as under:

- 5) The Associated Contractor will execute all E & M works in the wholesome manner as per terms and conditions of the agreement.
- 6) The Associated Contractor shall be liable for disciplinary action if he fails to discharge the action(s) and other legal action as per agreement.
- 7) All the machinery and equipments, tools and tackles required for execution of the E & M works, as per agreement, shall be the responsibility of the Associated Contractor.
- 8) The site staff required for the E & M work shall be arranged by the Associated Contractor as per terms and conditions of the agreement.
- 9) Site order book maintained for the said work shall be signed by the main contractor as well as by the Engineer of the Associated Contractor and by Associated Contractor himself.
- 10) All the correspondence regarding execution of the E & M work shall be done by the department with the Associated Contractor with a copy to the main contractor. In case of non-compliance of the provisions of agreement, the main contractor, as well as the associated contractor shall be responsible. The action under clauses 2 and 3 shall be initiated and taken against the main contractor.

SIGNATURE OF MAIN CONTRACTOR Date: Place:	SIGNATURE OF ASSOCIATED CONTRACTOR Date: Place:
1. Witness with address (From major component contractor side)	2. Witness with address (From minor component contractor side)

GOVERNMENT OF INDIA
CENTRAL PUBLIC WORKS DEPARTMENT

STATE : Odisha

Zone : CE cum ED, Berhampur

BRANCH : B & R

Division : EE & SM (E), IPED.

PERCENTAGE RATE TENDER & CONTRACT FOR WORKS

Percentage rate tender for the work of “Construction of Academic cum Administrative Building (G+6), Residential Buildings Type-II&III, 2 Blocks, 72 Nos, (S+9), Type-IV&IV(s), 1 block, 28 nos, (S+7), Type-V, 4 Blocks, 80 Nos, (S+10) with **Monolithic Concrete Construction technology**, Type-VI, 1 Block, 14 Nos, (S+7), Director’s Residence (G+1), 3 nos 656 bedded Hostel Buildings (S+8) with **Monolithic Concrete Construction technology**, Kitchen cum Dining (G+2), Guest House (G+2), 500 seated Auditorium (GF), Health Centre (G+1), Community Centre (G), Commercial facility Centre (S+1), Sports Complex (GF) including all internal & external services of Civil, Electrical, Mechanical including STP, WTP, Roads, Footpaths, Landscaping & Horticulture etc Fire, GRIHA & IGBC compliant building for a Functional Permanent Campus of IISER, at Berhampur, Odisha. (SH: Carrying out balance E&M Works in auditorium Building under clause 14 of the main work at risk & cost of the contractor.)”

To be uploaded online up to 15:00 hours on 01/09/2026 through website <https://etender.cpwd.gov.in> or www.etender.cpwd.gov.in

The bid to be opened on 01/09/2026 online in presence of tenderer who may be present at 15:30 hours on 01/09/2026 in the office of Executive Engineer & SM (E), IISER Project Electrical Division, CPWD, Berhampur.

TENDER

I/We have read and examined the Notice Inviting Tender, Schedules, Specifications applicable, Drawings & Designs, General Rules and Directions, Conditions of Contract, Clauses of Contract, Special Conditions, Schedule of Rate and 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 President of India within the time specified in Schedule ‘F’, viz. Schedule of Quantities and in accordance in all respects with the Specifications / Special conditions, Designs, Drawings and instructions in writing as referred to in this tender document and with such materials as are provided for, by and in respects in accordance with, such conditions so far as applicable.

I/We agree to keep the tender open for (30) Thirty days from the date of opening of bid and not to make any modifications in its terms and conditions.

I/We have deposited EMD for the prescribed amount in the office of concerned Executive Engineer as per the bid document.

A copy of earnest money deposit receipt of prescribed amount deposited in the form of Insurance Surety Bonds, Account Payee Demand Draft, Fixed Deposit Receipt, Banker's Cheque or Bank Guarantee (as prescribed) issued by a Commercial Bank, is scanned and uploaded (strike out as the case may be). If I/We, fail to furnish the prescribed performance guarantee within prescribed period, I/We agree that the said President of India or his successors, in office shall without prejudice to any other right or remedy, be at liberty to forfeit the said earnest money absolutely. Further, if I/We fail to commence work as specified, I/ We agree that President of India or the successors in office shall without prejudice to any other right or remedy available in law, be at liberty to forfeit the said performance guarantee absolutely. The said Performance Guarantee shall be a guarantee to execute all the works referred to in the tender documents upon the terms and conditions contained or referred to those in excess of that limit at the rates to be determined in accordance with the provision contained in Clause 12.2 and 12.3 of the tender form.

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

I / We undertake and confirm that eligible similar work(s) has/ have not been got executed through another contractor on back-to-back basis. Further that, if such a violation comes to the notice of Department, then I/we shall be debarred from the tendering in CPWD in future forever. Also, if such a violation comes to the notice of Department before date of start of work, the Engineer-in-Charge shall be free to forfeit the entire amount of Earnest Money Deposit/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 therefrom to any person other than a person to whom I/we/am/are may authorized to communicate the same or use the information in any manner prejudicial to the safety of the State.

Dated:	}	Signature of Contractor: -	}
Witness: -		Postal Address: -	
Address: -			
Occupation: -			
Telephone No:-			
Fax:-			
Email:-			

ACCEPTANCE

The above tender (as modified by you as provided in the letters mentioned hereunder) is accepted by me for and on behalf of the President of India for a sum of Rs.....

(Rupees.....)

The letters referred to below shall form part of this contract agreement.

i)

ii)

iii)

Signature

Dated: -.....

Executive Engineer & SM (E)

IPED, CPWD, Berhampur

For & on behalf of the President of India.

**To be filled in by the Executive Engineer

**To be filled in by the contract

PROFORMA OF SCHEDULES

(Separate Performa for Civil, Elect. & Hort. Works in case of Composite Tenders)

The Proforma of Schedule is for Electrical component. The schedules of quantities of different components are as pages mentioned below:-

PROFORMA OF SCHEDULES				
SCHEDULE 'A' Schedule of quantities: Page No. 284-301				
SCHEDULE 'D' Extra schedule for specific requirements/document for the work, if any				
		Page no.		
(a)	General Conditions of all E&M works	35	to	248
(b)	List of preferred makes for (Electrical Works)	249	to	282
SCHEDULE 'E'				
Reference to General Conditions of contract		General Conditions of Contract 2023 for Construction work as amended/modified up to the previous day to last date of Submission of Bid.		
Name of work :		Construction of Academic cum Administrative Building (G+6), Residential Buildings Type-II&III, 2 Blocks, 72 Nos,(S+9), Type-IV&IV(s), 1 block, 28 nos, (S+7), Type-V, 4 Blocks, 80 Nos,(S+10) with Monolithic Concrete Construction technology , Type-VI,1Block,14 Nos,(S+7), Director's Residence (G+1), 3nos 656 bedded Hostel Buildings (S+8) with Monolithic Concrete Construction technology , Kitchen cum Dining (G+2), Guest House (G+2), 500 seated Auditorium (GF), Health Centre (G+1), Community Centre (G) , Commercial facility Centre (S+1), Sports Complex (GF) including all internal & external services of Civil, Electrical, Mechanical including STP, WTP, Roads, Footpaths, Landscaping & Horticulture etc Fire, GRIHA & IGBC compliant building for a Functional Permanent Campus of IISER, at Berhampur, Odisha. (SH: Carrying out balance E&M Works in auditorium Building under clause 14 of the main work at risk & cost of the contractor.)		
Estimated cost of work:		Rs. 71,65,035/-		
(i)	Earnest Money :	Rs. 1,43,301/-		

(ii)	Performance Guarantee	(a) 5% of the tendered value or Estimate Cost Put to Tender (ECPT) (whichever is higher) (b) Where the tender amount is less than eighty percent (80%) of the Estimate Cost put to Tender (ECPT), the Performance Guarantee, in addition to the requirement under (a) above, shall be increased by an amount equal to the difference between eighty percent (80%) of the ECPT and the tendered amount
(iii)	Security Deposit	2.5% of Tendered Value

SCHEDULE 'F': GENERAL RULES & DIRECTIONS:-		
Officer Inviting Tender :		EE & SM (E), CPWD, IISER Project Electrical Division, CPWD, Berhampur
Maximum percentage for quantity of items of work to be executed beyond which rates are to be determined in accordance with clauses 12.2 & 12.3.		As per Clause 12 mentioned below
2 (v)	Definitions:	
	Engineer-in-charge	EE & SM (E), CPWD, IISER Project Electrical Division, CPWD, Berhampur or success thereof.
2(viii)	Accepting Authority	EE & SM (E), CPWD, IISER Project Electrical Division, CPWD, Berhampur or success thereof.
2 (x)	Percentage on the cost of material and labour to cover all overheads and Profits.	15 %
2 (xi)	Standard Schedule of Rates	E&M DSR 2025, Civil DSR-2023 with correction slips up to last date of submission of tender and Market Rate for Non-scheduled Items.
2 (xii)	Department	CPWD
9(ii)	Standard CPWD contract Form GCC 2023, CPWD Form 7/ 8 as modified & corrected upto	GCC 2023 (Construction work), CPWD Form 7 as amended/ modified up to the previous day to last date of submission of bid.
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 letter of acceptance	7 days Performance guarantee shall remain valid for a minimum period of 60 days beyond date of completion.
(ii) Maximum allowable extension with late fee @ 0.1% per day of Performance Guarantee amount beyond the period provided in (i) above	3 days
Clause 2:	
Authority for fixing compensation under clause 2.	CE cum ED, CPWD, Berhampur Project Zone or success thereof.

Clause 5:	Applicable
Number of days from the date of issue of letter of acceptance for reckoning date of start Mile stone(s) as per table given below:-	10 days
Milestone	As per Table attached on page-37
Time allowed for execution of work	01 (One) Month
Authority to decide:	
(i) Authority to convey the decision of shifting of milestones and extension of time	EE & SM (E), CPWD, IISER Project Electrical Division, CPWD, Berhampur
(ii) Rescheduling of milestones	CE cum ED, CPWD, Berhampur Project Zone or success thereof.
(iii) Shifting of date of start in case of delay in handing over of site	CE cum ED, CPWD, Berhampur Project Zone or success thereof.
Clause 6 Applicable clause	EMB through ERP
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	For Electrical Work Rs. 20.00 Lakh.
Clause 7A: Whether clause 7A shall be applicable.	Yes. No running account bill shall be paid for the work till the applicable labour licenses, registration with EPFO, ESIC & BOCW welfare board, etc. are

	submitted by the contractor to the Engineer-in-charge.
Clause 7B: Payment to third Party	Yes, (As per GCC Construction work -2023.)
Clause 10 A: List of testing equipment to be provided by the contractor at site lab.	As per requirement of execution of work.
Clause-10 B (i) (Secured Advance)	Not Applicable
Clause 10B (ii) (Mobilization Advance)	Not Applicable
Clause 10 C:-	Not Applicable
Clause 10 CC:-	Not Applicable

Clause 11: Specifications to be followed for execution of work	Electrical works: Part-I Internal 2023 Part-II External 2023
Note: - 1. The above specifications of CPWD shall be applicable along with correction slips up to the last date of submission of bid and amendments thereof. 2. Wherever the CPWD specifications are not given, the works shall be executed as per the additional specifications & terms & Conditions mentioned in the NIT. 3. The direction of the Engineer-in-charge shall be followed in the absence of the above two.	
Clause 12: Type of work	Construction Work
12.2 & 12.3 Deviation Limit beyond which clauses 12.2 & 12.3 shall apply	100%
12.4 i) Deviation limit beyond which clauses 12.2& 12.3 shall apply for foundation work (except items mentioned in earthwork subhead in DSR and related items)	100% NA

ii) Deviation limit for items mentioned in earthwork subhead of DSR and related items	
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Clause 16:-	
Competent Authority for deciding reduced rates	CE cum ED, CPWD, Berhampur Project Zone or success thereof.
Clause-17: Contractor liable for damages, defects during defect liability period	Yes (12 Months for overall works)
Clause 18:-	
List of mandatory machinery, tools & plants to be deployed by the contractor at the site:	T&P and machinery required for execution & completion of work as directed by the Engineer-in-charge.

Clause 19C	
Authority to decide the penalty for each default	EE & SM (E), CPWD, IISER Project Electrical Division, CPWD, Berhampur.
Clause 19D	
Authority to decide the penalty for each default	EE & SM (E), CPWD, IISER Project Electrical Division, CPWD, Berhampur.
Clause 19G	
Authority to decide the penalty for each default	EE & SM (E), CPWD, IISER Project Electrical Division, CPWD, Berhampur
Clause 19K	Rs 200/- per person per day

Clause 25

Constitution of Dispute Redressal Committee (DRC)	Competent Authority to Appoint DRC
Conciliator	Special Director General (Project Region Kolkata) CPWD, Kolkata
Arbitrator Appointing Authority	CE cum ED, CPWD, Berhampur Project Zone or success thereof.
Place of Arbitration	Berhampur / Bhubaneswar

Note: The above constitution of Dispute Redressal Committee is subject to change, for which necessary notification shall be issued by the competent authority of the department, if required.

Clause 32: Requirement of Technical Representative(s) & recovery Rate: -

For Major & Minor Components:

S. No.	Requirement of Technical Staff		Minimum experience (Years)	Designation of technical staff	Rate at which recovery shall be made from the contractor in the event of not fulfilling provision of clause 32(i)
	Qualification	Number			
1	Graduate Engineer Or Diploma Engineer	1	2 or 5 respectively	Project/Site /Planning/Billing Engineer	Rs. 15,000/- per month per person.

Note:-

1. Assistant Engineers retired from Government services & are holding Diploma will be treated at par with Graduate Engineers.
2. Diploma holders with a minimum 10 years relevant experience with a reputed construction co. can be treated at par with Graduate Engineers for the purpose of such deployment subject to the condition that such diploma holders should not exceed 50% of requirement of degree Engineers.
3. The contractor shall submit a certificate of such employment of the technical representative(s) (in the form of copy of Form-16 or CPF deduction issued to the Engineers employed by him) along with every account bill/final bill and shall produce evidence if at any times so required by the Engineer-in-charge.

TABLE OF MILESTONE (S)

Name of work:- "Construction of Academic cum Administrative Building (G+6), Residential Buildings Type-II&III,2Blocks,72 Nos,(S+9), Type-IV&IV(s),1block,28nos, (S+7), Type-V,4 Blocks, 80 Nos,(S+10) with

Monolithic Concrete Construction technology, Type-VI, 1 Block, 14 Nos, (S+7), Director's Residence (G+1), 3 nos 656 bedded Hostel Buildings (S+8) with **Monolithic Concrete Construction technology**, Kitchen cum Dining (G+2), Guest House (G+2), 500 seated Auditorium (GF), Health Centre (G+1), Community Centre (G), Commercial facility Centre (S+1), Sports Complex (GF) including all internal & external services of Civil, Electrical, Mechanical including STP, WTP, Roads, Footpaths, Landscaping & Horticulture etc Fire, GRIHA & IGBC compliant building for a Functional Permanent Campus of IISER, at Berhampur, Odisha. (SH: Carrying out balance E&M Works in auditorium Building under clause 14 of the main work at risk & cost of the contractor.)"

Time Allowed :- 01 (One) Month

Sl. No.	Description of Milestone (Physical)	Time allowed in days (from Date of start)	Amount to be withheld in case of non-achievement of milestone (Civil and/or electrical Tender Amount)
1.	Approval of all the design drawing and data sheets	7 Days	In the event of not achieving the necessary milestones as assessed from mile stone chart, 1.66% of the tendered value of work will be withheld for failure of each milestone.
2	Completion of all balance work	25 Days	
3	Testing, Commissioning and Handover	30 Days	

UNDERTAKING REGARDING GST REGISTRATION IN THE STATE OF ODISHA

To,

The Executive Engineer & SM (E),

CPWD, IPED, Berhampur (Odisha)

Name of Work: Construction of Academic cum Administrative Building (G+6), Residential Buildings Type-II&III, 2 Blocks, 72 Nos,(S+9), Type-IV&IV(s), 1 block, 28 nos, (S+7), Type-V, 4 Blocks, 80 Nos,(S+10) with **Monolithic Concrete Construction technology**, Type-VI,1Block,14 Nos,(S+7), Director's Residence (G+1), 3nos 656 bedded Hostel Buildings (S+8) with **Monolithic Concrete Construction technology**, Kitchen cum Dining (G+2), Guest House (G+2), 500 seated Auditorium (GF), Health Centre (G+1), Community Centre (G) , Commercial facility Centre (S+1), Sports Complex (GF) including all internal & external services of Civil, Electrical, Mechanical including STP, WTP, Roads, Footpaths, Landscaping & Horticulture etc Fire, GRIHA & IGBC compliant building for a Functional Permanent Campus of IISER, at Berhampur, Odisha. (SH: Carrying out balance E&M Works in auditorium Building under clause 14 of the main work at risk & cost of the contractor.)

Sir,

Having examined the details given in the bid document for the above work, I/we hereby submit that we are not having GST registration in the state of Odisha. Hence, we hereby under take the following:

"If work is awarded to me/us, I/we shall obtain GST Registration certificate in the state of

Odisha within one month from date of receipt of award letter or before release of any payment by CPWD, whichever is earlier, failing which I/We shall be responsible for any delay in payment which will be due towards me/us on account of work executed and/or for any action taken by CPWD or GST department in this regard."

Signature of Bidder(s) or an authorized

Officer of the firm with stamp

Date of Submission

(General Terms & Conditions for Electrical & Mechanical services)

General Terms & Conditions for Electrical & Mechanical services.

1. General:

1.1. The work is to be executed at site for Construction of IISER Berhampur, Odisha. The tendered in his own interest should visit the site and familiarize himself with site condition before tendering.

1.2. There are various sub works, each sub work shall be governed by its corresponding Design concept, SOQ, specifications, Drawings, testing procedures etc. These General Terms and conditions are broadly applicable for all Sub Works.

1.3. The rates for all items of work shall apply for all heights and depth unless otherwise specified.

1.4. Energy and water conservation is the theme of the building hence all the equipment selected should be energy and water efficient. All motor for pumps and fans should be IE-3 class (except the main electrical fire pump motor and drainage pumps which can be of lower class).

1.5. Contractor shall provide the latest model of the equipments meeting minimum requirement spelt out in SOQ and specifications. Only such components, equipment should be offered, which are serviceable by the contractor /OEM for minimum next 20 years without any problem of spares. The date of the manufacturing of all the equipments brought to site should not be more than one year from the date of receipt of the material at site. The contractor must plan to supply the material at site maximum 1 months before the use of all the E&M materials at site. from the progress of the work this must be evaluated and Engineer In charge must access the same before release of payment of material. This is based purely on engineering judgement of PM / Engineering in Charge . However the decision of PM / Engineering in Charge is final in this regard.

1.6. Contractors shall prepare working drawing for each service as per CPWD General Specifications for the respective work.

1.7. In case of difference in various documents the following order of priority shall be followed and interpreted

- i. Description of items as given in Schedule of quantities
- ii. Particular specifications
- iii. General Terms and Conditions
- iv. Tender drawings attached
- v. CPWD Specifications including up to date correction slips.
- vi. General Conditions of Contract for CPWD works including correction slips issued up to last date of submission of bid.
- vii. Indian Standards Specifications of B.I.S.
- viii. ASTM, BS, or other foreign origin code mentioned in tender document.
- ix. Manufacturer's specifications and as decided by the Engineer-in-Charge.
- x. Sound Engineering practices or well established local construction practices.

However In such case, the matter shall be brought to the notice of Engineer in Charge and the decision of the Engineer-in-Charge shall be final.

2. Associate Contractor : As per Eligibility criteria for few sub works /services Associate contractor is permitted, Once engaged, only one change of associate contractor (that too for not more than 2 such sub works), with prior approval of Engineer-in-Charge is permitted.

3. Once the Financial bids are opened, no change in Design, Drawings, Specifications, Makes and General Conditions shall be permitted at later date. Hence contractor are advised to go through the design concept, specifications and make list thoroughly and put their point during Pre-Bid meeting for consideration by the department.

4. Completeness of the Tender, Submission of Programme, Approval of Drawings and commencement of work

4.1. **Completeness of the tender:-** All sundry equipments, fittings, assemblies, accessories, foundation bolts, supports, termination lugs for electrical connections, cable glands, junction boxes and all other items which are useful and necessary for proper assembly and efficient working of the various equipments and components of the work shall be deemed to have been included in the tender, irrespective of the fact whether such items are specifically mentioned in the tender or not.

4.2. Submission of programme: Within stipulated time for completion from the date of receipt of the letter of award, the successful tenderer shall submit his broad programme/Master Bar Chart for submission of drawings, supply of equipment at site, installation, testing, commissioning and handing over of the installation to the Engineer-in-charge. This programme shall be framed keeping in view the building progress and the milestones fixed in Schedule 'F'. In case department desires some changes in the same, contractor shall do the same.

Once the broad programme/Master Bar Chart is agreed by Department, Contractor shall make a detailed activity schedule/CPM–PERT chart and the same shall be submitted to department. Department may insist on re-planning some of the activities.

4.3. Understanding SOQ of various SUB WORKS and IBMS compatibility: Contractor has to understand complete SOQ of all Sub Heads, Scope and Design concept of various Sub works, General Terms & Conditions, Technical specification, CPWD General conditions of contract 2014 up to date, Additional conditions etc. Contractor shall also understand/read all E & M drawing of services and check the same thoroughly for their completeness, correctness and inter dependence, suitability with special emphases with respect to Integrated Building Management System. All the sub works shall be planned & executed in such a manner that there is no duplication with respect to wiring/controls/sensors etc. because of IBMS. IBMS specialist of the contractor shall satisfy himself that the required signals are received, processed and transmitted for control/intended purpose.

The control of all equipments shall be IBMS compatible (refer master inventory indicating minimum controls and monitoring desire) and data input summary sheet of IBMS.

4.4. Submission of Drawings, Checking Structural and Architectural Provisions, Verification of Design:

Based on inventory and BOQ the distribution drawings, conduit layout drawings to be submitted including all other services well before time to Engineer in charge for approval of scheme and design. The drawing should be in Autocad format dully signed by the Engineers as per clause 36 of GCC.

Contractor has to prepare shop/working drawing for all services and conflict if any with water Plumbing lines and Sewage water lines be resolved by contractor himself by reworking the route of one or more services as required.

Contractor shall check the structural requirement for mounting/positioning of equipments i/c Electrical Panels etc. and inform the department for missing Architectural provisions, if any at the earliest.

While preparing working Drawings, care shall be taken to provide flexible/expandable material to take care of Thermal variations/ seismic vibration/ climatic changes. Reflected ceiling plan, all E&M services drawings layout, schematic GA drawing must be submitted before line start of work.

4.5 Procurement of Material at site: The Qty taken in SOQ are based upon estimate prepared by Department and are indicative. Only the required qty, as worked out by contractor and approved by Department shall be brought at site and paid. Any surplus quantity brought by contractor to site, need to be taken back by the contractor without any implication to the department.

Contractor shall CHECK/VERIFY DESIGN and Quantity THOROUGHLY, and suggestions for improvement (additional, substitute items etc.) and Deviations, enclosing full justification be given within 1 months from award of work for consideration by department. Orders for such additional/substitute items/deviated qty be placed on suppliers only after getting written confirmation from Department.

4.6 Works to be done by the contractor:

The Contractor shall execute the work on the basis of working drawings, prepared by contractor and approved by department. All Variations, i.e. additions, omissions or substitutions necessitated at any time for any reason whatsoever, shall be deemed to have been accepted by the Contractor as not vitiating the performance based nature of this contract. If any such variations, irrespective of whether such variations are intended to be executed by other agencies employed by the Engineer-in-charge, have any bearing on the performance of this Contract, the same shall immediately be brought to the notice of Engineer-in-charge by the Contractor in writing. In any case the Contractor shall have to guarantee for due and proper performance of the works agreed to be so erected.

Unless otherwise mentioned in the tender documents, the following works shall be done by the contractor and therefore, their cost shall be deemed to be included in their tendered cost- whether specifically indicated in the schedule of work or not:

- i. Foundations for equipments including foundation bolts and vibration isolation spring/pads.
- ii. Suspenders, brackets and floor/wall support for suspending/ supporting ducts/pipes.
- iii. Suspenders and or cable trays for laying the cables.

- iv. Sealing of all floor slab/wall openings provided by the Department or made by the contractor for lying of pipes, ducts and cables, from fire safety points of view.
- v. Painting of all exposed metal surfaces of equipments and components appropriate color as per relevant part of bid document.
- vi. Making opening in the wall/floors. Slabs or modifications in the existing openings wherever provided for carrying ducts/cable/cable tray etc. Opening in the slab/retaining walls/brick wall etc. shall be made by means of core cutting machines only.
- vii. All electrical works including cable/wires, earthing etc. beyond power supply made available by the department.
- viii. Making good all damages caused to the structure during installation and restoring the same to their original finish.
- ix. Approval from local authorities of Odisha state government as may be required as per local bye-laws. (The contractor's responsibility shall be limited to the work executed by him.) and Central Authorities like CFO, CEA, Municipalities and Authorities.

5. Commercial Conditions:

5.1 Terms of Payments Following payment terms shall be applicable.

- i. Following percentage of contract rates shall be payable against the stage of work shown herein: except - IEI & external Lighting, which will be paid as per the progress of work at site.

5.2 Taxes and Duties:

The tender is for entering into item rate works contract. The rates shall be inclusive of all taxes, duties, levies, cess, packing, transportation, handling etc.

The tender rates must be inclusive all taxes.

5.3 Funds Flow: Contractor shall submit the anticipated funds receivable required as per Detailed Activity Schedule.

5.4 No foreign exchange shall be made available by the department for the purchase of equipment, plants, machinery, materials of any kind or any other items required to be carried out in execution of work.

6. Storage Space: No dedicated space for storage of material shall be provided however of possible contractor shall be permitted to use part of basement area as storage space by providing suitable partition at their own cost. Once the sub-station, AC plant room, electric room is ready the same shall be handed over to contractor, for execution of work, this space can also be used as storage space. The material & equipment should be brought at site maximum one months before the use of the same at site.

7. Site, Movement of Vehicles, Security and VIP movements:

7.1 The site is in secured area of IISER, Berhampur. There are restrictions of plying the type of Vehicle, on registration and on their movements on road during certain times. Contractor shall well acquaint himself about the rules regarding the same. The contractor shall make his own arrangement for getting the permission to ply the trucks from the traffic police. The contractor shall plan his activities in such a manner that supply of material as required at site is received as per requirement. No request shall be entertained by the department in this regard.

7.2 At some occasion due to VIP visit / inspection, restriction may be imposed for working in certain areas, no claim what so ever on account of lose of time and labour shall be entered in this regard.

7.3 In the event of any restrictions being imposed by the Security agency, CPWD, Traffic or any other authority having jurisdiction in the area on the working or movement of labour/material, the contractor shall strictly follow such restrictions and nothing extra shall be payable to the contractor on this account. The loss of time on this account, if any, shall have to be made up by generating additional resources etc. General Security restrictions are given as under:

- i. Entry passes for labours and supervisory staff of the agency shall be arranged by the Department on receipt of details and materials as required by the Security staff.
- ii. The contractor shall be responsible for behaviour and conduct of his worker. No worker with doubtful integrity or having a bad record shall be engaged by the contractor
- iii. The labourers/staff should not be changed too frequently once the verification of the character and antecedents is done.
- iv. As and when there will be security requirements, certain additional restriction (s) can be imposed as per the requirement of the situation.
- v. No claim whatsoever will be entertained by the department on account of any restriction (s) imposed by the security agencies in execution of work.

8. Supervision:

8.1 Site Supervision: Contractor shall depute Project Manager and other staff as detailed in form A to F. Engineers so deployed shall not be allowed to be changed during the execution period without written approval from Project Manager in exceptional circumstances.

8.2 Site Coordination, Review Meetings and Joint Inspection: Frequent review and Coordination meeting shall be held at site by Chief Project Manager CPWD, which shall be attended by the Contractor or his appropriate representative. Joint Inspection of work site shall be carried out as required.

8.3 The agency / contractor must submit all document proof for the deployment of engineer as per clause 36. A register for labour must be kept at site for E&M daily deployment of labour against each services.

The Signature of the Engineers as per clause 36 must be submitted against his photograph and name and power of attorney should be given to them. Submission for acceptance of all technical instruments including drawings.

9. Conformity with statutory Acts, Rules, Standards and codes

Contractor shall obtain all local / statutory approvals required as per rule of land

i) All components shall conform to relevant Indian Standard Specifications, wherever existing, amended to date.

ii) All electrical works shall be carried out in accordance with the provisions of Indian Electricity Act, 2003 and Indian Electricity Rules, 1956 amended to date. They shall also conform to CPWD General Specifications for Electrical works, Part-I: Internal, 2013, Part-II: external, 1994 and Part IV (Sub- Station) 2013, HVAC -2017, Firefighting 2006, Fire Alarm System, Lift - 2003, Dg set - 2013 amended to date.

iii) The contractor shall comply with proper and legal orders and directions of the local or public authority or Municipality and abide by their rules and regulations and pay all fees and charges which he may be liable.

iv) The contractor shall give due notices to Municipality, Police and /or other authorities that may be required under the law/ rules under force in the and obtain all requisite licenses for temporary obstructions/ enclosures and pay all charges which may be liable on account of his execution of the work under the agreement. Nothing extra shall be payable on this account.

10. Safety Codes and Labour Regulations

i) All the staff and worker engage for the job shall wear proper badge indicating name of the contractor, name of the person, designation.

ii) While working or inspecting at site staff / worker shall wear safety helmet and safety shoes also if require.

iii) In respect of all labour employed directly or indirectly on the work, the contractor at his own expense, will arrange for the safety provisions as per the statutory provision, B.I.S. recommendations, factory act, workman's compensation act. CPWD code and instructions issued from time to time. Failure to provide such safety requirements would make the tenderer liable for cost consequences.

iv) The contractor shall provide necessary barriers, signals and other safety measures while laying pipelines, cables etc. or wherever necessary so as to avoid accident. He shall also indemnify CPWD against claims for compensation arising out of negligence in this respect. Contractor shall be liable, in accordance with the Indian law and Regulations for any accident occurring due to any cause. The department shall not be responsible for any accident occurred or damage incurred or claims arising there from during the execution of work. The contractor to cover the risk. No extra payment would be made to the contractor due to the above provisions thereof.

v) Contractor shall take all precautions to avoid accidents by exhibiting caution boards day and night, speed limit boards, red flags, red lights and providing necessary barriers and all other measures required from time to time. The contractor shall be responsible for all damages and accidents due to negligence on his part and shall solely for all legal and financial consequences.

11. Power Supply:

i) The 3 Phase, 415 volts, 50 Hz power supply shall be arranged by the contractor for execution of the work.

12. Water Supply: The water supply for testing and commissioning of the complete installation shall be made available by the contractor and nothing extra shall be paid.

13. Machinery for Erection: During construction as well as maintenance stage all tools and tackles required for unloading/ handling/ transporting/ testing/ Commissioning/ Maintenance of equipments and materials at site shall be the responsibility of the contractor.

14. Dispatch of Materials to Site and their Safe Custody: The contractor shall dispatch material to site in consultation with the Engineer-in-Charge. Space for storage accommodation shall be made available free of charge. The arrangement to make it lockable/secure by means of partitions, locks etc. shall be responsibility of the contractor. Watch and ward however, shall also be the responsibility of contractor. Program of dispatch of material shall be framed keeping in view the building progress. Safe custody of all machinery and equipment supplied by the contractor shall be the responsibility of the contractor till final taking over by the department. Contractor may note that various other agencies may also be working at site simultaneously. Hence proper arrangement be made by the contractor for safety and security of material kept at site as well as erected material. The materials should be brought at site maximum one months before its use at site.

15. Commencement and Execution of Work: The contractor shall commence work as soon as the drawings submitted by him are approved either in full or in part as the case may be. The work in general shall be carried out in accordance with the SOQ and Specifications enclosed separately. The following are general guidelines only.

15.1 In order to ensure that the work is carried out according to the programme drawn, the contractor shall ensure adequate supply of the material and employ required labour strength for execution of work. In case contractor fails to arrange/ employ adequate labour and does not stick to the programme, the Engineer-in-Charge may supplement the labour, at the cost of the contractor after issue of one day's notice to the contractor. No claims for idle labour on any account shall be entertained. The contractor shall put his authorized representatives daily at the site of work and Enquiry Office for receiving instructions from Junior Engineer/ Assistant Engineer and other inspecting officials of the department. His name and signature shall be attested by the contractor and kept on the record with the department.

15.2 The rooms / sites where the work is to be executed on any day shall be got approved from the representatives of the Engineer-in-Charge at the site of work.

No work shall be carried out in any room site without the approval of the representative of the Engineer-in-Charge at the site of work. Such works carried out without the approval of the representative of the Engineer-in-Charge shall be rejected and will not be measured and paid for.

15.3 Samples of all materials, fittings and other articles required for execution of the work shall be got approved from the Engineer-in-Charge. Articles manufactured by Firms of repute and approved by the Engineer-in-Charge shall only be used. Articles classified as "First Quality" by the manufacturer shall be used unless otherwise specified. Preference shall be given to those articles which bear BIS Certification mark. In case articles bearing BIS Certification mark are not available, the quality of samples brought by the contractor shall be judged by the 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. Make and model approval register should be kept at against each package and the make and model approved by competent authorities must be recorded in the register and sample also

Contractor shall prepare one sample for repetitive items like installation of conduit, cable, pump, fans, fitting, AHU, valves, fitting. The sample be jointly inspected with EE (E), deficiency if any be rectified and final approval taken and recorded. Then only the item shall be executed on mass scale.

15.4 The structural and architectural drawings shall at all times be properly correlated before executing any work. However, in case of any discrepancy in the item given in the schedule of quantities appended with the tender and architectural drawings relating to the relevant item, the same shall be brought to the notice of final decision shall be taken by the Engineer-in-Charge.

15.5 The work is required to be executed in such a manner that both speed and quality of execution are to be maintained by the contractor.

The work shall be carried out in the manner complying in all respects with the requirements of relevant bye-laws of the local body under the jurisdiction of which the work is to be executed or as directed by the Engineer-in-Charge and nothing extra shall be paid on this account.

The contractor shall provide such recesses, holes, openings etc. as may be required for the electric, air-conditioning and other related works.

15.6 The contractor shall not stack building material/malba on the Municipal land or road or on the land owned by any other authority, as the case may be. In case, the Contractor is found stacking the building material/malba as stated above, he shall be liable to pay the stacking charges as may be levied by MCD or any other local body or authority and also to face penal action as per the rules, regulations and bye-laws of the said body or authority. The Engineer-in-Charge shall be at liberty to recover the sums due but not paid to the concerned authorities on the above counts from any sums due to the contractor including amount of the Security Deposit or Retention Money in respect of this contract or any other contract.

15.7 The contractor shall be responsible to arrange at his own cost all necessary tools and plants required of execution of the work.

15.8 As several types of services shall run in the building, contractor shall use color code/Bands for TRAYS, CONDUITS, CABLE, wires etc. for example:

ITEM	COLOR							
	BLACK	BLUE	GREY	Yellow	WHITE	Green	RED	Orange
Wiring Conduit For	EI	CCTV, Security	Telephone and LAN	POWER Circuits	BMS/IBMS		Fire Control	UPS
Pipe For	Irrigation	Chilled Water					Fire services	
EI SUB Main wire	Neutral	Blue Phase		Y phase		Earth wire	Red phase	
Cable/ outer sheath for	Power cables	HVAC control cabling	Telephone	LAN	Sensors, IBMS		Fire Signal from Fire Alarm panel	UPS
EI point wiring;	Neutral wire in all cases	Fan control live wire from board	Call bell point live wire	Light fitting Luminaires live wire	Emergency light live wire	Earth wire for looping	Power point Live wire	UPS power point live wire
CABLE TRAY and Duct	GI finish, no need to paint							

15.9 The contractor shall conduct his work, so as not to interfere with or hinder the progress or completion of the work being performed by other contractor (s) or by the Engineer-in- Charge and shall as far as possible arrange his work and shall place and dispose of the materials being used or removed, so as not to interfere with the operations of other contractors, or he shall arrange his work with that of the others in an acceptable and coordinated manner and shall perform it in proper sequence to the complete satisfaction of others.

15.10 The contractor shall provide at his own cost suitable weighing, measuring and leveling equipments at site for checking the weight, dimensions and levels as may be necessary for execution of the work

15.11 If the work is carried out in more than one shift or during night, no claim on this account shall be entertained.

15.12 Existing drains, pipes, cables, overhead wires, sewer lines, water lines and similar services encountered in the course of the execution of the work shall be protected against the damage by the contractor at his own expense. The contractor shall not store materials or otherwise occupy and part of the site in a manner likely to hinder the operation of such services.

15.13 The contractor shall be responsible for the watch and ward of the material provided by him against pilferage and breakage during the period of installation and thereafter till the work is physically handed over to the department.

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

15.15 Vibration Isolation: All the Equipments, pipes, fittings shall be installed in fashion to isolate their vibration using best Engineering Practice materials/support for vibration isolation. Special care to be taken for ceiling suspension fans / equipments.

15.16 SEISMIC and Temperature consideration: Flexible Couplings/ joints shall be used, wherever required, to take care of seismic considerations and temperature variations during operations /whether change for Delhi Zone.

15.17 Green Building: The Complex is targeted to be a four Star GRIHA rated project, Contractor shall provide all calculations required to be submitted to GRIHA authorities in respect of items in the scope of work. Moreover Contractor shall Endeavour to achieve the targets.

15.18 During execution of work contractor shall make arrangement for cleaning of site daily after the work.

15.19 Testing of Materials for Quality at Site

i. Even certified /marked (BS/UL/EN/ISI marked etc.) materials 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/ material. Whenever ISI marked materials are brought to the site of work; the contractor shall, if required by the Engineer-in-Charge, furnish manufacturer's test certificate to establish that the material procured by the contractor for incorporation in the work satisfy the provisions of IS Codes relevant to the material and/or the work done.

ii. 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 there with including fee for testing, to and Fro carriage etc. in case the material fails. In all cases, cost of samples shall be borne by the contractor.

iii. Department shall not be responsible for any loss of material used by the contractor at site.

iv. Machineries like HT Panel, Transformers, Chillers, LT Panels, Cable HT/ LT must be tested and witnessed by the department representative at OEM premises as per standards applicable before dispatch of same to site.

16 Measurement of works: Shall be recorded in computerized measurement book.

Measurement of works/material supplied shall not be treated as takeover by the department and department shall not be responsible for any loss of material brought/used by the contractor at site, till the same is taken over by department for use or after completion of work.

17 Co-Ordination with other Agencies:

17.1 Other agencies may also simultaneously be executing the Civil work, Horticulture or external services and other building works for the same building along with this work. The following services shall be extended by contractor to other agencies for carrying out their work.

i. Access to various works of site.

ii. Make available clear site

17.2 The contractor shall co-ordinate with all other agencies involved at the site of work so that the work of other agencies is not hampered. Where activity of contractor is directly affecting the progress of other agencies, the same shall be given priority. Contractor is required to note the milestones of other agencies and plan his activities to facilitate so as to avoid any hindrance to other agencies. In case of any conflict with work schedule of any other agency at site, decision of Engineer-in- charge shall be final and binding.

17.3 Site shall be made available in phases. Contractor has to co-ordinate with other contractor in such a fashion so that they get reasonable time to take up their work. During execution of work Department may desire for completion of certain areas on priority, in such cases contractor shall modify his plan accordingly. For internal finishing purpose, Contractor shall take over the work Floor wise /specified work area wise , and the guiding sequence of work shall be as under:

Sl. No.	Activity to be completed by the Civil Contractor	Corresponding ACTIVITY by E&M contractor
i.	Handing over of area with bare walls and floor/ Slab by Civil Contractor.	Fixing of all type of Conduits and pipes, Cable trays, Switch boxes, Floor trunking, Main Ducts of ACs, DBs base with protective sheet.
ii.	Plumbing and Sanitary Work, Completion of wall plastering, Wall putty and Rough flooring work i/c doors and windows with locking arrangements by civil Contractor.	Ducting shoots including making collars and all remaining piping works with Insulation, wiring, switch boxes and switch with protective sheets, Fixing of frame of
iii.	Fixing of plumbing fittings, frame for false ceiling, Floor finishing, One coat of wall painting.	Fixing of FCU, sprinklers drop/ vertical pipes, sprinklers, pressure testing of piping and any other electrical fittings
iv.	Fixing of False Ceiling	Fixing of AC Grills, Testing and commissioning of services in the room by making temporary arrangements

17.4 Contractor may require some civil provisions for installation of equipments, opening in walls/slabs, all such provisions already shown in Architectural/Civil Drawings shall be carefully checked by the contractor for their suitability etc. at site. In case of any extra requirement, the matter shall be brought in writing to Engineer in Charge at the earliest at appropriate stage. The Engineer in Charge shall examine whether the civil provision being asked by contractor is required to be provided by Department/Civil contractor or by the contractor himself, whose decision shall be final and binding on the contractor.

17.5 The cost of Co-ordination/facilities extended to other contractors shall deemed to be included in the quoted amount and nothing extra shall be payable.

18 Quality of Materials and Workmanship:

- The components of the installation shall be of such design so as to satisfactorily function under all conditions of operation.
- The entire work of manufacture/fabrication, assembly and installation shall conform to sound engineering practice.
- All equipments and material to be used in work shall be manufactured in factories of good repute having excellent track record of quality manufacturing, performance and proper after sales service.
- All equipments and materials to be used in the work shall be brand new having its date of manufacturing not more than 6 month old from the date of delivery at site with manufacturer's certificates, warrantee cards, technical catalogues, instructions, manuals and wiring diagrams etc.
- Wherever contractor has to engage Associate or labor sub-contractor, they shall make sure that Associate or sub-contractor depute their Engineer, and the work carried out by their sub-contractor is comprehensively controlled and assured with respect to quality, coordination and delivery. OEM/ Sub contractor shall not be allowed to be changed except in very special circumstances to the satisfaction of Engineer in Charge of work, with penalty as mentioned elsewhere.

19 Care of the Building: Care shall be taken by the contractor during execution of the work to avoid damage to the building. Care shall also be taken by the contractor to avoid the damage to any of these

existing service/service lines, any part of the building etc. If any damage is caused to any of the existing services/service lines, or any part of the building the same shall be repaired / rectified and made functional or restored so its original finish by the contractor immediately at his own expenses failing which the same shall be repaired/ rectified and made functional by department at the risk and cost of the contractor. The decision of the Engineer-in-charge in this regard shall be final & binding. He shall also remove all unwanted and waste materials arising out of the installation from the site of work from time to time.

20 Initial Inspection and testing:

20.1 All equipment shall be tested at manufacturer's Works as per latest relevant EN/BS/BIS/CPWD specifications. Approved testing methods shall be followed and Test Certificates/ Reports submitted to the Engineer-in-charge.

20.2 In case of material requiring witnessing Factory Inspection by Department, as mentioned in the list of approved makes. The contractor shall intimate in advance the probable date of such tests to the Engineer-in-charge to enable their representatives to witness the tests if they so desire. The contractor shall give sufficient advance notice regarding the dates proposed for such tests to the department's representative(s) facilitate his presence during testing. The Engineer- in- Charge at his discretion may witness such testing. Equipments will be inspected at the manufacturer/authorized dealer's premises, before dispatch to the site by the contractor.

20.3 The department also reserves the right to inspect the fabrication job at factory and the successful contractor has to make arrangements for the same. The materials duly inspected by Engineer-in-Charge or his authorized representative shall be dispatched to site by the contractor.

20.4 No additional payment shall be made to the contractor for initial inspection /testing at the manufacturer's works by the representative of the Engineer-in-Charge. However, the department will bear the expenses of its representative deputed for carrying out initial inspection/testing.

20.5 The Contractor shall leave necessary provisions required for fixing instruments, gauges, meters, etc. for testing the installation even if these are not shown on the drawings. All such instruments, services etc. needed for the tests shall be arranged by the Contractor at his own cost.

20.6 It is the sole responsibility of Contractor to obtain all the necessary approvals from the statutory authorities, either prior to, during or after installation as required. All tests specified herein-after and witnessed/ approved by Engineer-in-charge, may be deemed to be invalid at the option of Engineer-in-charge, if the requisite, final and unconditional approvals from the concerned statutory authorities are not obtained by the Contractor. Obtaining CEA clearance per Ambistion, DG sets, , Fire clearance from state authority for fire protection system and other clearance as applicable.

20.7 The Contractor shall intimate in writing to Engineer-in- charge as and when individual components of the installation are ready for tests required for further progress of erection. All such tests shall be carried out as per these specifications and/ or as directed by Engineer-in-charge and recorded in the presence of Engineer- in-charge or his authorized representatives.

20.8 The Contractor shall intimate in writing to Engineer-in- charge, the proposed date of initial startup. The Contractor shall, on approval of Engineer-in-charge, proceed with necessary pre-commissioning activities and tests and put the installation initial operation and start- up during which preliminary adjustments and addressing shall be carried out.

20.9 Based on preliminary observations during the initial operation described above, necessary modifications/ repairs/ replacements/ etc. if any shall be carried out by the Contractor to the entire satisfaction of Engineer-in- charge. On successful completion of initial operation, the Contractor shall proceed with trial runs.

20.10 Notwithstanding approval of tests or equipment or materials by Engineer-in-charge etc., up to the tests in static state as described here-in above, the Contractor shall be required to perform site tests to prove

correctness of ratings and performance of equipment and materials supplied and installed by him, in normal operating condition.

20.11 All equipment shall be capable of performing the duties specified in these specifications without damage, distortion or failure of any component.

20.12 The performance of various equipment individually shall not be less than quoted ratings and consumption of power shall not exceed the ratings quoted by the tendered, when tested in normal operating condition. Otherwise the equipment / material are liable for rejection.

20.13 All test instruments shall be calibrated by contractor at his cost for accuracy prior to taking the performance tests.

20.14 Failing satisfactory performance of equipment and/ or overall installation after rectification etc. as stated above, the Engineer– in-Charge, at his sole discretion, reserves the option of charging liquidated damages for such non-performance or demand supply and installation of new installation all at no extra cost to Engineer- in- Charge or demand for full refund of all "On Account" payments made to the Contractor for that part of the work which has failed to perform, and the Contractor shall be obliged to do so as directed by the Engineer-in- Charge.

21 Final Inspection and Testing:

21.1 Final Inspection and testing will be done by the Engineer-in-Charge or his representative as per details indicated in relevant section of Technical Specifications.

21.2 The installation will be offered for inspection by local bodies (Chief Fire Officer, Lift Inspector, Environmental, Green Building Certification agency, Electrical Inspector, Labour Inspector etc.). The contractor or his representative shall attend such inspection, extend all test facilities as are considered necessary, rectify and comply with all observations of the Chief Fire Officer which are part of the agreement and arrange for obtaining necessary clearance certificate in favor of department. In case contractor fails to attend the inspection and make desired facilities available during inspection, the department reserves the right to provide the same at the risk and cost of the contractor and impose penalty for the same. The installation will be accepted by the department only after receiving clearance from Chief Fire Officer for the work executed by the contractor under the agreement.

21.3 But under no circumstances shall this absolve the Contractor of his responsibility for Performance of the Equipment or System

22 Safety Measures: All equipments shall incorporate suitable safety provision to ensure safety of the operating personnel at all times. The initial and final inspection reports shall bring out explicitly the safety provisions incorporated in each equipment.

23 Running in Period and Date of Acceptance: After the installation work has been completed by the contractor, he will conduct test and make adjustment as may be necessary to satisfy himself that the systems are capable of continuous running.

24 Guarantee:

24.1 The Contractor shall execute the work on the basis of indicative designs hereby given and accepted by him with or without modifications or new designs submitted by him at the tender stage and accepted by Engineer in charge, as the case may be. All Variations, i.e. additions, omissions or substitutions necessitated at any time for any reason whatsoever, shall be deemed to have been accepted by the Contractor as not vitiating the performance based nature of this contract. If any such variations, irrespective of whether such variations are intended to be executed by other agencies employed by the Engineer-in-charge, have any bearing on the performance of this Contract, the same shall immediately be brought to the notice of Engineer-in- charge by the Contractor in writing. In any case the Contractor shall have to guarantee for due and proper performance of the works agreed to be so erected. Guarantee for LED fittings shall be 5 years as mentioned in the BOQ.

24.2 The contractor shall guarantee the complete system to maintain the specified conditions under all conditions of ambient temperature.

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

25 Operations and Maintenance: *Contractor shall be required to carry out round the clock on site operation as per the requirement on the directions of Engineer-in-charge and maintenance of all the installation made under respective E&M sub-works, free of cost, for a period of ONE YEAR from the date of commissioning and handing over of the installation to the department.*

26 Taking-Over Certificate:

26.1 When the whole of the Works have been substantially completed and have satisfactorily passed any Tests on Completion prescribed by the Contract, the Contractor may give a notice to that effect to the Engineer-in-charge. Such notice and undertaking shall be deemed to be a request by the Contractor for the Engineer to issue a Taking-Over Certificate in respect of the Works. The Engineer-in-charge shall, either issue to the Contractor, a Taking-Over Certificate, stating the date on which, in his opinion, the Works were substantially completed in accordance with the Contract, or give instructions in writing to the Contractor specifying all the work which in the Engineer-in-charge's opinion, is required to be done by the Contractor before the issue of such Certificate. The Engineer-in-charge shall also notify the Contractor of any defects in the Works affecting substantial completion that may appear after such instructions and before completion of the Works specified therein. The Contractor shall be entitled to receive such Taking-Over Certificate, to the satisfaction of the Engineer-in-charge, of the Works so specified and remedying any defects so notified.

26.2 Taking-Over of Sections or Parts: Similarly, in accordance with the procedure set out in Sub-Clause 26.1, the Contractor may request and the Engineer-in-charge may Takeover (a) any section or (b) any substantial part of the Permanent Works which has been both completed to the satisfaction of the Engineer-in-charge and, otherwise than as provided for in the Contract, occupied or used by the Employer, or (c) any part of the Permanent Works which the Employer has chosen to occupy or use prior to completion (where such prior occupation or use is not provided for in the Contract or has not been agreed by the Contractor as a temporary measure).

26.3 Substantial Completion of Parts: If any part of the Permanent Works has been substantially completed and has satisfactorily passed all Tests on Completion prescribed by the Contract, the engineer may issue a Taking-Over Certificate in respect of that part of the Permanent Works before completion of the whole of the Works.

27 Uniformity in the quote of rates for same item: Same items of earthing, cable trays, cables, etc., have been considered under different sub-works for ease of convenience of associated contractors for that particular sub-work. The Contractor shall ensure to quote uniformly same rates for same items that are existing under different sub-works. If any difference in quoted rates of same items is noticed, the department shall consider the lowest such quoted rate for same item for all sub-works. Accordingly, the total quoted amount shall be worked out.

28 Quality Assurance:

i. The proposed building is a prestigious project and quality of work is of paramount importance. Contractor/associated contractor shall have to engage well- experienced skilled labour and deploy modern T&P and other equipment to execute the work. The sub-works of Electrical & Mechanical services are of specialized nature which require engagement of skilled workers having experience particularly in execution of such items.

ii. The contractor/associated 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 & contractor/associated contractor shall be bound to replace / remove such sub- standard / defective work immediately. If any material, even though approved by Engineer-In-

Charge is found defective or not conforming to specifications shall be replaced / removed by the contractor/associated contractor at his own risk & cost.

iii. In addition to the supervision of work by CPWD engineers, the Consultants deployed by the /CPWD shall also be carrying out regular and periodic inspection of the ongoing activities in the work and deficiencies, shortcomings, inferior workmanship pointed out by them shall be communicated by CPWD engineers to the contractor/associated contractor . Upon receipt of instructions from Engineer in Charge these are also to be made good by necessary improvement, rectification, replacement upto his complete satisfaction.

- All materials and fittings brought by the contractor/associated 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. Wherever make of material are not specified in the item of work, the contractor/associated contractor shall submit the samples for approval of Engineer-In-Charge.

- The tests, as necessary, shall be conducted from 3rd party laboratories. The laboratories shall preferably be Govt. Labs/ Govt. Autonomous bodies or as approved by the Engineer-in-Charge.

- The Contractor/associated contractor shall at his own risk and cost make all arrangements and shall provide all such facilities including material and labour for collecting, preparing, forwarding the required number of samples for testing as per the frequency of test stipulated in the contract specifications or as considered necessary by the Engineer-in-Charge, at such time and to such places, as directed by the Engineer-in-Charge. Nothing extra shall be payable for the above.

- The Contractor/associated contractor or his authorized representative shall associate in collection, preparation, forwarding and testing of such samples. In case he or his authorized representative is not present or does not associate him, the result of such tests and consequences thereon shall be binding on the Contractor/associated contractor .The Contractor/associated contractor or his authorized representative shall remain in contact with the Engineer-in-Charge or his authorized representative associated for all such operations. No claim of payment or claim of any other kind, whatsoever, shall be entertained from the Contractor/associated contractor.

- All the testing charges shall be borne by the contractor/associated contractor/ department in the manner indicated below:

- ☐ By the contractor/associated contractor, if the results show that the material does not conform to relevant specifications and BIS codes and BIS codes or any other relevant code for which confirmatory test is carried out.

- ☐ By the department, if the results show that the material conforms to relevant specifications and BIS 277codes or any other relevant code for which confirmatory test is carried out.

iv. The contractor/associated contractor shall arrange electricity at his own cost for testing of the various electrical installations as directed by Engineer-in-Charge and for the consumption by the contractor for executing the work. Also all the water required for testing various electrical installations, fire pumps, wet riser / fire fighting equipments, fire sprinklers etc. and also testing water supply, sanitary and drainage lines, water proofing of underground sump, overhead tanks, water proofing treatment etc. shall be arranged by the contractor at his own cost. Nothing extra shall be payable on this account.

v. The contractor/associated contractor shall make available, on request from the Department, the copies of challan, cash memos, receipts and other certificates, if any, vouchers towards the quantity and quality of various materials procured for the work and the same shall be kept in record. The contractor/associated contractor shall also provide information and necessary documentation on the name of the manufacturer, manufacturer's product identification, manufacturer's instructions, warning, date of manufacturing and test certificates (from manufacturers for the product for each consignment delivered at site), shelf life, if any etc., for the department to ensure that the material have been procured from the approved source and is of the approved quality, as directed by the Engineer-in- Charge. Wherever specified, day-to-day account of receipt of such material shall be maintained at site of work and shall be regulated by the department.

vi. If the contractor/associated contractor does not provide adequate supporting staff or labour or both for carrying out field tests or collecting and forwarding samples to outside laboratory or for maintaining test records, Engineer in charge may carry out field tests or collect and forward sample to outside laboratory or appoint any person to maintain the registers at risk and cost of Contractor. The charges so incurred shall be entirely borne by contractor and shall be deducted from Running or final bill of contractor.

29 Quality Assurance Plans:

The contractor/associated contractor shall follow the following Quality Assurance Plan for various sub-works of Electrical & Mechanical services under this contract:

i. Internal E.I.

- The detailed instructions on safety procedures given in BIS code no. 5216:1982 “Code of safety Procedures and Practices in Electrical works” shall be strictly followed.
- Safety procedures given in Chapter 10 of CPWD General Specifications for Electrical works Part-1 (Internal) shall be followed.
- Safety recommendation as per IE rules 1956 as per Appendix “C”.
- The materials shall be tested from 3rd Party laboratories are conduit, wires, cables etc.
- Provisions and fixing of check-nuts for conduit work as per CPWD Specifications.
- No. of wires in one conduit shall be ensure as per CPWD Specifications.
- Colour coding of wires to be ensure.
- Lugs and thimbles at cable/ wire ends in switch boxes as per CPWD Specifications.
- Leveling of switch boxes shall be ensured.
- Termination of earth terminals in earth pits, switch box, DBs and accessories to be ensured.
- Earth chamber to be constructed and proper marking to be done.
- A comprehensive schematic diagram is prepared starting from the main board up to the final DBs. All such boards are duly marked and (unique) numbered.
- The pre commissioning testing of the installation shall be carried out such as ☐ Insulation resistance test.
 - ☐ Polarity test of switch.
 - ☐ Earth continuity test.
 - ☐ Earth electrode resistance test.
- All the tests at site shall be carried out for the completed installations, in the presence of and to the satisfaction of the Engineer in Charge by the contractor. All the test results shall be recorded and submitted to the Department.
- On completion of an electrical installation (or an extension to an installation), a certificate shall be furnished by the electrical contractor, countersigned by the certified supervisor under whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as given in Appendix “E” of CPWD General Specifications for Electrical works Part-1 (Internal) in addition to the test certificate required by the local electric supply authorities.

v. Air Conditioning System:-

- Chilling unit (Chiller):
 - ☐ As the chiller model is to be approved after the award of work, the chiller model selection sheet shall be got verified.
 - ☐ One chilling unit of each capacity shall be tested for its capacity as well as IKW/TR at full load and IPLV etc. at contracted parameters at AHRI certified test bed.
- AHUs: It shall be tested at manufacturers works as per CPWD General Specification for Electrical Works. The factory test of fans w.r.t. DB level, static pressure, CFM and leaving velocity shall

be done at manufacturers works. The capacity test of one AHU in lot of 20 units irrespective of capacity shall be done. Engineer in charge shall choose the capacity of AHUs to be tested.

- MS Pipes shall be tested in respect of thickness and weight at site with respect to relevant BIS standards.
- Pressure testing of pipes for 1.5 times of working pressure as per CPWD Specifications.
- Ducting material shall be tested at 3rd Party Laboratories as per relevant BIS. Leakage test in the duct shall be done as per relevant standards.
- Thermal insulation materials shall be got tested at 3rd Party Laboratories as per specifications mentioned in tender particularly for density and K value.
- Inspection and testing of LT Panel shall be done as per given in Substation section.
- Inspection and testing of Bus Trunking shall be done as per given in Substation section.
- Cables shall be tested as per given in Substation section.
- Earthing shall be tested as per given in Substation section.
- Flushing of all chilled water (primary & secondary) pipe lines, condenser water pipe lines after completion of all works. Necessary by-pass arrangement required at evaporator and condenser end shall be made before hand. After carrying out the flushing all the strainers shall be cleaned and final filling of all water lines to be taken up.
- Pre commissioning test such as insulation, earth continuity, Valve adjustments etc. shall be done. All the safeties of chilling unit and pumps etc. shall be tested by simulating the conditions.
- Post Commissioning tests such as air outlet velocity at grills, capacity test of all the major equipments such as chilling units, cooling towers, AHUs etc. during main season shall be done. The closing fire dampers and tripping of AHU on initiation of fire alarm, safeties of AHU through starter panel, humidification arrangement and other associated systems installed shall also be checked for proper working. During working of all the plant room equipment, cooling towers, AHUs and ventilation fans, it shall be checked that no vibration is transmitting to the building structure.
- Testing of inside condition at various locations achieved as defined in design conditions. o) Display of schematic with operation logic in AC plant room as well as control room.

vi. Fire Fighting :

- Pipes shall be tested for thickness and weight as per Specifications and tender conditions.
- Pressure testing of the pipes shall be done as per relevant CPWD General Specification for Electrical Works after installation, welding etc. before commissioning of the system at 1.5 times the working pressure.
- Cable, LT Panel & Earthing shall be tested as given in Substation section.
- The auto operation of all pumps shall be tested as per the designed sequence and at required pressure drop.
- Fire conditions to be simulated and temperature of actuation of sprinkler to recorded.
- Checks for required Audio video signal as per agreement.
- The line diagram including schematic and operation logics will be made and displayed in Fire pump room as well as control room.

vii. Fire Alarms:

- Wires as per Section on EI.
- Pre commissioning tests:- ☐ Insulation tests.
- ☐ Fire Alarm Activation and Zone identification on Fire Alarm panel and PC at Fire control room.
- ☐ On activation, PA System to be tested for annunciation at all Zones and individual zone as defined.
- ☐ Testing of talk back system for operation and clear communication with fire control rooms.

x. IBMS and CCTV Wiring

- ☐ The materials shall be tested from 3rd Party laboratories are conduit, wires, cables etc.

30 Testing Plans:

The testing plan for quality control for major E&M services is as follows. To procure the genuine material from suppliers/ authorized dealer etc. shall be the responsibility of contractor who shall preserve copies of invoice/ excise gate pass/ proof of dispatch and the same shall be made available for especially to Engineer-in- charge for examination/ scrutiny/ verification as deemed fit by him.

Internal EI

Stage/ Sl no	Material / Process	Standard Applicable/ Test Required to be Done	Qty. (each type) mentioned in the agreement under different sub- works or lot size whichever is less	Whether Proof of Dispatch required	Whether Manufa cturer's test certifica tes required	Sample Size	Location of Test	
							At manu factu rer work s	At third Party Lab.
1	LT Panels with incomer of more than 200 A	CPWD specs. part IV/QA Plan: Construction, Ratings of SWG, air gaps etc. between phases , phase to body ,IP rating, Short Circuit	>10	Y	Y	2	Y	N

		ratings						
2	Rising Main	CPWD specs part IV/QA Plan	Length upto 500 mtr	Y	Y	10% length and fittings	N	N
3	Rigid MS Conduit	IS 9537 Pt I & 2	up to 2500 mtr	Y	N	N	N	N
4	Rigid MS Conduit	IS 9537 Pt I & 2	>2500 mtr	Y	Y	1 piece of 1 mtr for every 1000	N	Y
5	Cable Tray	CPWD Spec. Part- I/II: Check for perforation area, paint/Galvanising thickness and Material Composition	Length up to 500 mtr	Y	Y	N	N	N
6	Cable Tray	CPWD Spec. Part- I/II: Check for perforation area, paint/Galvanizing thickness and Material Composition	Length > 500 mtr	Y	Y	One piece of 1 mtr. for every 500 Mtr	N	Y
7	Wire	IS 694:1990	Up to 10000 mtr	Y	N	N	N	N

8	Wire	IS 694:1990	>10000 mtr	Y	Y	1 piece for every 10000 mtr or less	N	Y
9	LT Cable	IS: 7098 Part – I XLPE	Up to 2500 mtr	Y	N	N	N	N
10	LT Cable	IS: 7098 Part – I XLPE	>2500 mtr	Y	Y	1 piece for every 2500 mtr	N	Y

Air Conditioning

Stage / Sl no	Material / Process	Standard Applicable/ Test Required to be Done	Qty. (each type) mentioned in the agreement under different sub-works or lot size whichever is less	Whether Proof of Dispatch required	Whether Manufacturer's test certificates required	Sample Size	Location of Test	
							At manufacturer works	At third Party Lab.
1	Chiller	CPWD specs part VI/ECBC Code/ Agreement/QA Plan: COP, Capacity, IKW/TR, IPLV/ NPLV	Any	Y	Y	1	Y*	N
2	Pumps	As per tender specs.	Any capacity	Y	Y	100%	Y	N
3	MS Pipes	To be tested for thickness and weight as per applicable IS	Any	Y	Y	1 for every 100 mtr	N	N
4	Insulation/Acoustics material	To be tested for Density and K value as per tender specs.	up to 1000 Sq mtr	Y	Y	NA	N	N
			>1000 Sqmtr	Y	Y	1 Sample for every 1000 Sqmtr	N	Y
5	Fans for AHU, Ventilation and Pressurization	CPWD specs. part VI/QA Plan: Fans to be tested for Db level, static pressure, CFM and leaving velocity	>20 fans	Y	Y	1 for every 20 fans	Y	N

6	AHU's	CPWD specs. part VI/QA Plan: To be tested for capacity in assembled condition, Fabrication, Cooling coil and filters material & workmanship to be inspected critically.	>20	Y	Y	1 for every 20 AHU's	Y	N
7	Ducting material	As per relevant BIS	up to 1000 Sq mtr	N	N	NA	N	N
			> 1000 Sq mtr	Y	Y	1 Sample for	N	Y

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						every 1000 Sqmtr		
8	Valves	Flow and controls as per data sheet	up to 20	Y	N	NA	N	N
			>20	Y	Y	1 for every 20	N	Y
9	LT Panels with ACB	CPWD specs. part IV/QA Plan: Construction, Ratings of SWG, air gaps between phases , phase to body ,IP rating, Short Circuit ratings etc.	Any	Y	Y	1	Y	N
10	LT Panels with incomer of more than 200 A	CPWD specs. part IV/QA Plan: Construction, Ratings of SWG, air gaps between phases , phase to body ,IP rating, Short Circuit ratings etc.	>2 and < 10	Y	Y	1	Y	N
11	Cable Tray	CPWD Specs. Part I/II: Check for perforation area, paint/Galvanizing thickness and Material Composition	Length upto 500 mtr	Y	Y	N	N	N
12	LT Cable	IS: 7098 Part – I XLPE	Up to 2500 mtr	Y	N	N	N	N
13	LT Cable	IS: 7098 Part – I XLPE	>2500 mtr	Y	Y	1 piece for every 2500 mtr	N	Y
Y* Tested for its capacity at AHRI certified test bed (either at manufacturer's work or at 3 rd Party)								

Fire Fighting:

Before dispatch of material at factory or before use at site

Stage / Sl no	Material / Process	Standard Applicable/ Test Required to be Done	Qty. (each type) mentioned in the agreement under different sub-works or lot size whichever is less	Whether Proof of Dispatch required	Whether Manufacturer's test certificates required	Sample Size	Location of Test	
							At manufacturer works	At third Party Lab.
1	Pumps	As per tender specs.	Any capacity	Y	Y	100%	N	N
2	MS Pipes	To be tested for thickness and weight as per applicable IS	Any	Y	Y	1 for every 100 mtr	N	N
3	Valves	Flow and controls as per data sheet	up to 20	Y	N	NA	N	N
			>20	Y	Y	1 for every 20	N	Y
4	LT Panels with incomer of more than 200 A	CPWD specs. part IV/QA Plan: Construction, Ratings of SWG, air gaps between phases, phase to body, IP rating, Short Circuit ratings etc.	Up to 2	Y	Y	0	N	N
5	Cable Tray	CPWD Specs. Part I/II: Check for perforation area, paint/Galvanizing thickness and Material Composition	Length upto 500 mtr	Y	Y	N	N	
			Length > 500 mtr	Y	Y	One piece for every 500 Mtr	N	

Fire Alarm

Stage /	Material /	Standard Applicable/	Qty. (each type) mentioned in the	Whether Proof of	Whether		Location of Test	
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Sl no	Process	Test Required to be Done	agreement under different sub-works or lot size whichever is less	Dispatch required	Manufacture r's test certificates required	Sample Size	At manufacturer works	At third Party Lab.
1	Wire	IS 694:1990	Up to 10000 mtr	Y	N	N	N	N
2	Wire	IS 694:1990	>10000 mtr	Y	Y	1 piece for every 10000 mtr or less	N	Y
3	LT Cable	IS: 7098 Part – I XLPE	Up to 2500 mtr	Y	N	N	N	N
4	LT Cable	IS: 7098 Part – I XLPE	>2500 mtr	Y	Y	1 piece For every 2500 mtr	N	Y

CCTV Wiring

Stage/ Sl no	Material / Process	Standard Applicable/ Test Required to be Done	Qty. (each type) mentioned in the agreement under different sub-works or lot size whichever is less	Whether Proof of Dispatch required	Whether Manufacturer's test certificates required	Sample Size	Location of Test	
							At manufacturer works	At third Party Lab.
							N	N
1	Wire	IS 694:1990	>10000 mtr	Y	Y	1 piece for every 10000 mtr or less	N	Y
2	LT Cable	IS: 7098 Part – I XLPE	Up to 2500 mtr	Y	N	N	N	N
3	LT Cable	IS: 7098 Part – I XLPE	>2500 mtr	Y	Y	1 piece for every 2500 mtr	N	Y

4	Rigid PVC Conduit	IS 3419 : 1989	up to 2500 mtr	Y	N	N	N	N
5	Rigid MS Conduit	IS 3419 : 1989	>2500 mtr	Y	Y	1 piece of 1 mtr for every 1000	N	Y

In the preceding table, Y stands for Yes; N stands for No/Not applicable

31 Third Party Quality Assurance Agency:

The contractor/ associated agency shall extend full cooperation to TPQA agencies engaged by the department for the Project during their field visits for arranging the necessary quality assurance tests for materials and the construction works.

32 It is the responsibility of the main contractor to coordinate all the agencies for effective completion of work in time.

33. The main Agency has to submit the undertaking from the OEM of LED for the five years warranty received from the date of Handing over of all installations as given the proforma. In order to ensure 5 years of warranty of all LED luminaries used for construction , 2.5 % of tendered cost for this package of IEI and street lighting portion of work will be retained as security deposit with EE(Major) / EE(minor) and the same will be released proportionally year wise upto 5 years.

TECHNICAL SPECIFICATION OF ELECTRICAL & MECHANICAL

1 INTERNAL ELECTRICAL INSTALLATION

1.1 GENERAL

Technical Specifications in this section cover the Internal Wiring Installations comprising of:

- a. Wiring for lights and convenience socket outlets etc. in concealed/surface conduit/raceways.
- b. Wiring for telephone outlets.
- c. Sub-main wiring/cabling.
- d. Wiring for Low voltage system

1.2 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.

660/1100 V grade PVC insulated wires.	IS 694 : 1990
Rigid steel conduits for electrical wiring.	IS 9537 : Part I 1980
	IS 9537 : Part II 1981
MS/PVC conduits for electrical wiring.	IS 9537 : Part III 1980
Accessories for rigid steel conduits	IS 3837 : 1990
Flexible steel conduits for electrical wiring	IS 3480 : 1990
Switch socket outlets	IS 4615 : 1990
Switches for domestic and similar purposes	IS 3854 : 1997
Boxes for the enclosure of electrical accessories	IS 5133 : Parts I & II 1969
Code of practice for personal hazard fire safety of buildings	IS 1644: 1998
Code of practice for electrical installation fire safety of buildings	IS 1646 : 1997
Code of practice for electrical wiring installations	IS 732 : 1989

All the Internal electrical installation work shall be done as per the CPWD specifications for IEI 2013 or as applicable on the work/ part work etc. as amended up to date.s For Indoor Lighting: All Light fixtures should be LED only with the minimum following specifications:

SPECIFICATION FOR LED SCOPE

- This specification covers for supply of Light Emitting Diode (LED) lighting that shall be used as general lighting.
- The lumen maintenance of the LED fittings (of the system not chip) shall not be less than 70% after 50000 hrs. i.e. (L70; B10). It shall have a warranty of 5 years after delivery.
- The product should be latest state of art and compliant to relevant IEC 60598- 1, 2, 3, or their latest edition depending on the type of luminaire. In addition to the above luminaire shall

adhere to relevant BIS standards IS 15885, 16101, 16104, 16105, 16106, 16107 (Part I & II) as per the application. The product shall be of proven design & manufacturer shall provide type test certificate / performance certificate from any NABL accredited laboratory. The product and its major components shall be state of art and of proven design.

FIXTURES

- The fixture shall be suitable to work under following ambient conditions.
- Maximum ambient temperature of 45°C
- Atmosphere - The equipment shall be designed to work in coastal, humid, salt laden and corrosive atmosphere.
- Housing: For indoor luminaires shall be made of 0.5 mm thick CRCA sheet / Extruded Aluminium (1 mm) or pressure die cast (PDC-1 mm), conforming to relevant standards, polyester powder coated of at least 40 microns) and high U.V. & corrosion resistance. For Street lights & flood lights luminaires, the housing shall be made of minimum 2mm thick PDC/GDC/Extruded Aluminium as the same shall be exposed to all outdoor conditions.
- Heat sink, if used/added separately should be of extruded/PDC/GDC Aluminium having high conductivity preferably ADC 12/LM 6 or CRCA or FR grade Plastic/polycarbonate & should have life equivalent to that of luminaire. In case of indoor luminaires, if the luminaire body is being used as heat sink, the same should be of minimum 0.50mm thickness.
- Luminaires should be covered with suitable Glass or diffuser with High Transitivity.
- Outdoor luminaire shall be with clear toughened glass or clear polycarbonate cover or direct glass lenses should be used for LEDs except in case of LED Pathways and Bollards.
- Lighting fixtures and accessories shall be designed for continuous trouble free operation under diverse atmospheric conditions without deterioration of materials. Degree of protection of enclosure shall be at least IP-65 for outdoor fixtures. However, down lighter and other internal fixture shall be provided with at least IP-20 protection.
- The fixture should have a surge protection of 2 KV.
- The fixture should conform to applicable IS 10322 / IEC 60598 (All parts & amendments) and should have the associated LM-79 report (for Electrical and photometric test methodology for LED lighting) from NABL accredited lab. Test report shall be submitted along with relevant catalogues.
- The fixture shall be surface suspended or recessed type depending on the application area.
- If Aluminium Reflectors are used then the same shall have high efficiency to achieve proper light distribution as per application.
- The fixture shall be provided with proper wiring up to terminal along with proper earthing arrangements. All Internal wiring for the luminaires shall be FRLSZH type.
- Provision shall be made for main connection directly & the location of connector shall be finalized in discussion with Employer's representative for ease of execution.
- All the indoor luminaires shall have minimum system efficacy of 80lm/w with exception for decorative luminaires & bulkhead luminaires. The bulk head luminaire shall have minimum system efficacy of 60lm/w. All outdoor luminaires shall have minimum system efficacy of 90lm/w except for post-tops, bollards, landscape lighting luminaires, façade lighting luminaires or any other decorative luminaires.

LED FEATURES

- Manufacturer should have LM-80 report and projected life of the chip. Manufacturer has to submit the LM-79 test report for luminaires.

- High lumen efficacy LEDs suitable for the application along with following features shall be used:
- LED Efficacy at the chip level shall > 100 lumen/watt (For High power LED)
- The efficiency of the LED at 85 Degree C junction temperatures shall be more than 85%.
- The minimum system luminous efficacy of LED luminaire' shall be as under:-

Efficacy > 75 lumen/Watt for low wattage luminaries
(<45W); and Efficacy > 90 lumen/watt for high wattage
luminaries (>45W) For decorative luminaires: 60lm/w.

The luminaire shall be designed so as to have proper thermal management sustainable performance of luminaries.

- Minimum view angle of the LED shall not be less than 120°C.
- Power factor of complete fitting shall be more than 0.9.
- LED shall be surface mounted type duly soldered to PCB by Reflow system or COB type. The Solder used shall be ROHS compatible for environment friendliness.
- Input frequency range shall be between 50Hz±3%.
- Colour rendering index CRI >=80 for Indoor luminaires and CRI > = 70 for Outdoor luminaires except decorative luminaires.
- Correlated Colour Temperature shall be in the range of 3000K-6500K. While designing it should be taken care to choose CCT which helps in achieving higher system efficacy & consistency of CCT should be maintained in all areas & special care should be taken that luminaire with different CCT are not used across different areas.
- It shall have an SDCM (standard deviation in colour maintenance) of < 5.
- The LED efficiency shall be more than 85% at a junction temperature of 85°C.
- LED driver and Control Circuit Specification:- LED driver shall have following features:
 - The LED driver shall be constant current type.
 - Input voltage range within 160 V (RMS) to 270 V (RMS) at 50 HZ.
 - The driver shall be able to withstand surge (EFT+ESD interference) of minimum 2 KV with a rise time of 20 nanoseconds.
 - Output voltage of the driver shall be designed to meet the power requirement of the system.
 - The driver shall have over voltage withstand protection & output short circuit protection.
 - Output voltage ripple shall be within 3%.
 - The LED drivers should have dimming option only if the same is mentioned in tender BOQ line item.
 - The driver shall have an efficiency ~ 85%
 - Total Harmonic Distortion shall be :-

- For 0- 50 W for shall be less than 25% (<25% for 0-50 W) - bove 50 W rating shall be less than 15%. (<15% for >50 W) - The Current waveform should meet EN 61000-3-2.
- LED driver shall withstand voltage of 340V for 2 hours and restore normal working when normal voltage is applied.
- The driver should comply with CISPR 15 for limits and methods of measurement of Radio Disturbance characteristics.
- The equipment should comply with IEC 61547 for EMC immunity requirements.
- The control gear should be compliant to IEC 61347-2-13, and IEC 62384.
- It shall have a power factor >.9.

General

- a. The lumen maintenance of the LED lightings shall not be less than 70% after 50,000 hours i.e. L70 (B50).
- b. The supplier shall provide evidence that the LED chipset manufacturer has the patent right to produce the supplied LED chipset to avoid infringement of white LED patent.
- c. **All the LED fitting, fixture shall be warranty for the period of 5 years** Guarantee for LED fittings shall be 5 years as mentioned in the BOQ. **from the date of handed over to the department. The warranty is directly from the original manufacturer. The contractor shall submit the warranty certificate from the OEM to the department. The warranty of replaced/rectified item shall remain for balance period from the date of rectification/replacement. Test reports for various parameters i.e. Flux, power, efficacy, chromaticity, Co related Colour.**
- d. All the lighting fixture to be installed in the false ceiling should be supported from the ceiling. For this adjustable suspension arrangement will be used for hanging the fitting in the false ceiling. Nothing extra will be paid by the department in this regard.

OCCUPANCY SENSORS Introduction

The work covered in this section is subject to all the requirements in the General Conditions of the Specifications.

The contractor shall coordinate all of the work in this section with all trades covered in the other sections of the specifications to provide a complete and operable system.

DESCRIPTION OF WORK

1. The extent of the lighting control system work is indicated by the drawings and by the requirements of this section. It is defined to include, but is not limited to, occupancy sensors, power packs and auxiliary relays.
2. System installation includes the installation of occupancy sensors, power packs and auxiliary relays in accordance with manufacturer's installation instructions.

QUALITY ASSURANCE

1. Component Testing: All electronic component board assemblies are to be factory tested and burned in prior to installation.
2. System Support: Factory fax/telephone/email support shall be available free of charge during normal business hours.
3. NEMA (National Electrical Manufacturers Association) Compliance: Comply with applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.
4. NEC Compliance: Comply with applicable portions of the NEC.
5. UL Compliance: UL Listed in compliance with applicable UL Safety Standard.
6. FCC Emissions: All assemblies are to be in compliance with FCC Part 15, Class B.

CEILING MOUNTED OCCUPANCY SENSORS

1. Sensors shall operate on a class 2, three-conductor system. Sensors shall operate at nominal 24VDC.
2. Sensor shall immediately turn on lighting when occupancy is detected.
3. Sensor shall employ Power Pack to supply power to sensor.
4. Sensor shall employ power pack or auxiliary relay to switch class 1 lighting loads and control switching of lighting loads.
5. Sensor shall have sensitivity, mode and time delay adjustments located behind a snap-on cover which is accessible when sensor is fully installed and mounted, and does not require the sensor to be moved or removed to make adjustments.
6. Sensor shall have a set of normally opened and normally closed contacts, called an isolated form c relay, rated no less than 1A@24VDC, allowing the sensor to interface with building automation systems (BAS), HVAC, security, lighting control and other control systems.
7. Sensor shall detect occupancy using passive infrared (PIR) technology and employ a lens with 360 degree coverage pattern covering up to 500 sq. ft. at a mounting height of 9 ft.
8. Sensor shall have a mode selector switch and have 2 operating modes; automatic and manual. In the manual mode, sensor remains activated and will not turn off (for service and maintenance use only).
9. Sensor shall have a 360 degree coverage pattern covering Minimum area up to 500 sq. ft. at a mounting height of 9 ft.

Sensor shall have a mode selector switch and have 2 operating modes; automatic and manual. In the manual mode, sensor remains activated and will not turn off (for service and maintenance use only)

For Indoor LED fixtures:

Sl. No.	PARAMETERS	Values
	Light Source	SMD LED Chip or Chip on Board as per BOQ
	LED Make	NICHIA/ OSRAM/ SEOUL/LUMILEDS/ LEDNIUM/ CREE/
1	System Efficacy at Chip Level	> 140 Lm/W
2	System Efficacy at Luminarie Level	> 110 Lm/W
3	Life of LED	50,000 Hrs or above @ L70

4	Operating Temperature	-10° to +50°
5	CRI (Colour Rendering Index)	> 80
6	CCT (Colour Temperature)	5700K, 4000K, 3000K
7	THD (Total Harmonic Distortion)	< 5%
8	Lumen Depreciation	30% after life of 50K
9	Lumen Output	11000 Lumen (Min)
10	Power Consumption	100W (Max)
11	Power Factor	> 0.98
12	Junction temperature of LED	< 85 degree Celsius.
13	IP of Luminaire	IP 20
14	IK Protection of Complete Luminaire	> IK 07
15	Light Engine	The light engine should use Metal Core PCB.
16	Luminaire Housing	The luminaries should be pressure die cast non-corrosive aluminum alloy enclosure
17	Driver	The driver should be rated for IP20. Driver housing shall be made of extruded Aluminum case and covered with heat shrink sleeve to ensure additional safety against electrical shock risk, also increase the reliability against internal heat and moisture ingress. Driver should be capable of handling wide voltage variation ranges from 140V AC to 280V AC & frequency range of 50Hz $\pm$ 3% with isolated type operate in constant current topology. Driver should have high efficiency >88%. Driver should have inbuilt safety features like Over voltage, Short circuit, Over load, thermal protection and Reverse Polarity protection
18	Surge Protection	The luminaire should have an internal surge protection of > 3KV L-N
19	NABL Lab	Firm should have their OWN Testing facility with NABL accreditation

FOR OUTDOOR LED FIXTURES:

Sl. No.	PARAMETERS	Values
	Light Source	SMD LED Chip or Chip on Board as per BOQ
	LED Make	NICHIA/ OSRAM/ SEOUL/LUMILEDS/ LEDNIUM/ CREE/
1	System Efficacy at Chip Level	> 150 Lm/W
2	System Efficacy at Luminaire Level	> 120 Lm/W
3	Life of LED	50,000 Hrs or above @ L70
4	Operating Temperature	-10° to +50°
5	CRI (Colour Rendering Index)	> 80
6	CCT (Colour Temperature)	5700K, 4000K, 3000K
7	THD (Total Harmonic Distortion)	< 10%

8	Lumen Depreciation	30% after life of 50K
9	Lumen Output	12000 Lumen (Min)
10	Power Consumption	100W (Max)
11	Power Factor	> 0.98
12	Junction temperature of LED	< 85 degree Celsius.
13	IP of Luminaire	IP 66
14	IK Protection of Complete Luminaire	> IK 08
15	Light Engine	The light engine should use Metal Core PCB.
16	The luminaire Construction	Windage area should not exceed 0.1 sq.m. per fixture. Each LED should be covered with IP 66 or more protected lens.
17	Luminaire Housing	The luminaries should be powder coated and housed in a single piece pressure die cast non-corrosive aluminium alloy enclosure with optimal fins for Heat Sinking Mechanism.
18	Driver	The driver should be rated for IP67 against dust and moisture for a longer life. Driver housing shall be made of extruded Aluminum case and silicon potted to ensure additional safety against electrical shock risk, also increase the reliability against internal heat and moisture ingress. Driver should be capable of handling wide voltage variation ranges from 90V AC to 300V AC & frequency range of 50Hz $\pm$ 3% with isolated type operate in constant current topology. Driver should have high efficiency >90%. Driver should have inbuilt safety features like Over voltage, Short circuit, Over load, thermal protection and Reverse Polarity protection along with the Inbuilt surge protection of 6KV L-L and 4KV LN. Driver should work continuously up to 320V AC without any failure.
19	Surge Protection	The luminaire should have an internal surge protection of > 6KV L-N and >10KV external
20	NABL Lab	Firm should have their OWN Testing facility with NABL accreditation

In order to ensure the 5 years of warranty of luminaires 2.5% of tendered cost for this package C1 will be retained as security deposit with EE (E) and the same will be released proportionately year wise up to 5 years.

NOTE: - Only NABL Acc. Lab. Reports will be accepted as per respective IS Code/BIS for all items mentioned above. Actual CCT need to be ensured at manufacturer's premises in or NABL test lab through inspection if required. Agency has to arrange this well before time of supply and indicated the same the BAR Chart so that progress of work should not be hampered.

The latest model available should be used if the model of a particular item of luminaire is obsolete. A certificate to be obtained from OEM that the obsolete model is upgraded and a data sheet showing equal or better lumen and improved efficacy level is achieved with the improved model. The rates will be guided by GCC and CPWD office procedure as per the decision of Engineer in Charge. The decision of engineer in charge is final and binding on the contractor.

UNDERTAKING LETTER FROM MANUFACTURERS OF LED FITTINGS
(ON THEIR LETTER HEAD)

We hereby agree that

1. All the LED fittings supplied by us are guaranteed for five years including drivers from the date of handing over.
2. In case of discontinuation of model and non-availability of spares, we will replace the fittings with equivalent/ high end model in case of manufacturing defect during the warranty period of 5 years.

For M/S

.....

....

(Authorised
signatory of
manufacturer
of LED
luminaries)

Counter Signature,

Major contractor

Note: The contractor has to submit the above undertaking after handing over of system in complete shape. The date of warranty will be reckoned from the date of handing over of system to the client department.

11 MOLDED CASE CIRCUIT BREAKER (MCCB) (For Panels other than Main LT Panels & Emergency Panel)

11.1 GENERAL:

MCCBs shall comply with standards IS/IEC 60947-1 & 2. The breaking capacity performance certificates shall be available for category A to the above-mentioned standards.

MCCB shall have a rated operational voltage (U_e) of 415V, insulation voltage (U_i) of 690 V (AC 50/60 Hz) & impulse voltage (U_{imp}) of not less than 8kV.

MCCBs shall be current limiting type. The design is required to minimize the effects of short circuit currents i.e. limit the let through energy and improve the life of cables.

MCCB shall not have any line load bias

MCCB shall comply with the environmental directives like RoHS.

11.2 PERFORMANCE:

The MCCBs shall have a rated service breaking capacity (I_{cs}) equal to the ultimate breaking capacity (I_{cu}) at 415V and as per system fault levels (refer SLD).

The limiting capacity of a circuit breaker is expressed by two curves which are a function of the prospective short-circuit current (the current which would flow if no protection devices were installed): The thermal stress

(A^2s), i.e. the energy dissipated by MCCB during fault should be as low as possible. Cable selection to be done as per Maximum permissible cable stresses for which manufacture should produce current limiting and energy limiting curves of MCCB's.

11.3 SAFETY:

For maximum safety, the power contacts shall be insulated in an enclosure made of a thermosetting material from other functions such as the operating mechanism, the case, the trip unit and auxiliaries (ON/OFF/Trip Contact, Shunt, Under Voltage etc.). All poles shall operate simultaneously for circuit breaker opening, closing and tripping. MCCBs shall be actuated by a toggle or rotary-handle that clearly indicates the three distinctive positions: ON, OFF and TRIPPED. MCCB shall clearly indicate the suitability for isolation in the name plate identified by the symbol .

MCCBs shall be equipped with a “push to trip” button in front to test operation and simultaneous opening of all poles together.

MCCBs shall be designed to prevent access to live parts when the cover is removed, means main current path of the circuit breaker should be isolated from auxiliary section i.e. MCCB shall offer class –II front face as per IEC standards 61140 and 60664-1

The electrical life of MCCBs shall be 8,000 operations up to 250A & 4000 operations up to 630A.

All MCCBs termination shall be done using circular lugs being bolted to enhance safety and reliability of the terminations. In case spreaders/rear connectors are used in between MCCB and bus bar/lugs then the spreaders shall be cross bolted with the MCCB connectors.

11.4 AUXILIARIES AND ACCESSORIES:

Following separate Field installable auxiliary contacts for signaling different functions shall be provided with all

MCCBs

- a. open/closed position contact
- b. trip signaling contact
- c. Electrical fault trip signaling contact

Rotary handle shall ensure IP40 for direct type and IP 55 for extended Rotary handle.

MCCB shall have provision for Rear connection - MCCB mounting on a back plate with suitable holes enables rear connection. The rear connections are simply fitted to the device connection terminals.

11.5 PROTECTIONS REQUIREMENTS:

MCCBs shall have thermal magnetic trip units upto 250A and microprocessor trip units above 250A.

Thermal magnetic trip units shall have variable overload settings from 0.7 to 1 Ir and fixed short circuit settings Microprocessor trip units shall have variable overload settings from 0.5 to 1 Ir and variable short circuit settings from 2 to 10Ir

In case of 4 pole microprocessor based MCCBs neutral shall be protected & adjustable as a Neutral unprotected / Neutral protected at 0.5 In/ Neutral protected at In.

MCCB's should be provided with auxiliary contacts for signaling different functions, as: open/ closed position, fault signal and shunt trip coil for remote/emergency tripping of MCCB.

Where ever it is required based on electrical distribution network need, MCCB shall have Earth Fault Protection. MCCB Earth Fault Protection should have following settings and features:

- a. Selection of Ir MCCB rating
- b. Earth fault sensitivity selection from 20% – 60% In.
- c. The time delay selection in case of Earth Fault from 0.5 to 3 Sec/ instantaneous.
- d. There shall be a separate fault differentiation indication (LED) for Over current and Earth fault. Indication for over current and earth fault tripping shall be extended to the panel door via indication lamps
- e. Separate LED shall be there to show healthiness of earth fault protection system
- f. EF protection module shall be suitable for 3P 4W system. It shall take the input from neutral for correct earth fault protection.
- g. Earth fault module shall have auxiliary contacts for earth fault signaling.

14 ENERGY METERS.

14.1 HT Panels

Power Quality Analyser - High end power quality analyser with Class 0.2 active energy Accuracy with Sag/Swell - Waveform capture and Individual harmonics monitoring upto 63rd . Power Quality analyser needs to be capable of Disturbance direction detection with onboard dual ethernet Port communication.	
Basic Parameters	* Current, voltage, frequency * Active, reactive, apparent power Total and per phase * Power factor Total and per phase * Current measurement range (autoranging) 0.05 - 10A
Energy Parameters	* Active, reactive, apparent energy * Settable accumulation modes
Demand Parameters	* Current Present and max. values * Active, reactive, apparent power - Present and max. values * Predicted active, reactive, apparent power * Synchronization of the measurement window * Setting of calculation mode - Block / sliding
Power Quality Parameters	* Total Harmonic Distortion Current and voltage * Individual harmonics - Upto 63rd * Waveform capture * Detection of voltage swells and sags * Disturbance Direction detection
Sampling Rate / Cycle	Minimum 256 Samples / Cycle

Data Recording	512MB of standard non-volatile memory. 10 MB of standard non-volatile memory dedicated to capture billing data, events, and waveforms. Logs of Min/max of instantaneous values, Event logs, Trending/ forecasting, SER (Sequence of event recording).
Class Accuracy	Active Energy - Class 0.2S IEC 62053-22 , Reactive Energy Class - 0.5S IEC 62053-24, Power Factor - Class 0.5 as per IEC 61557-12
PQ Standards	PQ compliance reporting as per IEC 61000-4-30 Class S, - IEC 62586 PQI-S
Communication	Onboard Dual ethernet port for daisy chaining over ethernet. Meters need to have Modbus Mastering capability by connecting Slave devices over RS485 port
Time Synchronization	GPS clock (RS485) or IRIG-B (digital input) to +/- 1 millisecond.
Digital IO	Standard: 3 digital status inputs for Breaker ON/OFF/ Trip monitoring & 1 KY (form A) energy pulse output for interfacing with other systems. Expandable DI/DO, ADI/ADO capability
Display	Bright LCD color display with meter dimension 96 X 96 mm only

14.2 FOR LT PANEL other than Main LT Panels

Multifunction Meter - Multifunction meters with Power and harmonics monitoring capturing abnormalities in the system with date and time stamp	
Basic Parameters	* Current - Average line current of 3-phase, per-phase, and calculated neutral current * Voltage Average voltage of L-L, L-N parameters, and per-phase * Frequency * Displacement power factor Average and per-phase signed * True power factor Average and per-phase signed * % unbalance among the phase for I, V L-N, V L-L
Energy & Power Parameters	* Real, reactive, and apparent power Total and per-phase value * Accumulated Active, Reactive and Apparent Energy, Received and Delivered registers , Net and absolute energy values, time counters
Demand Parameters	* Current average, Active power, Reactive power, Apparent power - Present, Last, Predicted, Peak, and Peak Date Time * Demand sync methods Thermal, Timed, Command Sync, and Clocked Sync * Demand calculation mode Sliding, fixed and rolling block * Demand intervals - settable from 1 to 60 minutes
Power Quality Parameters	THD as per IEC 61557-12 for THD and individual harmonics up to 15th over communication
Sampling Rate / Cycle	Minimum 64 Samples / Cycle
Class Accuracy	Active energy - Class 0.5S as per IEC 62053-22
Communication	RS 485 port Modbus RTU and disabling RS485 port against unauthorized access.
Calibration LED	configurable from 1 to 9999000 pulses/k_h (kWh, kVAh, or kVARh)
Min/Max values	instantaneous parameters with timestamp
Display	Bright red color LED display with meter dimension 96 X 96 mm only

15 FINAL DISTRIBUTION BOARDS & DEVICES

15.1 GENERAL

This section covers specification of DBs.

15.2 STANDARDS AND CODES

The latest and amended upto date 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.

15.3 MINIATURE CIRCUIT BREAKERS & RESIDUAL CONTROL DEVICES

Miniature circuit breakers shall be of approved design and make and must be tested and validated as per IS/IEC 60898 and IEC 60947-2 standards.

MCBs shall be suitable for operation at 240V/415V, 50Hz supply. The MCB ratings shall be available from 1-125A in 1P/2P/3P/4P versions. The rated short circuit capacity acc to IS/IEC 60898 shall be of 10,000A. MCBs shall be offered with B, C or D tripping characteristics as per the BOQ requirements. The MCBs shall be suitable for mounting on a 35mm DIN rail.

MCBs shall carry ISI and CE marking. The MCB manufacturer (through the bidder) has to submit the valid BIS license certificate at the time of offer submission.

MCBs shall ensure complete electrical Isolation of downstream circuit or equipment, when the MCB is switched OFF (to be marked on the MCB in symbolic form)

IP 20 Degree of Protection shall be ensured to prevent electrical shocks by accidental touch to any live parts, by providing finger touch proof terminals.

Energy Limitation Class-3 shall be to ensure minimum let through energy in the event of a fault, for safety & longevity of downstream circuit equipment. (to be mentioned on the as per standards)

MCBs shall be line-load reversible with no derating.

MCBs shall have bi-connect facility to terminate fork type busbar and wires, simultaneously. Terminal capacity shall be minimum 25 sq.mm. for ratings up to 25A, and 35 sq.mm. for ratings 32A & above to ensure perfect termination of wires and cables. Terminals of MCBs shall have captive screws.

Basic technical parameters, rating, operating voltage, energy limiting class 3 etc. shall be printed on front face of MCB for ease of identification.

The devices must be capable of heavy-duty operation and to that end, the manufacturer shall guarantee the following performance levels, defined by IEC / EN 60947-2 standards:

- suitability for isolation (section 7.2.7)
- rated insulation voltage (section 4.3.1.2): 500 V
- pollution degree (Part 1, section 6.1.3.2): 3
- rated impulse-withstand voltage (section 4.3.1.3): 6 kV
- Discrimination for power continuity
- Validated Cascading tables as per standard IEC 60947-2

Operating knob shall have provision to lock in ON / OFF condition without affecting any automatic tripping

Circuit-breakers shall be capable of operation under ambient temperature up to 50 °C, without derating of their overload tripping threshold with respect to their rated operating current. The same must be tested and validated as per IEC 60947-2 standard.

The material used to manufacture MCB shall be 100% recyclable and must comply Green Premium certificates RoHS ,REACH standards.

MCBs shall be suitable for field-fittable Protection auxiliaries (viz. Over-voltage release, Under-voltage release, Shunt trip) and Indication Auxiliaries (like Auxiliary Contact, Trip alarm contact).

For critical application feeders wherever for remote monitoring of circuit breakers status is required, MCB shall be communication ready to indicate the status of the device (On/Off/Trip), Number of On/Off cycles and Number of Tripping over universally open Modbus and Ethernet (TCP IP) protocol so as to have seamless connectivity with any Energy and Building Management System.

15.4 RESIDUAL CURRENT DEVICES (RCDs):

RCDs shall be of approved design and make and must be tested and validated as per respective IS 12640 -1 & IEC 61008 standards for RCCBs IS 12640 -2 & IEC 61009 standards for RCBOs.

It shall carry also CE marking.

RCDs shall be suitable for operation at 240V/415V, 50Hz supply

RCDs shall have IP 20 Degree of Protection shall be ensured to prevent electrical shocks by accidental touch to any live parts, by providing finger touch proof terminals.

Basic technical parameters, rating, operating voltage, etc. shall be printed on front face of RCDs for ease of identification.

RCDs shall have clear indication of 'Tripping on fault' on front facia. RCDs must be voltage independent and purely current operated.

Operating knob shall have provision to lock in ON / OFF condition without affecting any automatic tripping

The material used to manufacture RCDs shall be 100% recyclable and must comply to RoHS and REACH standards.

RCDs shall be suitable for field-fittable Protection auxiliaries (viz. Over-voltage release, Under-voltage release, Shunt trip) and Indication Auxiliaries (like Auxiliary Contact, Trip alarm contact).

Where ever required, the residual current circuit breakers shall be communication ready to indicate the status of the device (On/Off/Trip), Number of On/Off cycles and Number of Tripping over universally open Modbus protocol, so as to have seamless connectivity with any Energy and Building Management System.

For electrical loads in environment causing disturbance, Super Immunised (SI) type earth leakage protection range i.e. SI RCDs shall be used, which shall be immune to electrical impurities (viz. Harmonics, pulsated DC components, transient over-voltages).

SI RCD is helps to avoid nuisance tripping and ensures continuity of supply.

It also helps to avoid blinding, that is RCD failing to trip when there is danger of people's safety downstream. SI RCD shall guarantee the highest continuity of service and electrical immunity.

15.5 RESIDUAL CURRENT CIRCUIT BREAKERS (RCCBs):

RCCBs must conform to IS12640 -1 and IEC/EN 61008 standards.

RCCBs shall be suitable for operation at 240V/415V, 50Hz supply. The RCCB ratings shall be available from 25A-125A in SPN and TPN versions with the sensitivity of 30mA (for personal protection) and 100/300mA (for Fire protection), as per the BOQ requirements.

RCCBs shall carry ISI marking. The RCCB manufacturer (through the bidder) has to submit the valid BIS license certificate at the time of offer submission.

RCCBs shall have bi-connect facility to terminate fork type busbar and wires, simultaneously. Terminal capacity shall be minimum 25 sq.mm. for ratings up to 32A, and 35 sq.mm. for ratings above 32A, to ensure perfect termination of wires and cables. Terminals of RCCBs shall have captive screws.

15.6 RCCB WITH OVER CURRENT PROTECTION (RCBOS): 2 MODULE VERSION

RCBOs must confirm to IEC/EN 61009 standards.

RCBOs shall be suitable for operation at 240V/415V, 50Hz supply. The RCBO ratings shall be available from 6A-40A in SPN version with the sensitivity of 30mA (for personal protection) and 300mA (for Fire protection), as per the BOQ requirements.

15.7 RCCB WITH OVER CURRENT PROTECTION (RCBOS): RCD ADD ON MODULE VERSION

RCD Add on module must confirm to IEC/EN 61009 standards.

RCD Add on module, when integrated with MCB shall provide protection against Over load, Short Circuit and Earth Leakages

RCD Add on module shall be adaptable to mount MCB as per desired rating of the loads and wires to ensure precise protection to the installation

RCD Add on module shall be suitable for operation at 240V/415V, 50Hz supply. The RCD Add on module ratings shall be available till 125A in SPN, TP and TPN version with the sensitivity of 30mA (for personal protection) and 100/300mA (for Fire protection), as per the BOQ requirements.

15.8 DB (DISTRIBUTION BOARD)

Distribution Boards shall have following features:

Recess/ Surface type with integral loose wire box.

Phase/ neutral/ earth terminal blocks for termination of incoming & outgoing wires.

Din Channel for mounting MCBs.

Arrangement for mounting incomer MCB/ RCCB/ RCBO/ MCCB as required. Copper Bus bar

Earthing bolts- 2 nos.

Wiring from MCBs to phase terminal block.

Terminal blocks should be suitable for termination of conductor/ cable of required size but minimum rated cross section of the terminal blocks should be 6 sq. mm.

Terminal block shall be made of flame retardant polyimide material.

Colour terminal blocks and FRLS wires for easy identification of RYB Phases, Neutral and Earth.

Prewired DB shall be provided with a detachable PAN assembly for safe removal of MCBs, RCCBs.

The prewired DB shall have have cement spill protector /masking sheet for protection from cement, plaster, paints etc. during the construction period.

Detachable plate with Knock out holes shall be provided at the top/ bottom of board. Complete board shall be factory fabricated and pre-wired in factory ready for installation at site. The box and cover shall be fabricated from 1.6mm sheet steel, properly pre-treated with 7 tank process and duly powder coated, phosphatized with powder coated finish.

DB shall have neutral & earth terminal block on the side, not on top or bottom to provide better wiring space and heat dissipation inside the DB.

DBs shall be provided with rotary knob and shall have flexibility to change to Key lock on field.

The Ingress Protection for entire range of DBs must be certified by any neutral testing authority (viz. ERDA /

CPRI/ any govt certified lab) as per standard IS/IEC 60529 for the degree of; IP43 for DBs for indoor application and IP 54 for outdoor application

The Impact Protection for entire range of DBs must be certified by any neutral testing authority (viz. ERDA, CPRI, any govt certified lab) as per standard IEC 62262 for the degree of : IK09 for DBs with Double Door Environmental regulations for Green Buildings : DB shall comply with RoHS and REACH standard and shall have high Strength-to-Weight ratio to avoid burden on building structure. Where specified it shall be of double door construction provided with hinged cover in the front.

17.23 COOLING TOWERS AND WATER CIRCULATING EQUIPMENT

17.23.1 GENERAL

The various items of the water circulating system shall be complete in all respect and comply with the specification given below. The total sound intensity with all fans in operation shall not practically exceed noise levels as prescribed in CTI, CPWD and other relevant norms, from all around the cooling towers.

17.23.2 COOLING TOWERS (FRP CONSTRUCTION)

The cooling towers shall be of FRP, Vertical induced draft type complete with FRP basin FRP body, fan and motor assembly, fill media, distribution pipes etc.

17.23.3 GENERAL CONSTRUCTION

The body shall be made of FRP (Fibre glass reinforced plastic) section of equal segments, all bolted together. The surface on both inside and outside shall be smooth, for minimum air resistance. The fan deck shall form an integral part of the body. The structural strength of the body shall be sufficient to withstand wind velocities upto 60 m/sec. Vibrations and earth quake.

The water basin shall also be of FRP. Having an auxiliary suction tank, at the bottom. The basin shall be complete with connections for drain, overflow, makeup water, quickfill and float valve, plus hot dipped galvanized stainer.

The support structure for the tower shall be of mild steel duly hot dipped galvanized. The water diffusion deck shall of rigid PVC fill in Honeycomb design, arranged in a suitable pattern for ease of replacement. PVC fills shall be of high efficiency. The colour of the cooling tower body shall be of the owner / architect choice.

17.23.4 WATER DISTRIBUTION SYSTEM

The hot water shall be distributed through a sprinkle system consisting of PVC sprinkler pipes, which shall be mounted on the top of the main supply stand pipe. Each cooling tower shall have twin header system coupled with gravity flow distribution system.

17.23.5 FAN ASSEMBLY

The fan shall be of axial flow type with cast aluminium multiple blades of aerofil design and adjustable pitch. The fan assembly shall be statically balanced. The fan outlet velocity shall not be less than 10 m/ s and the tip speed shall be below 4500m / minutes. The fan shall be directly mounted on the motor or through speed reduction gears. In the latter case, the housing shall be of heavy cast iron, construction with large oil reservoir. The fan motors shall be totally enclosed fan cooled squirrel cage type confirming to IP 55 Protection for outdoor operation.

The fan guard shall be hot dipped galvanized with wire mesh screen to prevent bird nesting during idling period.

17.23.6 LADDER

All towers, whose height exceeds 2.5 mtrs, shall be provided with a ladder, made out of hot dip galvanized MS Tubes.

17.23.7 PUMP SETS

The pump sets shall be mono block type with end suction and top discharge flanged connections directly mounted on the dripproof squirrel cage induction motors and suitable starter as specified.

The impeller shall be of Bronze, single enter shrouded design, and properly balanced. Water seal shall be of mechanical type to minimized water leakage and should be easily serviceable in the field.

Motor and starter shall confirm to relevant specifications and of rating given in ' schedule of quantities'.

17.23.8 MISCELLANEOUS

The following items to be provided:

Water pressure gauge at inlet and outlet of each pump complete with gauge cocks and connected tubing.(To be priced separately) Vibration isolation pads for each pumps. Drain line from each pumps up to drain pit, (priced separately).

17.23.9 INSTALLATION AND TESTS

The cooling towers shall be mounted on the beam/ steel structure member, provided by Contractor and shall be unconnected with the roof slab. All nuts / bolts etc. for mounting shall be provided by the Contractor.

On installation of the capacity of the cooling towers shall be checked by measuring water flow rate, water IN and OUT temperature and the ambient W.B. Temperature and then computing the capacity and efficiency.

The pumps sets shall be mounted on cement concrete foundation which shall be provided by HVAC contractor including grouting nuts, bolts, channels etc. shall be provided by the contractor.

On installation the capacity of the pumps shall be checked by measuring water flow. Motor current and pressure difference at inlet and outlet. The reading shall be recorded to compare actual performance with the specified data. Magnetic level switches shall be provided for low level alarm, in each cooling tower.

17.23.10 PIPE WORK

General :

All piping work shall confirm to quality standards and shall be carried out as per specifications and details given hereunder:

Pipes:

All pipes in sizes 200 shall M.S. E.R.W. tube (black steel) heavy class as per I.S. 1239-79, Part -1 with amendment-I. All pipes above 150 mm dia. shall be minimum 6.4 mm thick.

Fittings:

The dimensions of the fittings shall conform to I.S. 1239/69 Part-II unless otherwise indicated, in the specifications.

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

All bends in sizes 200 mm and larger dia., shall be fabricated from pipes of the same dia and thickness, with a minimum of 4 sections, and having a minimum centre line radius of 1.5 diameter of pipes. All fittings such as branches reducers etc. in all sizes shall be fabricated from pipes of the same dia. And thickness and its length should be at least twice the dia. of the pipe.

The branches may be welded straight to the main line without making a separate fitting, where specified on drawings or required by engineer-in-charge.

Blank ends are to be formed with flanged joints and 6 mm thick blank between flange pair for 150 mm and over, in case where, a future extension is to be made otherwise blank and discs of 6 mm thickness are to be welded on, with additional cross stiffeners from 50mm x 50mm M.S.

Heavy angles, for sizes up to 350mm. All ends larger than 400 mm dia. shall have dished ends.

Flanges.

All flanges shall be of mild steel as per I.S. 6392/71 and shall be steel slip-on-type, welded to the pipes, flanges thickness shall be to suit class-II pressures.

Flanges may be tack welded into position, but all final welding shall be done with joints dismantled. 3 mm thick gaskets shall be used with all flanges joints. The gaskets shall be filler reinforced rubber as approved by the Engineer-in-charge. Special adhesive compound shall be used between flanges of steam, air and gas lines.

Flanges shall be used as follows :-

Counter flanges for equipment having flanges connections.

Flanged pairs shall be used on all such equipment, which may require to be isolated or removed for service e.g. Pumps, refrigeration machines air handling units etc.

All thread valves shall be provided with nipples and flanged pairs on both sides to permit flange connections, for removal of valves from main line for repair/replacement.

Valve :

Butterfly Valves

The butterfly valve shall consist of cast iron body preferably in two piece construction.

The discs shall consist of disc pivot and driving stem shall be in one piece centrally located.

The valve seat shall be synthetic material suitable for water duty. It shall line the whole body.

The discs should move in slides bearing on both ends with 'o' ring to prevent leakage.

The handle should have arrangement for locking in any set position.

All gate valves and check valves up to & including 65 mm dia. shall be of gunmetal screwed type, conforming to class 2 of I.S. 778. and shall be with I.S.I marking and certification.

All gate valves and check valves up to 80 mm dia. and above shall be of cast iron flanged type, conforming to class 2 of I.S. 780/69 (for sizes up to 350 mm) and of I.S. 2906/69 (for sizes 350 mm and above) marking and certification.

All gauge cocks shall be of gunmetal plug type, complete with siphon (brass chrome plated).

All drain valves shall be of gunmetal with a hose union connection of one hand.

All valves on the supply of fan coil units shall be of gunmetal ball type with integral water strainers, having (BSP) fpt inlet and flare type MPT outlet connection.

All valves on the return line of fan coil units shall be as in 5.6 but without integral water strainer.

Balancing Valves :

The balancing valves up to 80 mm dia. shall be of gunmetal screwed type confirming to B.S. 5154 or equivalent specifications.

The valves shall be cast gunmetal ASTM B-62 and complete with non rising spindle. PTFE disc seal cast metal hand wheel.

The port opening shall permit precise regulation of flow rate, by accurately measuring the pressure drop across the port.

The valves shall be complete with two ports for connection to a mercury manometer, to measure the pressure drop, as well as a drain port.

The spindle shall have shielded screw to set the flow at the desired level. The valves shall be used wherever specified.

Strainers :

The strainers shall either be pot type or 'Y' type with cast iron or fabricated steel body, tested up to pressure applicable for the valves as shown on the drawings.

The strainers shall have a perforated bronze sheet screen with 3 mm perforation and with a permanent magnet, to catch iron fillings.

Pot strainers shall be provided with flanged connection and 'Y' strainers shall be provided with flanged ends.

The strainers shall be designed to facilitate easy removal of filter screen for cleaning without disconnection of pipe line.

Jointing

All pipes line shall be welded type.

Square cut plain ends will be welded for pipes up to and including 100 mm dia.

All pipes 125 mm dia or larger will be beveled by 35 deg before welding.

Miscellaneous :

Provide all pipe work as required to make the apparatus connection complete and ready for regular and safe operation.

Unless otherwise noted, connect all apparatus and equipment in accordance with manufacture's standard details, as approved by Engineer-in-charge.

Unless otherwise specified, pitch the lines of piping as follows:-

All condensation drainage, including air handling unit and fan coil unit shall be pitched in the direction of flow to ensure adequate drainage, with an adequate trap seal to prevent leakage of air due to static pressure developed by air conditioning units. Pitch, 20 mm per meter wherever possible, but not less than 10 mm per meter.

Drains from other equipments shall be pitched similarly without trap seal. Provide valves and capped connections for all low points in piping system, where necessary or required for draining system. Provide isolating valves & drain valves in all risers to permit repairs without interfering with the rest of the system.

Support piping independently of all equipment so that the equipment is not stressed by the piping weight or expansion.

To facilitate the maintenance, repair and replacement.

Provide shut-off valves where indicated and for individual equipment, units at inlet
 And outlet, to permit unit removal for repairs, without interfering with the remainder of
 The system. Additional shut-off valves shall be provided as required to enable all systems to be fully sectionalized. By-pass and stop valves shall be provided for all automatic control valves as specified.
 Arrange piping for maximum accessibility for maintenance and repair, locate valves for easy access and operation. No valves shall be installed with handles pointing down, unless unavoidable.
 Cut the pipes accurately according to measurements, established site &

Work into phase without springing or forging.

Pipe supports shall be adjustable for height and prime coated with rust preventive paint

& finish coated with grey paint, both as approved by engineer-in-charge. The spacing of

Pipe supports shall not be more than that specified below:-

Nominal pipe size mm		spacing (meters)	
15	...	...	1.25
20&25	...	...	2.00
32,30,50,&65	...	...	2.50
80,100,&125	...	...	2.50
150&Above	...	...	3.00

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

Insulated piping shall be in such a manner as not to put undue pressure on the insulation, such as providing teak wood block between pipe and support.

Where pipes are to be buried under ground, they should be coated with one coat of bituminous paints. The top of the pipes shall not be less than 75 cms. From the ground level. Where this is not practical permission of engineer-in-charge shall be obtained for burning 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 proved, the trench shall be refilled with the excavated soil, excess soil shall be removed from the site of work by the contractor.

Hangers & Supports :

Hangers & supports shall be provided and installed for the piping and tubing wherever indicated, required or otherwise specified. Wherever necessary, additional hangers and support shall be provided to prevent vibration or excessive deflection of piping and tubing.

All Hangers & supports shall be made of steel or other durable and noncombustible material, given two coat of primer red oxide and then painted with aluminium colour paint. Wood wire or perforated strap iron shall not be used as permanent hangers or supports.

Hangers shall be supported from structural steel, concrete inserts & pipe racks, as specifically approved.

No hangers shall be secured to underside of light weight roof decking and light weight floor glass.

Mechanical equipment shall be suspended midway between steel joists and panel points.

Drilling or punching of holes in steel joist members will not be permitted.

Sleeves :

Where pipes pass through floors, walls, etc provide Galvanized steel pipe sleeves 50 mm larger than outside diameter of pipe.

Where pipes are insulated, sleeves shall be large enough to ample clearance for insulation.

Where pipes pass through outside walls or foundation, the space between pipe and sleeve shall be caulked with lead wool and oakum.

The centre of pipes shall be in the centre of sleeves, and sleeves shall be flush with the finished surface.

Expansion or Contraction :

The contractor shall provide for expansion and contraction of all piping installed by the use of swing connection and expansion loops.

Arrangement and alignment of Piping :

All piping shall be arranged and aligned in accordance with the drawings as specified. Where special conditions are encountered in the field, the arrangement and alignment of piping shall be as directed by the engineer-in-charge. The piping shall be installed in a uniform manner, parallel to or perpendicular to walls or ceiling, and all changes in directions shall be made with fittings. The horizontal piping shall be run at right angle and shall not run diagonally across rooms or other piping. Wherever possible all piping shall be arranged to provide maximum head room. All piping shall be installed as directly as possible between connecting points in so far as the work of other trades permits. Where interference occurs with another trade whose work is more difficult to route, this contractor shall reroute his pipes as required to avoid interference, at the discretion of the engineer-in-charge. All piping shall be carefully installed to provide for proper alignment, slope and expansion.

The stresses in pipe lines shall be guided and pipes shall be supported in such a manner that pipe lines shall not creep, sag or buckle.

Anchors and supports shall be provided wherever necessary to prevent any misalignment of piping.

Small tubing gauges, controls or other equipment installed on any apparatus, shall not be coiled nor excessive in length, but shall be neatly, carefully bent at all change in direction, secured in place and properly fastened to equipment at intervals to prevent sagging. The piping shall be grouped wherever practical and shall be installed uniformly in straight parallel lines in either vertical or horizontal positions.

Testing:

In general, tests shall be applied to piping before connection of equipment and appliances. In no case shall the piping, appliance be subjects to pressures exceeding their test ratings.

The tests shall be completed and approved before any insulation is applied. Testing of segments of pipe work will be permitted, provided all open ends are first closed, by blank offs or flanges.

After tests have been completed the system shall be drained and flushed 3 to 4 times and cleaned of all dust and foreign matter.

All strainers, valves and fitting shall be cleaned of all dirt, filling and debris.

All piping shall be tested to hydraulic test pressure of at least one and half times the maximum operating pressure but not less than 10 kg/sq. cm for a period of not less than 12 hours. All leaks and defects in the joints revealed during the testing shall be rectified to the satisfaction of the engineer-in-charge, without any extra cost.

All the piping system shall be tested in the presence of the engineer-incharge or their authorized representative. Advance notice of test dates shall be given all equipments, labour, materials required for inspection, and repairs during the test shall be provided by the contractor. A test shall be repeated till the entire systems are found to be satisfactory to the above authority. The tests shall be carried out for a part of work if required by engineer-in-charge in order to avoid hindrance in the work of the insulation contractor.

All steam and condensate pipes shall be tested and proven tight under hydrostatic pressure of 20 kg/sq.cm, unless otherwise stated, for a minimum period of 4 hours without drop in pressure.

Miscellaneous piping, tests with air at 10.5kg/sq.cm for a minimum of 24 hours without drop in pressure.

Painting:

All pipes supports, hangers, etc, shall be given two coats of red oxide primer. All pipes, which are not to be insulated, shall then be given one coat of finish paint, of a type and colour, as per ISI code.

TECHNICAL SPECIFICATIONS FOR FIRE-FIGHTING SYSTEM

1. The work in general shall confirm to the rules of the Tariff Advisory Committee for Wet riser installation and must be done in accordance with IS:1648-1961 for Code of Practice for Fire safety of Building (General).
2. The items of work detailed in enclosed schedule of quantities should be carried out as per CPWD General Specifications for Electrical Works, Part-I Internal (2013), Part-II (External 1994), Part-V (Wet Riser & Sprinkler System-2006). In case of any deviation between these additional conditions and specifications and the provisions contained in CPWD General Specifications, these additional specifications shall have precedence. Nothing extra shall be paid for complying with these additional specifications which are mandatory.
3. All materials used in the work as far as applicable shall comply with the relevant Indian Standard specifications with all its upto date amendments. These materials having ISI mark shall have precedence over the ones conforming to ISI specifications.

a. **CODES & STANDARDS**

The following codes and standards with upto date amendments shall be applicable for the design, manufacture, testing, erection, fabrication at site, trial operation of piping, valves and specialized requirements :

IS:554	Dimensions for pipe threads where pressure tight joints are required on the threads
IS:638	Sheet rubber jointing and rubber insertion jointing.
IS:778	Copper alloy gate, globe and check valves for water work purposes
IS:780	Sluice valves for water-works purposes (50 mm to 300 mm).
IS:901	Couplings, double male and double female, instantaneous pattern for fire fighting
IS:1239	Mild steel tubes, tubulars and other wrought (Part I & II) steel fittings
IS:884	Swinging type wall mounted hose reel with drum,
IS:388	Hose tubing.
IS:4038	Foot valves for water-works purposes
IS:5290	Landing valves
IS:10221	Anti corrosion treatment for underground MS pipes.
IS:5312	Swing check type reflux (non-return) valves
	Rules for Automatic sprinkler installation & Tariff Advisory Committee

PUMPS	
IS:1520	Horizontal centrifugal pumps for clear, cold and fresh water.
BS:599	Methods of testing pumps.
PTC:8	ASME Power Test Codes - Centrifugal Pumps
MOTOR	
IS:325	Induction motors, three-phase
IS:900	Induction motors, installation and maintenance, code of practice for
IS:7816	Guide for testing insulation resistance of rotating machines.
IS:4029	Guide for testing three phase induction motors.
IS:3043	Code of practice for earthing.
Further to those stated above, the design, manufacture, installation and performance of motors shall conform to the latest Indian Electricity Act and Indian Electricity Rules. The motor shall also be acceptable to the Tariff Advisory Committee.	
CODES AND STANDARDS FOR CONTROL PANEL	
Equipment shall conform to the latest applicable Standards as mentioned	
In case of conflict between the Standards and this specification, this specification shall govern	
IS:13947 (Part 2&5), 1993	Low voltage switchgear & control ars
IS:2147, 1966	Degree of protection
IS: 13947 (Part 4, Sec. I), 1993 BS: 60947-4-1, 1992: IEC:158	Contactor for voltage not exceeding 1000V AC
IS:375, 1993	Marking and arrangement of bus bars
IS:694, 1990 & IS:8130, 1984	PVC Insulated cables and aluminum conductor
IS:1248,1991	Direct citing electrical indicating instruments
IS:13703, 1991	Low voltage fuses
IS:13118 (All parts), 1991	Alternating current circuit breakers
IS:2705 (Part 1 to 4), 1992	Current transformers
IS:3156 (Part 1 to 3), 1992	Voltage transformers

4. Electrical Driven Pump Sets

- 4.1 The electrical fire pumps shall be suitable for automatic operation and both the motor and pump shall be assembled on a common bed plate, fabricated from MS channel. The pumps shall be horizontal split casing centrifugal type direct driven by means of a flexible coupling with coupling guard. The pumps shall be single/multi stage designed for continuous operation and shall have a continuously rising head characteristic without any zone of instability. The delivery pressure at pump outlet shall be not less than 7 Kg/sq.cm. in any case.
- 4.2 The motor for each pump shall have a 15% margin of power rating over the rated pump input power and shall be totally enclosed fan cooled type conforming to relevant protection class of IS 4691-1968. The class of insulation shall be 'F' and motor shall be rated for continuous duty and shall have horse power necessary to drive the pump at 150 percent of its rated discharge with at least 65% rated head. The motor shall conform to IS 325-1978.
- 4.3 In case the pump & motor/engine are from different manufacturers, the contractor shall assume full responsibility in the operation of the pump and the drive as one unit.
- 4.4 All pumps shall be capable of a minimum of 150 percent of rated capacity at a total head of not less than 65 percent of the total rated head. The total shut-off head shall be within 120 percent of total rated head on the pump.
- 4.5 An automatic air release valve shall be provided to vent air from the pump. This valve shall be located in the pump house in the discharge line between the pump and the discharge check valve.
- 4.6 The centrifugal pumps shall conform to IS 1520.
- 4.7 The pump casing shall be heavy section close grained cast iron and designed to withstand 1.5 times the working pressure. The casing shall be provided with shaft seal arrangement as well as flanges for suction and delivery pipe connections as required.
- 4.8 The parts like impeller, shaft sleeve, wearing ring etc. shall be of non-corrosive metal like bronze/brass/gun metal. The shaft shall be stainless steel.
- 4.9 The bearings of the pumps shall be effectively sealed to prevent loss of lubricant or entry of dust or water.
- 4.10 The pumps shall be provided with plates indicating the suction lift, delivery head, discharge, speed and number of stage.
- 4.11 The cable boxes and terminators of motors shall be suitable for receiving 1.1 KV grade armored power cables and so designed to enable easy disconnection and replacement of cables.
- 4.12 The base plate shall be supported on suitable height cement concrete foundation of 1:2:4 (1 cement : 2 coarse sand : 4 coarse aggregate) ratio. Edge of foundation shall be protected by MS channel of size 35 x 35 X 3 mm all around.

5. Diesel Engine

- 5.1 The diesel engine of diesel fire pump shall be required to operate under the conditions of site environment and the same shall be designed with regard to ease of maintenance, repair, cleaning and inspection. This will also provide interchangeability of parts.
- 5.2 The engine shall be capable of both automatic and overriding manual start by push button without any preliminary heating of combustion chamber and all controls/mechanisms which have to be operated in the starting process shall be within easy reach of the operator.

5.3 The automatic start of Diesel Engine shall be initiated by a high torque DC motor charged by one set of two batteries each of 12V capacity and of 180AH rating.

5.4 The battery bank shall be used for no other purpose than starting of the engine and shall be fully charged at all times with provisions for trickle & boost chargers. After starts of the engine the charger shall be disconnected, the battery being fed from the engine dynamo. The battery charger of air cooled type shall be able to charge one battery bank at a time.

5.5 The engine shall be multi cylinder/ vertical 4 stroke cycle water cooled developing required HP at the operating speed of 1500 RPM to drive the fire pump. The continuous capacity of diesel engine available for the load shall be after correction of ambient temperature and humidity. This shall be at least 20% greater than the maximum HP required to drive the pump at its duty point. The engine shall also be capable of driving the pump at 150% of the rated discharge at 65% of rated head. The engine shall have 10% overload capacity for one hour in any period of 12 hours continuous run.

5.6 The diesel engine shall conform to BS 649/IS 1601/IS 10002 all amended upto date.

5.7 Engine Accessories – The engine shall be complete with the following accessories:

- (i) Fly wheel dynamically balanced.
- (ii) Direct coupling for pump and coupling guard.
- (iii) Radiator with hoses, fan, water pump, drive arrangement and guard.
- (iv) Corrosion resister
- (v) Air cleaner, dry type
- (vi) Fuel service tank support, semi-rotary pump and fuel oil filter with necessary pipe work.
- (vii) Pump for lubricating oil and Lubricating oil filter.
- (viii) Electrical silencer battery (2 x 12V)
- (ix) Exhaust silencer with necessary pipe work.
- (x) Governor.
- (xi) Instrument panel housing all the gauges including Tachometer, hour meter and starting switch with key (for manual starting).
- (xii) Necessary safety controls

5.8 Cooling System – The engine cooling system shall be radiator water cooled system. The radiator assembly shall be mounted on the common bed plate. The radiator fan shall be driven off the engine as its auxiliary with a multiple fan belt. Cooling water shall be circulated by means of an auxiliary pump of suitable capacity driven by the engine in a closed circuit. When half of the belts are broken, the remaining belts shall be capable of driving the fan.

5.9 Fuel System – The fuel shall be gravity fed from the engine fuel tank to the engine driven fuel pump. The engine fuel tank shall be mounted either over or adjacent to the engine itself or suitably wall mounted on brackets at a height not less than 60cm above the fuel injection pump. The fuel filter shall be suitably located to permit easy servicing.

All fuel tubing to the engine shall be with copper, with flexible hose connections where required. Plastic tubing shall not be permitted.

The fuel tank shall be of welded steel construction (3 mm thick) and of capacity sufficient to allow the engine to run on full load for atleast 8 hours . The tank shall be complete with necessary floor mounted support, level indicator (protected against mechanical injury) inlet,

outlet, overflow connections and drain plug and piping to the engine fuel tank. The outlet should be so located as to avoid entry of any sediment into the fuel line to the engine.

A semi rotary hand pump for filling the daily service tank together with hose pipe 5 metre long with a foot valve etc. shall also form part of the scope of work.

5.10 Lubricating Oil System - Forced feed Lubricating Oil System shall be employed for positive lubrication. Necessary lubricating oil filters shall be provided, located suitably for convenient servicing.

5.11 Exhaust System – The exhaust system shall be complete with residential silencer suitable for outdoor installation, and silencer piping including bends and accessories needed. Silencer pipe shall be extended up to 1 m outside pump house duly insulated with 50 mm thick glass wool and 1.00 mm thick aluminium sheet cladding. The total back pressure shall not exceed the engine manufacturer's recommendation. The exhaust shall be MS heavy class pipe. All piping within the pump room and external exposed shall be lagged with 50mm thick asbestos with two layer of chicken wire mesh and cladding of aluminum sheet. All above mentioned

works shall be included in the cost of the DG pump set. Nothing extra shall be paid on account of this.

5.12 Governing system - The engine shall be provided with an adjustable governor to control the engine speed within 5% of its rated speed under all conditions of load upto full load. The governor shall be set to maintain rated pump speed of maximum pump load.

5.13 Engine shut down mechanism – This shall be manually operated and shall return automatically to the starting position after use.

5.14 Engine Instrumentation – Engine instrumentation shall include the following –

- (i) Lubricating oil pressure gauge
- (ii) Lubricating oil temperature gauge
- (iii) Water pressure gauge
- (iv) Water temperature gauge
- (v) Hour meter
- (vi) The instrumentation panel shall be suitably resident mounted on the engine.

5.15 Engine Protection Devices – Following engine protection and automatic shut down facilities shall be provided:

- (i) Low lubricating oil pressure
- (ii) High cooling water temperature
- (iii) High lubricating oil temperature
- (iv) Over speed shut down.

5.16 Pipe Work – All pipe lines with fittings and accessories required shall be provided for fuel oil, lubricating oil and exhaust systems, copper piping of adequate sizes shall be used for lubricating oil and fuel oil. MS piping will be permitted for exhaust.

5.17 Anti Vibration Mounting – Suitable vibration mounting duly approved by Engineer-in-charge shall be employed for mounting the unit so as to minimize transmission of vibration to the structure.

5.18 Battery Charger – Necessary float and boost charger shall be incorporated in the control section of the power and control panel, to keep the battery under trim condition. Voltmeter to indicate the state of charge of the batteries shall be provided. The charger shall

have the capacity to restore a full discharged battery to a state of full charge in 10 hours with some spare margin over maximum charging rate. Visual and audible annunciation for trouble or failures in the power supply system such as charger failure, 'batter low voltage' etc. shall be provided.

6.0 Power Control Panel

- 6.1 General features – The power and control panel shall be totally enclosed, free standing, floor mounted cubical type, fabricated out of sheet not less than 2mm thick. Where necessary, additional stiffening shall be provided in the frame work. General construction shall be of compartmentalization and sectionalisation such as mains incomer, electric w/s pump, AC pump, pressurization pump, priming pump and control, so that there is no mix up of power and control wiring and connections in the same sections as far as possible. The panel shall be front operated type with all connections accessible from the front. Front doors shall be hinged type. Back doors shall be hinged type or removable type for inspection. The door hinges shall be concealed type. The doors shall be provided with quick fixing doors knobs with indication. The general arrangement of the panel shall be got approved before fabrication. The cubicle construction shall be to IP 21 as per IS:2147.
- 6.2 Cable entries and gland plates – All cable entries shall be through gland plates which are removable and sectionalized. Necessary compression type glands shall also be provided. Where heavy cables are brought in and terminated, suitable clamps shall be incorporated to relieve the stress on the glands due to the weight of the cable. Cable entries shall be from top.
- 6.3 Busbar and Connections – The busbars shall be air insulated and of copper and of adequate cross section. Current density shall not exceed 130 amps per sq.cm. All connection to individual, circuits from the busbars shall preferably be with solid connections. The busbars and the connections shall be suitable covered with PVC sleeves or in an approved manner. Busbars shall be suitable supported using non hygroscopic insulated supports such that they may stand 50 KA RMS symmetrical current for one second. High tensile bolts and spring washers shall be provided at busbar joints.
- 6.4 Earthing Arrangement – Copper strip 25mm x 5mm shall be run at the rear of the board, bonding all the sections suitably. 2 Nos. earth terminals shall be provided at the ends of the strip for connection to earth system. Earth terminals shall be with a flexible loop and the hardware shall be of GI or passivated and plated iron.
- 6.5 Terminal Blocks and Small Wiring - Terminal blocks shall be of heavy duty type and generally not less than 15 amps 250V grade upto 100V, and 600V grade for the rest of the functions. They shall be easily accessible for maintenance. All control wiring inside the panel shall be with PVC insulated copper conductor of 2.5 sq. mm size and 600V grade conforming to IS:694-1977, suitable colour coding may be adopted. Wiring harness shall be neatly formed and run preferably function wise, and as far as possible segregated voltage wise. Identification ferrules shall be used at both ends of the wires.
- 6.6 Instrument and lamps – All indication lamps and instruments shall be of size 96mm conforming to Clause 1.5 of IS 1248 for accuracy.

Current transformers shall be provided with ammeters.

Indicating lamps to indicate the availability of electric supply shall be provided at the incoming section. Necessary indicating lamps for alarm indication pump status, overhead/status and other specified alarm indication shall be provided in the respective sections.

All indicating lamps and voltmeter shall be protected with MCB.

- 6.7 Labels – All internal components shall be provided with suitable identification labels suitably engraved labels shall be based at the panel for all MCCBs, switches, instruments, push buttons, indicating lamps etc.

6.8 Painting – The entire panel shall be given a primer coat of red lead after degreasing and phosphating treatment, and 2 coat of final paint of approved shade before assembly of various items.

7.0 Piping

7.1 Pipes of the following are to be used.

- (a) G.I. pipes as per IS: 1239, heavy duty (for pipes of sizes 150 mm N.B. and below) suitably lagged on the outside to prevent soil corrosion.
- (i) MS black pipe (Welded black steel pipe), class 2, conforming to IS: 3589, for sizes greater than 150 mm. These pipes shall be factory rolled and fabricated from minimum 6 mm thick M.S. Sheet for pipes upto 350 mm dia and from minimum 7 mm thick M.S. Sheet for pipes of 400 mm dia and above.
 - (i) GI pipe lines upto 150 mm dia. shall have all fittings as per IS:1239, Part-II (heavy grade) while pipelines above 150 mm dia shall be fabricated from IS:3589 Gr.320 pipes as applicable or from steel plates.
 - (ii) For GI pipelines upto 50 mm dia screwed jointing shall be adopted, while for pipelines above 50 mm dia welded or flanged construction is to be carried out.

7.2 PIPING INSTALLATION

- (i) The drawings indicate schematically the size and location of pipes. Pipes runs and sizes may, however, be changed to meet the site conditions. The contractor on the award of the work, shall prepare detailed working drawings showing the cross section longitudinal section, details of fittings, locations of isolating drain and air valves etc. they must keep in view the specific openings in buildings and other structures through which the pipes are designed to pass.
- (ii) Hangers and supports shall be capable of carrying the sum of all concurrently acting loads. They shall be designed to provide the required supporting effects and allow pipeline movements as necessary. All guides, anchor, braces, dampener, expansion joint and structural steel to be attached to the building structure trenches etc. shall be provided.

Hangers and components for all piping shall be approved by the Consultant / Client / Architect.

- (iii) Pipe supports shall be of steel, adjustable for height and primer coated with rust preventive paint and finish coated black. Where pipe and clamp are of dis-similar material, a gasket shall be provided in between. Pipe supports shall be spaced suitably keeping in view the site and structural requirements of different locations. Pipe hangers shall be fixed on walls and ceilings by means of dash fasteners.
- (iv) Flanged joints shall be used for connections to vessels, equipment, flanged valves and also on suitable straight lengths of pipeline of strategic points (@ at every 15-20 mtr.) to facilitate erection and subsequent maintenance work.
- (v) Excavation for pipe line shall be in open trenches. Pipes shall be buried atleast one meter below ground level and shall have 230 mm x 230 mm masonry supports atleast 300mm high at 3m intervals. Masonry work to have plain cement concrete foundation (1 cement: 4 coarse sands: 8 stone aggregate) of size 380 x 380 x 75 thick resting on firm soil.
- (vi) Wherever required Contractor shall support all trenches or adjoining structures with adequate supports to prevent landslides.
- (vii) On completion of testing and painting trenches shall be refilled with excavated earth in 15 cm layers and compacted.

- (viii) Contractor shall dispose off all surplus earth within the site.
- (ix) Contractor shall provide suitable cement concrete anchor blocks for overcoming pressure thrusts in underground / external pipes. Anchor blocks shall be of cement concrete 1:2:4 mix.
- (x) Fittings shall be new and from reputed manufacturers. Fittings shall be of malleable casting of pressure ratings suitable for the piping system. Fittings used on welded piping, shall be of the weldable type. Flanges shall be new and from standard manufacturers.
- (i) Tee-off connection shall be through reducing tees, wherever possible, 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.
- (ii) All equipment and valve connections shall be through flanges.
- (iii) All welded piping is subject to the approval of the Engineer-in-charge and sufficient number of flanges and unions shall be provided.
- (xiv) Pipe supports shall be of steel, adjustable for height and primer coated with rust preventive paint and finish coated black. Where pipe and clamp are of dissimilar material, a gasket shall be provided in between. Pipe supports shall be spaced suitably keeping in view the site and structural requirements of different locations. Pipe hangers shall be fixed on walls and ceilings by means of dash fasteners.
- (xv) Piping work shall be carried out with minimum disturbance to the other works being done at the site. A program of work shall be chalked out in consultation with the Engineer-in-charge.
- (xvi) Piping layout shall take due care for expansion and contraction in pipes and the expansion joints in the building.
- (xvii) All pipes using screwed fittings shall be accurately cut to the required sizes and threaded in accordance with IS:554 and burrs removed before laying. Open ends of the piping shall be locked as the pipe is installed to avoid entrance of foreign matter. 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.

7.3 Vibration Elimination

Piping installation shall be carried out with vibration elimination fittings wherever required.

7.4 Testing

- (i) All piping shall be tested to hydrostatic test pressure of 14 Kg/sq.cm. or twice the design pressure whichever is higher for a period of not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified to the satisfaction of the Engineer-in-charge.
- (ii) Piping required subsequent to the above pressure test shall be re-tested in the same manner.
- (iii) Systems may be tested in sections and such sections shall be securely capped.
- (iv) The Engineer-in-charge shall be notified well in advance by the contractor of his intention to test a section of piping and all testing shall be witnessed by the Engineer-in-charge or his authorized representative.
- (v) The contractor shall make sure that proper noiseless circulation of fluid is achieved through the system concerned. If proper circulation is not achieved due to any block connections. The contractor shall notify the defective connections. He shall bear all the expenses for carrying out the above rectifications including the tarring-up and re-finishing of floors, walls etc. as required.
- (vi) The contractor shall provide all materials, tools, equipment, instrument, services and labour required to perform the test and shall ensure that the plant room and other areas are cleaned up and spill over water is removed.

7.5 Painting

- (i) After the piping has been installed, tested and run for at least ten days, the piping shall be given two finish coats of approved colour.
- (ii) Pipes shall be given one primary coat of red-oxide paint before being installed. Pipes shall be sloping towards drain points.
- (iii) The direction of flow of fluid in the pipes shall be visibly marked in white arrows or as directed by the Engineer-in-charge.

8.0 STRAINERS :

- 8.1** Strainers shall be pot type fabricated out of C.I. bodies designed for system pressure.
- 8.2** Strainers shall have 0.6 mm bronze screen having 3 mm 0-perforations to provide min. free area of 4 times the cross section area of the pipe line in which it is installed.
- 8.3** Strainers shall be provided with flanges or threaded sockets depending on pipe size with bypass arrangement for maintenance.
- 8.4** They shall be provided with removable cover and designed so as to enable blowing out accumulated dirt and facilitate replacement of screen without disconnection of main pipe.
- 8.5** Strainers shall be provided as shown in applicable drawings or as required at suction of pump.

9.0 Air Vessel and Air release valve

The air vessel shall be provided of adequate size but of not less than 450mm dia and 2 metre height. The air vessel shall compensate for slight loss of pressure in the system and to provide an air cushion for counter acting pressure surges whenever the pump set comes into operation. It shall be normally partly full of water, the remaining being filled with air which will be under compression when the system is in normal operation. Air vessel shall be fabricated from 8 mm thick MS plate with dished ends and suitable supporting legs. It shall be provided with a 100 mm dia flanged connections from pump, one 25 mm drain with air release valve, one water level gauge and 25 mm sockets for pressure switch and necessary piping to meet the functional requirement of the system. The air vessel shall be hydraulically tested for twice the working pressure.

10.0 Pressure Switches

Pressure switches shall be provided for switching on and off the pressurization pump at preset pressures and also for switching on the fire pumps at pre-set pressure. Being the main component for initiating the signal for the operation of the pumps, the pressure switches shall be totally reliable, sturdy in construction and of long life. The pressure settings shall be adjustable.

11.0 Low Water level indicator and switch

To prevent the dry running of fire pumps due to emptying of the static tank, a water level indicator and switch shall be provided. This shall trip the electric motor or stop the diesel

engine, as the case may be when the water level goes below a present level. This shall also furnish a distinct low water level audio visual alarm. This should indicate the level of water at different stages in the Power and Control Panel.

12.0 Power Supply for Controls

In order to ensure that the control system remains operational at all times, the control system shall be designed for 24V DC operation, fed from 24V lead acid maintenance free battery. This shall be independent of the starting battery for the engine. The battery shall remain trickle charged at all times from the battery charger at the control section.

13.0 Vertical Wet Risers

- 13.1 Necessary MS clamps of suitable size for using the pipes to wall ceiling, beam & flooring etc. are to be provided and these shall be placed at an interval of not more than 1.5 metre and shall be got approved from the Engineer-in-charge before starting the work. The clamps shall be grouted at appropriate place and necessary work of grouting i/c finishing the surface as directed and required by Engineer-in-charge shall be carried out. The cost of this is deemed to be included in the unit rate of respective item. Necessary cut-outs have been provided to erect the wet risers and any other requirements of making out openings at the time of execution shall be done by the contractor at no extra cost. The remaining openings in the cut-outs shall be sealed after the jobs have been completed with necessary filling material matching with surroundings and the cost of such sealing is also deemed to be included with unit rate of item. Nothing extra shall be paid on this account.

- 13.2 Fittings required for wet riser shall be appropriate thickness & galvanized.

14.0 Stand Post External Yard Hydrants

- 14.1 Yard or External Hydrants shall be as per IS:908 and the valve as per IS:5290-1977 type 'A'. The hydrant shall consist of stand post assembly and a masonry base 200 mm X 200 mm X 200 cm high and shall be made at the point where it comes out of the soil. Stand post column shall be cast iron, casted in one piece conforming to grade 20 of IS:210-1970. The valve shall complete with hand wheel, quick coupling connection spring and blank cap. The hydrant shall be laid on 150/100 dia main tee off to 100mm dia.
- 14.2 Yard or External hydrant shall be controlled by a cast iron butterfly valve. Hydrant shall have oblique female instantaneous pattern 63 mm diameter outlet with caps and chains. The hydrant shall be of gunmetal and flange inlet and single outlet conforming to IS:5290, flanged riser of required height to bring the hydrant to level above ground. The valve body, stop valve, check valve, nut, instantaneous female outlet and blank cap shall be of leaded-tin bronze conforming to Grade-II of IS:318-1962. The valve spindle shall be of brass rod conforming IS:320 - 1962. The hand wheel shall be mild steel or cast iron washers gaskets shall be of rubber conforming to IS:638 - 1965 or leather conforming to IS:581 : 1969.
- 14.3 Each external hydrant shall be provided with two nos. 63 mm. Diameter 15 mtr. Long hose pipe with gunmetal male and female instantaneous type coupling, machined wound with G.I. wire hose of IS 636 type A and couplings to IS:903 with IS certification, gunmetal branch pipe with 20 mm nozzle conforming to IS:903.
- 14.4 All hydrants outlets shall be situated one metre above the ground level.
- 14.5 Metal box enclosing the yard hydrant is being paid separately. However, the masonry work to support this metal box is deemed to be included in the unit rate of the item.
- 14.6 Opening in the stand post shall be suitable to accept the hydrant landing valve.

15.0 Hose Pipe

- 15.1 Hose pipe shall be 63 mm in dia & 15 meter length and fabric reinforced rubber lined as per IS 636 Type 'A'. They shall be flexible and capable of being rolled.

- 15.2 All hose pipes shall carry ISI marking on the body of the hose.
- 15.3 The instantaneous couplings shall be as per IS:901. It shall be fixed to the hose pipe by galvanized wire and copper rivets.
- 16.0 **INTERNAL HYDRANT:**
- 16.1 Internal hydrant shall be provided at each landing or at suitable location consisting of single / twin headed gunmetal landing valve as indicated in BOQ with 63 mm dia. Outlet and 80 mm inlet (IS:5290-1969) with separate shut off valve. Landing valves shall be 63 mm dia. oblique female instantaneous pattern with caps and chains. Landing valves shall be of gunmetal and fitted with instantaneous coupling conforming to IS:901. The valve body, stop valve, check valve, nut, instantaneous female outlet and blank cap shall be of leaded-tin bronze conforming to Grade-II of IS:318-1962. The valve spindle shall be of brass rod conforming IS:320 - 1962.
- The hand wheel shall be mild steel or cast iron washers gaskets shall be of rubber conforming to IS:638 - 1965 or leather conforming to IS:581 : 1969. The coupling shall be fitted with an internal plug secured by chain landing valves shall be installed on hydrant riser at a height of 1.0 to 1.2 meter from the floor level.
- 16.2 Each internal hydrant shall be provided with two nos. 63 mm. Diameter 7.5 mtr./15 mtr. Long hose pipe with gunmetal male and female instantaneous type coupling, machined wound with G.I. wire hose of IS 636 type A and couplings to IS:903 with IS certification, gunmetal branch pipe with nozzle conforming to IS:903.
- 16.3 To avoid undesirably high pressure in the hydrants and hoses, special pressure reducing arrangements like orifice plates in the landing valves shall be provided and nothing extra shall be paid in this account. The limit of operating pressure from valves shall be 7 Kg/cm² and the orifice plate shall be so designed to restrict the pressure to above value. The orifice plate shall be fabricated of 6mm thick, stainless-steel plate.
- 16.4 A cap with chain is to provide one head of the outlet which will have an instantaneous pattern female coupling for connecting to hose pie and adoption and other head for the first & hose reel connections.
- 17.0 **HYDRANT VALVES (LANDING VALVES)**
- Landing valves shall be 63 mm dia. oblique female instantaneous pattern with caps and chains. Landing valves shall conform to IS:5290 in all respects. Double headed landing valves shall have separate control valves. Landing valves shall be of gunmetal and fitted with instantaneous coupling conforming to IS:901. The valve body, stop valve, check valve, nut, instantaneous female outlet and blank cap shall be of leaded-tin bronze conforming to GradeII of IS:318-1962. The valve spindle shall be of brass rod conforming IS:320 - 1962. The hand wheel shall be mild steel or cast iron washers gaskets shall be of rubber conforming to IS:638 - 1965 or leather conforming to IS:581 : 1969. The coupling shall be fitted with an internal plug secured by chain landing valves shall be installed on hydrant riser at a height of 1.0 to 1.2 metre from the floor level.
- 18.0 **HOSE CABINETS (HOSE BOX)**
- Each hydrant shall be housed in a Hose cabinet of suitable size. The hydrant cabinet shall hold double / single headed hydrant as specified, 2 hoses and one branch pipe as required. Internal hydrants shall normally fit the size of the niche made for it. The cabinet shall be of minimum 14 SWG M.S. sheet with centre opening, double glass front doors (clear glass of 5 mm thickness). The glass shall be firmly fixed by means of steel clips and screw with rubber beading. Hinges shall also be screwed and not welded. The corner members (frame) shall be of 25 x 25 x 3 mm thick angle. The hose box shall be firmly fixed to the wall/support by means of brackets and dash fasteners. The steel work shall have one coat of primer and two coats of red paint. The words “Yard Hydrant”, “Hydrant” etc. should be painted in white or red on the glass in 75 mm high letters. The hose box shall be lockable.

19.0 AIR CUSHION TANK

Every wet riser shall be provided with an air cushion tank at its top most point. The air cushion tank shall be provided with an automatic air release cock, 20 mm dia. drain pipe, drain valve and shut off valve.

20.0 First Aid Hose Reel (Swinging type)

- 20.1 MS sheets may be used in the manufacturing of sides of hose reel. These shall conform to 'D' drawing type sheet specified in IS:513-1968
- 20.2 The hose reel shall be directly tapped from the hydrant ring main through 25 mm dia pipe, the drum and the reel being firmly held against the wall by use of dash fasteners. The hose reel shall be swinging type (180 degrees) and the entire drum, reel etc, shall be as per IS:8841969. The rubber tubing shall be of approved quality and the nozzle shall be 6mm dia shut off type.
- 20.3 Manually operated stop valve of 20 mm size shall be provided for the hose reel and hose reel tubing shall be 20 mm dia & length specified.

21.0 Branch pipe & Nozzle

- 21.1 The branch pipe inlet connections shall be of instantaneous pattern. The branch pipes shall be of gun metal and shall conform to IS:903. One end of the branch pipe will receive the coupling while the other end shall have a nozzle screwed to it.
- 21.2 The branch pipe & nozzle shall be of dimensions mentioned in IS 903-1973 and shall be ISI marked.

22.0 Fire Brigade Connections

- 22.1 The fire brigade outlet landing to storage tank from siamease connections shall not be connected directly into the side of the storage tank but arranged to discharge not less than 150 mm above the top edge of the tank.
- 22.2 It shall be installed at height not more than one metre at street level in a wall box at location given by Engineer-in-charge. Piping only for the purpose of connecting different accessories shall be paid under the respective items. However, different accessories like Tee, Bends, Flanges, insertions in order to fix the Siamese connections in wall box shall be born by the contractor & nothing extra shall be paid on this account.
- 22.3 Fire Brigade Inlet

There shall be one set of instantaneous Fire Brigade connection comprising of instantaneous male inlet couplings with plug & chain. The connecting inlet line to the static fire tank shall be 4 way while the connecting inlet landing to the wet riser shall be 3 way provided with 10 mm dia cast iron double flanged class-I sluice valve and one number non return valve. The fire brigade inlet shall be complete with necessary components like special fittings of medium quality GI bends, GI double flanged tees, GI reducers etc. Cost of slice slues valve & nonreturn valve shall be paid separately against item of the Schedule these Siamese connections shall be housed in a standard hose cabinet. The cost of this hose cabinet is not included in the item.

23.0 External Hose Cabinet

- 23.1 The external hose cabinets shall be made of not less than 2.0mm thick sheet steel having centre opening glazed door. The size of the cabinet shall be approx. 120 cm (H) x 60 cm (W) x 50 cm and supported by means of a brick pedestal which shall have 12 mm thick plaster of 1: ration and finished with 2 coats of snowcem paint.
- 23.2 Hose cabinet should be painted with two coats of rust resisting fire red paint over a coat of primer.

- 23.3 The box shall have central openings and spring locking arrangements which can be operated with handle without a key after breaking the glass. The hose cabinets shall be provided with locking arrangements by means of socket spanner.
- 23.4 The front opening doors shall have glass glazing of suitable size.
- 23.5 The thickness of the glass shall be 5.5 mm at least and the same shall be fixed by means of 12 mm x 12 mm square M.S./Aluminum bars on both sides and screwed to the shutter frame.
- 23.6 The word FIRE will be painted in the red color with letter size of 75 mm height.
- 23.7 The portion embedded in concreted/brocks shall be painted with one coat of red oxide (Primer)
- 23.8 The contractor shall get the necessary drawings of cabinet (to be fabricated by him) approved by Engineer-in-Charge before going ahead with this item.

24.0 Sluice valves

- (i) Sluice valve upto 65 mm shall be of GM construction & above 65 mm shall be of cast iron conforming to class-I or PN 16 IS:780. These valves shall be of right hand type. Valve wheels shall be of right hand type. Valve wheels shall have an arrow head engraved or cast there on showing directions for turning open & close.

25.0 Valves Pits

These shall be provided for housing sluice valves fixed in the open. A masonry pit of internal dimensions 1 metre x 1 metre x 1 metre depth shall be built to accommodate each of the valves placed externally. The walls shall be 230 mm thick with a base of PCC (1 cement : 3 sand : 6 coarse aggregate). It shall be provided with heavy duty ISI marked man hole covers and frames.

26.0 Non-return valves

Non-return valves shall be cast iron spring action swing check type. An arrow mark in the direction of flow shall be marked on the body of the valve. These valves shall conform to IS:5312. The flap shall be of cast iron and flap seat ring of leaded gun metal.

27.0 Polymeric Corrosion Protection Tape (Pypkote ckoth)

Polymeric corrosion protection tape (pypkote cloth) shall be wrapped on MS pipes to be buried in earth. This corrosion protection tape shall be 4mm thick and would conform to requirements of IS 10221 and A W W A C 203 for prefabricated tapes. Before application of polymeric corrosion protection tape all foreign matter in pipe shall be removed with help of wire brush and suitable primer shall be applied over the pipe thereafter. The primer shall be allowed to dry until the solvent evaporates and the surface becomes tacky. Corrosion protection taps shall then be wound around the pipe in spiral fashion and bonded completely to the pipe. The overlaps shall be maintained at 15mm and 250mm shall be left uncoated on either end of pipe to permit installation & welding. This area shall be coated insitu after the pipe line is installed.

28.0 SPRINKLER SYSTEM

28.1 SCOPE OF WORK:

To supply, install, testing and commissioning of sprinkler system as per drawing and SLD. Sprinkler piping is planned by taking tapping from External Hydrant Main Sprinkler heads spacing shall be in conformity with the drawings and properly coordinated in reflected ceiling with electrical fixtures, ventilation ducts and grills and other services along the ceiling.

Sprinkler heads shall be brass / gunmetal with quartz bulb with temperature rating of 68 degree celsius. Sprinkler heads shall be of type and quality approved by the local fire brigade authority/NFPA 13. The inlet shall be screwed. Sprinkler heads spacing shall be pendent, recessed or special side all type. All sprinklers shall conform to the specifications given by TAC, IS, NFPA, FOC, UL & FM.

28.2 SPRINKLER HEADS

(i) Sprinkler heads shall be provided at approximate spacing so as to cover 9-10 sq.mtr. per sprinkler head. The spacing shall however be in uniformity with the drawings and properly coordinated with electrical fixtures, ventilation ducts and grilles and other services along the ceiling. Sprinkler heads shall be gunmetal quartz bulb type with a temperature rating of 68°C. Sprinkler heads shall be of upright conventional type with fusible link for operation. Sprinkler head shall be approved by the under writers Laboratories (U.L.) or Fire Officers Committee (FOC). The finish shall be as specified in bill of quantities.

(ii) Contractor shall install cabinet (fabricated from 16 Gauge M. S. sheets with lockable glass shutters. Shelves for keeping spare sprinklers and spanner at locations approved by the Engineer-in-Charge and given in the schedule of quantities. The contractor shall also give required tools for removing and fixing of different types of sprinkler free of cost as directed by Engineer-in- Charge.

28.3 PENDENT TYPE SPRINKLER HEAD

- (i) Sprinkler heads shall be quartzite bulb type with bulb, valve assembly, yoke and the deflector. The sprinkler shall be of approved make and type with 15 mm nominal diameter outlets.
- (ii) The bulb shall be made of corrosion free material strong enough to withstand any water pressure likely to occur in the system. The bulb shall be shatter when the temperature of the surrounding air reaches at 57 c.
- (iii.) The nominal bore shall 15 mm diameter and color of liquid shall be Red / Yellow.

28.4 CONCEALED TYPE / WITH ROSSETE SPRINKLER HEAD

- (i) Adjustable concealed sprinklers shall be provided as specified in B.O.Q. in areas where an attractive appearance is primary concern. Concealed Sprinkler heads shall be infinitely adjustable for a full 15 mm so as to compensate for uneven ceiling heights & allow adjustment of the sprinkler cover at any timer. The sprinkler shall be of approved make and type with 15 mm nominal diameter outlets.
- (ii) The bulb shall be made of corrosion free material strong enough to withstand any water pressure likely to occur in the system. The bulb shall be shatter when the temperature of the surrounding air reaches at 68 c.
- (iii) The nominal bore shall 15 mm diameter and colour of liquid shall be Red / Yellow.

28.5 INSATLLATION CONTROL VALVE & REALATED EOUIPMENTS FOR SPRINKLER STSTEM

- (i) The sprinkler installation shall have a set of installation control valve comprising of main stop valve, alarm valve and water motor gong.
- (ii) Installation control valve for sprinkler system shall consist of a 100 mm /150 mm vertical alarm valve with a provision to install water operated turbine alarm. A cast iron Butter fly valves of 100 mm/150 mm (as required) shall be provided on downstream of alarm valve.
- (iii) One water operated turbine alarm with gong shall be provided. The alarm shall operate and sound a gong on the drop of pressure and flow of water in the mains. The drawing of Installation Control valve assembly shall be got approved from the Engineer-in-Charge and installed at approved location. The Alarm shall be provided with suitable test cock.

(iv) Installation Control Valve shall include CI Butter fly valve, Alarm valve, Alarm Motor and Gong, Drain Valve, Test valve, Drain piping and all fittings including 2 Nos. Pressure gauges required to complete the work.

(v) Both alarm valve and turbine alarm shall have TAC/FOC/UL/FM approval.

29.0 FLOW SWITCH

29.1 Flow switch shall have a paddle made up of flexible material of the width to fit within the pipe bore. The terminal box shall be mounted over the paddle / pipe through a connecting socket. The switch shall be potential free in either NO or NC position as required. The switch shall be able to trip and make/ break contact on the operation of a single sprinkler head. The terminal box shall have connections for wiring to the Fire alarm panel. The seat shall be of stainless steel. The flow switch shall have IP: 55 protections.

29.2 The flow switch shall work at a minimum flow rate of 100 LPM. Further, it shall have a retard to compensate for line leakage or intermittent flows.

30.0 BUTTERFLY VALVE

30.1 The Butterfly valve shall be suitable for waterworks and tested to minimum of 16 kg/sq cm Pressure. The valves shall fulfill the requirements of BIS(Indian Standard)BS: 5155 or AWWA C 504, API 609 and MSS-SP-67.

30.2 The body shall be of cast iron to IS: 210 in circular shape and of high strength to take the minimum water pressure of 10 kg/sq cm. The disc shall be heavy-duty cast iron with antiCorrosive epoxy or nickel coating.

30.3 The valve seat shall be high grade elastomer or nitrile rubber. The valve in closed position shall have complete contact between the seat and the disc throughout the perimeter. The elastomer rubber shall have a long life and shall not give away on continuous applied water pressure. The shaft shall be of ENB grade carbon steel.

30.4 The valve shall be fitted between two flanges on either side of pipe flanges. The valve edge rubber shall be projected outside such that they are wedged within the pipe flanges to prevent leakages.

30.5 The valve shall be supplied with manual gear operated opening/ closing system by lever.

20 PUBLIC ADDRESS SYSTEM CUM VOICE EVACUATION SYSTEM

- a. The public address system with microphone and amplifier of adequate capacity with 2 Nos. manual selector switches for selecting between: (a) alarm or public address system (b) Alert tones or Evacuation tones to all the channels.
- b. The amplifier shall work on A.C. or 24 VDC power supply separate from that of the fire alarm panel. Master control for adjustment of volumes shall be provided. The amplifier unit shall have complete protection against over loads, short circuits and wrong battery polarity. The amplifier shall have hum and noise level better than 60db.
- c. Speakers with line impedance transformers (at speaker end) shall be connected to amplifier. This will be integrated with panel and shall be capable of announcing pre-recorded messages.
- d. A Message Unit shall be provided having up to 30 seconds of pre-recorded emergency messaging.
- e. The message contained in the message unit shall be recordable in the field.
- f. The Public address system shall be provided with a separate full battery back-up and suitable chart.

21 CCTV & SURVEILLANCE SYSTEM

The Entire surveillance system is proposed and designed to control and monitors the different buildings. All the buildings shall have IP Based Dome/Bullet Camera indoor type and PTZ Cameras for outdoor surveillance. The different types of cameras shall be provided at locations as mentioned in Design Basis Report.

The indoor Dome Cameras and Bullet Cameras are proposed to be installed at all Entry & Exit Points in Ground floor. And in other Floors these cameras will be fixed in corridors, Lift Lobby & staircase entrances.

All the outdoor cameras shall be in IP 66 Housing and Junction box, power supply unit, media converter etc are proposed in dust proof housing The existing LAN network switches would be used for CCTV connectivity and will be connected to central CCTV server & cameras shall have POE connectivity ports. The power supply to LAN switches will be on UPS. The video recording shall be non embedded based recording server of reputed make with video management software.

Control Room shall be located in the Admin block in the Security /Control Room. The wiring inside the building shall be with CAT 6A cable in PVC conduit and Armoured fiber Optic Cable and Outdoor connectivity shall be under ground in HDPE pipes with suitable Manholes for proper Maintenance of the system. PTZ cameras will be placed on roof top and Street light Poles in external areas. The video management server should have minimum 30 days storing capacity.

21.1 CAMERA SPECIFICATIONS-

1.2MP IR Rugged Outdoor Bullet Camera

2MP IR Rugged Outdoor Bullet Camera	
Image Sensor	1/2.8" Progressive Scan
Resolution range	1920 x 1080p complied with SMPTE 274M-2008
Frame rate	30 FPS
Compression	H.265/H.264 or superior, MJPEG
WDR Measured according to IEC 62676 Part 5	85 db or better
Video Streaming	Quad streaming Stream, fully configurable
Alarm Input and Output	01 I/p, 01 relay O/P
Network Port	RJ45 10/100 Base T
Protocol	TCP, HTTP, HTTPS, SMTP, SNMP, SNTP, RTP, RTSP, SSL, 802.1x, QoS, DNS, ICMP, UPNP, DDNS, IP v4 & v6 Remote Administration: Remote configuration and status using web based tool
Lens	2.8 to 12 mm
Focus	motorised focus and zoom
Illumination / Sensitivity at F1.3, 30IRE	colour 0.052 lux Mono: 0.008 lux IR Distance, 60 mtrs or better, IR from camera OEM only
Audio Compression	Two way Audio : Required Input / Output : 1in and 1out
Protection and housing	IP67 and IK10 Rated camera enclosure from camera OEM
Operating Temperature:	-40° to 60°
Video Analysis(edge based)	Object in field, Line crossing , Enter / leave field, Loitering, Follow route, Idle / removed object, Counting, Occupancy, Crowd density estimation, Condition change, Similarity search - licenses for all these analytics to be considered with camera.
Electronic Shutter Speed (AES)	1/30 s to 1/15000 s
BLC	yes
Defog	yes
Security	Network authentication with EAP/TLS , Embedded Login Firewall, on-board Trusted Platform Module (TPM) and Public Key , Infrastructure (PKI) support.

Other features	ONVIF : Profile S Compliant Signal to Noise Ratio: ≥ 55 db
Local Memory	Minimum 512GB or better (during downtime of the connectivity to server, captured data should be stored locally and the same should automatically upload into the storage after restoring of connectivity)
Certification	CE,FCC, UL, EN

2. Network TDN Low-Light 2MP IR Indoor Dome Camera,

Network TDN Low-Light 2MP IR Indoor Dome Camera,	
Image Sensor	1/2.9" Progressive Scan
Resolution range	1920 x 1080p complied with SMPTE 274M-2008
Frame rate	30 FPS
Compression	H.265/H.264 or superior, MJPEG
WDR Measured according to IEC 62676 Part 5	85dB WDR as per IEC62676-PART5
Video Streaming	Quad streaming Stream, fully configurable
Alarm Input and Output	01 I/p, 01 relay O/P
Network Port	RJ45 10/100 Base T
Protocol	TCP, HTTP, HTTPS, SMTP, SNMP, SNTP, RTP, RTSP, SSL, 802.1x, QoS, DNS, ICMP, UPNP, DDNS, IP v4 & v6 Remote Administration: Remote configuration and status using web based tool
Lens	3 to 10 mm
Focus	motorised focus and zoom
Illumination / Sensitivity at F1.3, 30IRE	0.12 lux (color), 0.02 (mono), 30 mtr IR Range, IR from camera OEM only
Audio Compression	Two way Audio : Required Input / Output : 1in and 1out
Operating Temperature:	-40° to 60°

Video Analysis(edge based)	Object in field, Line crossing , Enter / leave field, Loitering, Follow route, Idle / removed object, Counting, Occupancy, Crowd density estimation, Condition change, Similarity search - licenses for all these analytics to be considered with camera.
Electronic Shutter Speed (AES)	1/30 s to 1/15000 s
BLC	yes
Defog	yes
Security	Network authentication with EAP/TLS , Embedded Login Firewall, on-board Trusted Platform Module (TPM) and Public Key , Infrastructure (PKI) support.
Other feautres	ONVIF : Profile S Compliant Signal to Noice Ratio: ≥ 55 db
Local Memory	Minimum 512GB GB or better (during downtime of the connectivity to server, captured data should be stored locally and the same should automatically upload into the storage after restoring of connectivity)
Certification	CE,FCC, UL, EN

3. Outdoor IP IR PTZ Camera

3	Outdoor IP IR PTZ Camera	
	Image Sensor	1/2.8" Progressive Scan CMOS or better
	Resolution	1920x1080, complied with SMPTE 274M-2008
	Frame rate	60 fps at all resolutions
	Compression	H.265/H.264 or superior, MJPEG
	WDR Measured according to IEC 62676 Part 5	90 db or better
	Video Streaming	Quad streaming Stream, fully configurable
	Alarm Input and Output	01 I/p, 01 relay O/P
	Network Port	RJ45 10/100 Base T

Protocol	TCP, HTTP, HTTPS, SMTP, SNMP, SNTP, RTP, RTSP, SSL, 802.1x, QoS, DNS, ICMP, UPNP, DDNS, IP v4 & v6 Remote Administration: Remote configuration and status using web based tool
Lens	4.5mm to 135mm (F1.6 - F4.4) for 30x Optical zoom, Digital zoom of 16x
Focus	Automatic with manual override
Illumination / Sensitivity at F1.6, 30 IRE	Colour: 0.05 lux Mono: 0.01 lux. IR Distance: 180 Mtrs or better (IR should be Internal / External with 360 degrees coverage) IR from Camera OEM only
Audio Compression	Two way Audio : Required Input / Output : 1in and 1out
Preposition Accuracy	$\pm 0.1^{\circ}$
Protection:	IP66 enclosure
Operating Temperature:	-20° to 60°
Video Analysis(edge based)	Object in field, Line crossing , Enter / leave field, Loitering, Follow route, Idle / removed object, Counting, Occupancy, Crowd density estimation, Condition change, Similarity search - licenses for all these analytics to be considered with camera.
Electronic Shutter Speed (AES)	1/30 s to 1/15000 s
BLC	Supported
Defog	Supported
PAN and Tilt Speed	Pan: 0.1°/s - 240°/s; Tilt: 0.1°/s - 120°/s
Security	Network authentication with EAP/TLS , Embedded Login Firewall, on-board Trusted Platform Module (TPM) and Public Key , Infrastructure (PKI) support.
PAN& Tilt Angle	PAN:360°; Tilt:3° to -90°
Other features	ONVIF : Profile S Compliant Signal to Noise Ratio: ≥ 55 db, Privacy mask supported atleast 24 and 256 presets
Local Memory	Minimum 512GB (during downtime of the connectivity to server, captured data should be stored locally and the same should automatically upload into the storage after restoring of connectivity)
Certification	CE,FCC, UL, EN

4. Pre-licensed with 64 ch. And supports up to 128 channels

4	NVR	
	No. of Channels	Pre-licensed with 64 ch. And supports up to 128 channels
	storage	usable capacity 39TB in Raid 5 configuration
	Processor	Intel Xeon Processor E3-1275 V3
	Bandwidth	475mbps
	Memory	8 MB Cache, 3.5 GHz
	RAM	8 GB, DDR3-1666 ECC
	operating system.	Microsoft Windows Storage Server 2012 R2
	No. of Concurrent connection	128 concurrent iSCSI connections
	Ethernet	Dual Intel i210AT Gigabit LAN Ethernet ports for highest speed iSCSI connectivity
	Remote monitoring	desktop application, browser or SNMP.
	Hard drives	8 Trays: 3.5-inch SATA
	Operating temperature	+10 °C to +35 °C
	form factor	2HU Rak mount.

5. Pre-licensed with 32 ch And supports up to 128 channels

5	NVR	
6	Client work station	
	No. of Channels	Pre-licensed with 32 ch.
	Processor	Intel Core i7 4770 3.4 GHz (up to 3.9 GHz), „Video resolution
	storage	usable capacity 16TB in Raid 5 configuration
	RAM	Minimum 8 GB RAM
	Processor	Intel N3150
	Graphics	2GB with monitor output
	Bandwidth	310mbps
	operating system.	Windows 8.1 /10 (64-bit,Professional or Enterprise)
	Memory	2 MB Cache, 2.08 GHz
	Web Browser	Internet Explorer 11,
	RAM	4 GB, DDR3L-1333 MHz

	Ethernet	1000Base-T
	operating system.	Microsoft Windows Storage Server 2012 R2
		with 32 bit 102-key keyboard and mouse.etc
	No. of Concurrent connection	32 concurrent iSCSI connections
7	Video Viewing monitor	
	Ethernet	2 x Gigabit LAN Ethernet ports for highest speed iSCSI
	Screen Size	connectivity.43"
	Panel BacklightRemote monitoring	desktop applicatiIPS LED on, browser or SNMP.
	ResolutionHard drives	Full HD 1920 x 1080p4 Trays: 3.5-inch SATA
	BrightnessOperating temperature	410+10cd/m °C to +35 °C2
	Aspect Ratioform factor	416:09-bay mini tower
	Viewing angle	178deg / 178 deg.
	Inputs	2 x HDMI, VGA, 1 USB,PC AUDIO in,
	Speaker	Full range 2 x 10W
	Power consumption	74W
	Power requirement	AC 110~240V,50/60Hz
	Sefty regulations	IS 13252:2010
	Certifications	BIS
8	PTZ control Keyboard	
	Communiucation Interface	USB 2.0 Based
	Control	jog shuttle, joystick(4-axis emulation), 38 backlit keys
	Alarm	buzzer
	Power option	USB Powered
	Power consumption	350 mA max
9	VMS server Hardware	
	Processor	Intel Xeon E5-2620v3 (2.4 GHz,6-core, 15MB, 85W)
	RAM	Minimum 8 GB RAM
	Free Disc Space	15GB
	operating system.	Windows Server 2016(64-bit)

	Web Browser	Internet Explorer 11,
	Ethernet	1000Base-T
		with 32 bit 102-key keyboard and mouse.etc

5. 54" Full HD LED Display Monitor.

Sr.NO	Parameter	Specification
1	Display:	
2	Screen Size:	54" (Diagonal)
3	Panel:	DIRECT LED
4	Resolution (HxV):	1920 x 1080 pixels
5	Brightness:	800 cd/m ²
6	Viewing Angle:	178 degrees
7	CONNECTION TERMINAL:	
8	VIDEO IN:	BNC x 1
9	AUDIO IN (L/R):	RCA x 1 set
10	COMPONENT/RGB IN:	1 set (BNC x3)
11	HDMI IN:	HDMI x 1
12	DVI-D IN/Out:	24pin x 1/24pin x 1
13	PC IN:	MINI D-SUB 15PIN x1 (Female)
14	AUDIO IN:	M3 jack x 1
15	Speaker Out:	External Speaker Jack (Side), 20W (10W x 10W)
16	Line Out:	RCA Pin (L/R) x1 (Side)
17	CONTROL TERMINAL:	
18	LAN:	RJ45 x 1 (Web Browser Control)
19	SERIAL Port:	D-SUB 9 pinx 1 (SERIAL IN/Out) RS-232C Compatible
20	IR IN/OUT:	M3 Jack x 1/x 1
21	ELECTRICAL:	
22	Power Requirements:	110-127 V AC, 50Hz/60Hz, 120 V AC 50/60HZ
23		220-240 V AC, 50/60Hz

24	Power Consumption:	Less than 320 W
25	MECHANICAL:	
26	Display (WXHxD): only	47.9" X 27.1" X 4.8"
27		(1216 mm X 687 mm X 122 mm)
28	Temperature:	32°F to 104°F(0 to 40 degrees C)
29	Humidity(Non condensation):	20% to 80% (Non condensation)

6. 40" Full HD LED Display Monitor.

Sr.NO	Parameter	Specification
1	Display:	
2	Screen Size:	40" (Diagonal)
3	Panel:	DIRECT LED
4	Resolution (HxV):	1920 x 1080 pixels
5	Brightness:	350 cd/m ²
6	Viewing Angle:	178 degrees
7	CONNECTION TERMINAL:	
8	VIDEO IN:	BNC x 1
9	AUDIO IN (L/R):	RCA x 1 set
10	COMPONENT/RGB IN:	1 set (BNC x3)
11	HDMI IN:	HDMI x 1
12	DVI-D IN/Out:	24pin x 1/24pin x 1
13	PC IN:	MINI D-SUB 15PIN x1 (Female)
14	AUDIO IN:	M3 jack x 1
15	Speaker Out:	External Speaker Jack (Side), 20W (10W x 10W)
16	Line Out:	RCA Pin (L/R) x1 (Side)
17	CONTROL TERMINAL:	
18	LAN:	RJ45 x 1 (Web Browser Control)
19	SERIAL Port:	D-SUB 9 pinx 1 (SERIAL IN/Out) RS-232C Compatible
20	IR IN/OUT:	M3 Jack x 1/x 1
21	ELECTRICAL:	

22	Power Requirements:	110-127 V AC, 50Hz/60Hz, 120 V AC 50/60HZ
23		220-240 V AC, 50/60Hz
24	Power Consumption:	Less than 250 W
25	MECHANICAL:	
26	Temperature:	32°F to 104°F(0 to 40 degrees C)
27	Humidity(Non condensation):	20% to 80% (Non condensation)

TECHNICAL SPECIFICATIONS	Compliance (YES/NO)	Remarks
Video Management System Software (VMS) The video management system (VMS) specified shall be client/server based IP video security solution that provides seamless management of digital video, audio and data across an IP network. The video management system is designed to work with own CCTV cameras and Onvif profile compliant 3rd party products as part of a total video security management system to provide full virtual matrix switching and control capability. The video management system consists of the following software modules: management server, recording services, configuration client and operator clients. Video from other sites may be viewed from single or numerous workstations simultaneously at any time. Cameras, recorders, and viewing stations may be placed anywhere in the IP network. The software components of the video management system can be deployed together on a single PC for small system applications or on separate PCs and servers to meet large systems requirements. The management server and the Recording Manager shall run as services on The VMS shall be Windows based/Linux. The VMS shall support iPad and iPhone devices as well as html5 based web clients as mobile video clients. The VMS shall be designed to use a facility's existing IT infrastructure and require no special cabling.		

The VMS shall allow a operator client to control and view live and playback streams of cameras allocated to the RECORDING MANAGER, VSG and DVRs from a remote site (across WAN). The VMS shall automatically detect when management servers are located in different time zones by means of the local time settings in the servers. The operator shall see from the server list in device tree, which management servers' time zone is currently displayed in the operator's User Interface. The operator shall be given the possibility to set his own operation time to a dedicated time zone of one of the management servers. Selected time zone shall be applied to live view, playback, the alarm list and the logbook.		
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The VMS shall provide up to 10 different and independent programmable recording schedules. The schedules may be programmed to provide different record frames rates for day, night, and weekend periods as well as special days. Advanced task schedules may also be programmed that could specify allowed logon times for user groups, when events may trigger alarms, and when data backups should occur. The VMS shall allow the establishment of user groups and Enterprise user groups that have access rights to specific cameras, priority for pan/tilt/zoom control, rights for exporting video, and access rights to system event log files. Access to live, playback, audio, PTZ control, preset control, and auxiliary commands shall be programmable on an individual camera basis. The VMS shall support Dual Authorization logon. It shall function as follows: Dual Authorization user groups may be created. Logon pairs, consisting of any two normal user groups, may be assigned to each Dual Authorization user group. A separate set of privileges and priorities can be assigned for each Dual Authorization user group. For each user group assigned as part of a logon pair, it shall be configurable whether the group can - Log on either individually or as part of the logon pair - Or log on only as part of the logon pair. The logbook shall log the log on procedure to identify a single user or a dual authorization log on. Subsequent user actions shall be logged as the actions of the first user. The VMS Should have provision for 40 Maps Maximum,200 Task Schedules(limited in configuration) and Compound events 1000, up to 10 devices per compound event. The VMS workstations may be connected to up to 4 monitors where each monitor may be configured to display live streaming video, playback video, site maps, or alarms. The VMS shall support Lightweight Directory Access Protocol (LDAP) that allows integration with enterprise user management systems such as Microsoft Active Directory. The VMS shall export video and audio data optionally in ASF format to a CD/DVD drive, a network drive, or a USB drive. The exported data in ASF format may be played back using standard software such as Windows Media Player.		
The VMS shall be able to simultaneously configure multiple encoders or decoders, even of different types. When devices of different types are being configured, only the parameters available in all devices are available for configuration. The VMS shall support continuous operation during management server down- times as live viewing, playback of recording and export of video data. The operator client shall indicate its connection status to the management server.		

The VMS shall be designed in such a way that configuration changes to any part of the system shall not interrupt operational tasks, until the operator decides to update refresh the workstation configuration. Video Management System Components The management server software shall provide management, monitoring, and control of the entire system. The management server software should typically be installed on a serverclass computer, but may be installed, with all the other video management software modules on one workstation. The management server shall also maintain data stream management, alarm management, priority management, central logbook, central configuration and user management. Operator client software shall provide the user interface for system monitoring and operation. The operator client maintains live monitoring, storage retrieval, and alarm handling. Alarm Management Capability The video management system shall provide the capability to allow alarms to be scheduledependent. The video management system shall allow alarms to be individually allocated to specific user groups for processing. The video management system shall support replication of events such that a single physical event causes multiple system events. These multiple events shall be independently configurable to allow independent handling of the alarms by multiple operator groups, or to be handled differently according to different schedules. The video management system shall be programmable to selectively, per alarm and per user group, automatically pop-up the alarm video. The video management system shall display alarm video in rows of Alarm Image Panes, with one row per alarm, and with up to 5 Image Panes per row. The video management system's Alarm Image Panes shall be configurable to display live video, playback video, text documents, site maps, HTML files, or web sites (URLs). Per alarm one playback video and one site map can be configured. The video management system shall provide an alarm reaction time of maximum 2 seconds when sufficient network bandwidth is available. The video management system shall distribute alarm notifications, via entries in the alarm list of the operator user interface, to all members of the user groups to which the alarm is assigned. The alarms shall appear in all said users' alarm lists.		
The video management system shall support the association of workflows with alarms. Workflows shall consist of action plans and comment boxes. An action plan shall display a text document, HTML page, or web site that typically contains instructions for handling the alarm. Comments entered in the comment boxes shall be logged in the system logbook. The video management system shall allow alarms to be configured to send PTZ cameras to prepositions or to execute camera Aux commands on occurrence.		

The video management system shall be configurable to put any IP-connected camera into alarm recording mode on alarm occurrence. The video management system shall be configurable to send an e-mail or SMS message in response to an alarm. The VMS shall be capable of displaying video on analog monitors connected to video decoders in response to alarms. The VMS alarm response shall take advantage of the row and column arrangement of analog monitor groups by associating a row of analog monitors with each active alarm. Each alarm may display video on multiple monitors, limited by the number of columns in the analog monitor group. As new alarms are received, alarm rows shall stack in priority order on the analog monitors. The VMS shall support for alarms to display video on multiple analog monitor groups, with configurable assignment of individual assignment of alarms to monitor groups. Logbook The system shall protocol every event and alarm in an SQL database. The alarm entry shall contain the camera titles that have been recorded due to this alarm. The logbook shall be able to store at least 500,000 entries per hour. If the capacity of the logbook is filled up the oldest entries will be deleted to create space. The user shall be able to search the logbook for events and alarms. The user shall be able to export the search results into a comma separated value list (CSV). Pre-Programmed Camera sequences The video management system shall support pre-programmed camera sequences. These sequences will allow cameras to be automatically displayed on the computer image panes and/or analog monitors connected to decoders. The sequences shall support simultaneous display on multiple image panes or monitors. The sequences shall also support camera prepositions for each PTZ camera on each sequence step. The system shall be configurable such that operators can select these sequences from the logical tree or a site map. Pre-programmed camera sequences can be displayed in operator client and on Analog Monitor Groups. Configuration Changes Configuration changes made in the VMS configuration client shall modify a working copy of the configuration, and shall not affect the active operating configuration.		
It shall be possible to activate the working copy through a user action in the configuration client, at which point the working becomes the new active operating configuration. It shall be possible to set a date and time in the future at which the working copy becomes active.		

It shall be possible to view a list of all configuration activations that have been applied to the system. It shall be possible to select any of the activated configurations, and have the system "roll back" to an earlier configuration. Recording Manager System Software The RECORDING MANAGER shall be an optional package of the installation program of the VMS. The video management system shall be capable of managing multiple RECORDING Managers. The RECORDING MANAGER shall be configured from the VMS configuration client. It shall be possible to assign encoders and IP cameras to it. The recording parameters shall be configured in the recording tables of the VMS configuration program. These settings will be replicated into the devices from the management server. The RECORDING MANAGER shall manage exclusively the encoders, IP- Cameras, Streaming Gateways, and the supported iSCSI storage systems. It shall offer system wide recording monitoring and management of iSCSI storage, video servers and cameras. The RECORDING MANAGER shall support the encoders and cameras to directly stream the data to the iSCSI storage. The RECORDING MANAGER shall not be involved in the processing of the data. The RECORDING MANAGER shall manage all disk arrays in the system as a single virtual common pool of storage. It shall dynamically assign portions of that pool to the encoders and IPCameras. The transfer rate of the data from the encoder or IP-Camera is limited by network speed and the iSCSI data throughput rate. The RECORDING MANAGER shall provide redundancy for storage provisioning and failover design for central recording management service. The RECORDING MANAGER shall be able to restore a lost recording database from data on the iSCSI storages. The RECORDING MANAGER shall provide flexible retrieval of recordings. It shall be able to determine on which iSCSI disk array data from each camera or encoder has been stored. It shall be possible to secure the access to the RECORDING MANAGER software with a password. This shall be done in the configuration client. The RECORDING MANAGER software shall provide status monitoring information as a web interface. The following information shall be provided: Status on recording and storage		
The video management system shall allow configuring if playback of recordings is streamed through the RECORDING MANAGER or is streamed directly from the iSCSI storage.		

The video management system shall support to retrieve the playback information, i.e. from which iSCSI storages to retrieve the video, audio and meta-data, either from the Video Recording Manager or directly from the IP encoder or camera. Playback information directly from the when one ,multiple and any Storage disk arrays fails or inaccessible perhaps due to network outage .It automatically redirects to remaining Storages disk arrays and recording continues. when one ,multiple and any Storage disk arrays fails or inaccessible perhaps due to network outage .It automatically redirects to remaining Storages disk arrays and recording continues. Operator Client If an operator client loses its connection to the management server, the user shall nevertheless be able to continue working with the connected devices. The video management system shall provide an administrator-configured Logical Tree. The logical tree shall be freely configurable with any tree structure, with nodes consisting of folders or maps, and leaves consisting of devices (cameras, inputs, and relays), sequences, documents, URLs, or command scripts. Each user group shall only see items in the logical tree for which the administrator has granted access. The user shall be able to search the logical tree for item names. The VMS shall provide a user-dependent bookmark Tree. The bookmark tree shall allow saving a time period or a single point in time for later investigation and export. Bookmarks shall be available both for live mode and for playback mode. The VMS shall provide a user-dependent Favorites Tree. The favorites tree shall allow maps, folders, and devices and complete views (image pane patterns with camera assignments) to be configured by each user in a user-defined structure. The user's favorites tree shall be available irrespective of the computer with which he logs on to the system. The video management system shall provide an Image Window that displays a collection of Image Panes. The layout shall be optimized for standard and widescreen monitors. With standard monitors the number of image panes per image window shall be variable between 1 (a single full-window video) and 25, arranged in a 5x5 grid. A slider shall be available allowing the grid size to be changed from 1x1, 2x2, 3x3, 4x4, and 5x5. With widescreen monitors the number of image panes per image windows shall be variable between 1 and 30, arranged in grids of 1x1, 3x2, 4x3, 5x4, and 6x5. The VMS shall allow image panes to be enlarged or decreased in size within the grid. E.g., in a 5x5 grid, a single image pane can be enlarged to use 4 of the grid elements, creating a larger image within the grid. Any pattern can be created within the grid structure. An image pane can be resized by clicking and dragging on any corner, dragging the corner to the desired size. The video management system shall support the audio channels of the encoders and IP cameras. It shall be possible to assign audio sources to cameras. In the operator client it shall be possible to turn on/off the replay of the audio per camera.		
The video management system shall support two different audio modes, single source audio and multi source audio. In single source audio mode only the audio source assigned to the camera in the selected image pane is replayed. In multi source audio mode all audio sources of the cameras displayed in the client application are replayed.		

The video management system shall support site maps with hot-spot icons for devices (cameras, relays, and inputs), command script initiation, camera sequence initiation, and links to other site maps. The site maps shall be capable of being zoomed. The hot-spot icons shall be configurable to optionally display the device name or link title.		
The operator client shall display live streams from encoders. For IP-cameras and encoders it shall be possible to configure per workstation and individually per camera which encoding stream (Stream 1 or Stream 2) of these devices shall be displayed.		
The video management system shall support automatic sequencing. It shall be possible for users to multiple-select cameras (control-click or shift click), and drag the multiple-selection to an image pane or a graphic representing an analog monitor connected to a decoder. All of the cameras in the selection shall then sequence in the image pane or monitor at a user-selectable rate. It shall also be possible to drag a folder to an image pane or analog monitor. In this case, all of the cameras contained within the folder shall sequence.		
The video management system shall support digital zoom of any image pane. A dedicated graphical control shall be provided in the user interface for this purpose. In addition, the mouse wheel shall control digital zoom when the mouse cursor is hovering over a selected image pane.		
The video management system shall provide an Instant Playback function that displays recorded images on one or multiple image panes. Recorded images from a single camera may also be played back on multiple panes. Instant playback supports pause, play forward, play reverse, single step forward, single step reverse, fast-forward, and fast-reverse.		
The video management system shall support simultaneous time-synchronous playback of up to 16 cameras. Playback shall support single-step forward and backwards; play normal speed forward and backwards; play high-speed forward and backwards; and play slow-speed forward and backwards.		
The video management system shall support search of recorded video with at least the following criteria: object size, object color, direction, and speed as well as detecting objects entering or leaving designated areas. This Intelligent Video Analysis (IVA) based postrecording search will work for cameras recorded by RECORDING MANAGER and Local Storage.		
The video management system shall optionally display the information of the video analytics such as cells with detected motion, object masks, and trajectories in live and playback.		
The video management system shall support searching based on any combination of time/daterage, event type(s), alarm priority, alarm state, and device(s). It shall be possible to save and recall search parameters.		
The video management system shall graphically display device states on its icons in the logical tree structure and on sitemaps. For cameras, the states shown shall include: loss of the analog video signal, network connection loss, video recording, video signal too noisy, video signal too bright, video signal too dark, video de- adjusted, and video includes associated audio. For relays and contact inputs, the open or close state shall be indicated.		
The video management system shall support switching of cameras to analog monitors connected to decoders. The cameras shall be selectable via drag and drop from the logical tree or from the sitemaps.		

The video management system shall support an indication for the operator client regarding the connection state to the management server. This shall include connected, disconnected, and configuration out-of-sync between management server and operator client. Audio Intercom Functionality The video management system shall support bidirectional audio intercom functionality. Audio intercom streams audio data from an operator client Workstation to the audio output of the encoders. The audio intercom function shall be activated by a button in the operator client Workstation. When the button is pressed the operator shall be able to speak into a microphone on the client computer. The audio shall be transmitted to the audio source which is assigned to the currently selected camera. CCTV Keyboard Control The system shall allow system control via the keyboards Keyboard connections shall be possible to both Decoders and to operator client Workstations.		
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26 IPABX SYSTEM

IP Based Central IPABX of initially capacity of 2000 Telephones & expandable up to 5000 telephones shall be located at a central location. All the Telephone in the Complex will be IP Based and will use the existing LAN Network for the communication within the complex as well as for outside the complex. All Rack Panels of Individual buildings shall be connected to Central EPABX system through Optical Fiber Cable to be laid underground in HDPE Pipe of suitable size. Manholes with covers shall be provided in the underground HDPE pipe at suitable lengths for easy pulling & maintenance of cables. Type of IP Phones shall be provided as detail given below as per directions of Engineer In Charge:-

1. Type -4 IP Phone – President, Director, Dean, Principal, Auditorium Conference Room, . etc.
2. Type -3 IP Phone – Office In Director’s Residence, HODs, Chairman, Conference Room etc.
3. Type -2 IP Phone – Guest House, Security room, Server Room, Fire Control Room, etc.
4. Type-1 IP Phone – All Residential Blocks, Hostels, Dining Block, Fire Station, ESS, etc. The following are the specifications for the proposed IPABX System:

27 LAN NETWORKING & WIFI SYSTEM SPECIFICATIONS

27.1 GENERAL

RJ 45 data outlets are proposed to be provided for Computers, networking, telephones, Wi-Fi, etc. as per requirement in rooms and other areas at various floors in all the blocks / buildings .

The Data Outlet points shall be connected to Rack Panel/Computer hub with 4 pair Cat6A wiring in recessed conduit / Raceways.

The maximum Length of the Cat 6A cable from end user point to the Hub or Edge switches shall not be more than 90Mtr. Beyond this length Fiber Optic Cable shall be used. UPS Power supply to these computers will also run through conduits/ floor trunking.

The Rack Panel/computer hub at various floors will be connected to Main rack of the building/ block with fiber optic cable through conduit or raceways on surface/in recess. The Server is proposed to be located in server rooms in Admin Building . The main server shall be connected to Distribution switch through Optical fiber cable of 40 Gbps and Distribution switch shall be connected to Edge switches of each building/ block with fiber cable of 10 Gbps link in underground HDPE pipe of suitable size in outside connectivity or in cable raceway/conduit inside the buildings. Brick masonry manholes with covers shall be provided at suitable lengths to facilitate easy wire pulling & Maintenance.

The LAN SYSTEM comprises of Passive components and Active Components. The Technical specifications of both the components are given below:

27.2 Scope Of Work

Complete installation shall be done in accordance with installation practices for a well structured cabling system, using components from a single vendor to ensure consistent and assured performance. The structured cabling distribution network shall serve as a vehicle for transport of data, video and voice telephony signals over a common network throughout the network.

Devices and services that shall run on the passive network shall include, but not limited to, the following:

- a.) Wired LAN access
- b.) Wireless LAN access
- c.) Voice communications servers and IP/SIP end-points
- d.) IP-based CCTV/Surveillance Cameras

Cabling installation for data and voice communications shall originate at networking racks and terminate at IOs terminated at wall.

Installation, termination and identification of wiring between networking distribution rack(s) and main rack (s), shall be considered part of the system provider's work.

All cables and terminations shall be tested, identified, labelled and documented at all locations.

The system provider carrying out the SITC shall make the system entirely operational for its intended use, by addition of components specific to its make/model even if not specifically mentioned in the BoQ.

Wherever there is reference to multiple standards and/codes, the ones most recent and most stringent shall apply. It shall be the responsibility of the system integrator and OEM manufacturer to ensure that:

- The Passive Components of structured cabling distribution network will be free from manufacturing defects in material and workmanship under normal and proper use.
- All Passive Components in the structured cabling distribution network shall meet or exceed the relevant component specification of the EIA/TIA 568-B and EIA/TIA 568-C.2 series and ISO/IEC 11801: 2002 standards; or later version as applicable at the time of installation.
- The structured cabling distribution network compliant channels will meet or exceed the Guaranteed Channel Performance as per relevant standards in the structured cabling distribution network Performance Specifications in effect at the time of installation.

The site will be duly **certified by OEM for a period of 25 years from the date of issuance of the registration** certificate or installation, whichever is earlier, for which they shall submit detailed performance test reports for every component installed.

The specifications for items in this section, applies to the following:

- a.) multi mode fiber optic cable (OM4/OM3) and associated components such as distribution shelves, LIUs, pigtails and patch cords
- b.) Category 6A cables and associated components such as distribution shelves, Patch panels, patch chords, Information Outlets, faceplates etc.
- c.) Networking Racks – for termination of networking cables

Installation Considerations

Fiber optic cable can be installed inside buildings using the same methods as coax or twisted pair; however, the following guidelines should be observed:

Do not deform the cable sheath, specifically when using cable fasteners or ties to secure the cable to a support or hardware

Do not exceed the cable's maximum pulling tension.

Do not pull fiber optic cables with copper cables

Do not pull fiber optic cables over existing cables. The friction could be excessive and cause cable damage. The cables may also become entangled, resulting in damage to the fiber optic cable.

Do not exceed minimum (installed and long-term) bend radius. (The minimum bend radius varies with the cable diameter. Consult the appropriate Cable specification.) Do not pull the cable around sharp corners, such as support brackets.

Provide additional crush / mechanical protection in high-risk environments.

Secure the cable to larger permanent cables or available supports when possible. Do not attach the cable to cables that may be removed later or to steam or water lines

Caution: Installation tension exerted on fiber cables may cause the buffered fibers to assume a sinusoidal “wave” appearance. This effect is caused by installing the cable incorrectly. OEMs generally recommend that all tight- buffered cable pulls employ a grip on the pull end of the cable coupled to the aramid strength member, not the cable jacket.

Pulling grips should be used regardless of the length or duration of the pull. If the pulling end of the cable has not been connectorised, then a knot can be tied in the pull-end of the cable before attempting the pull. If cables are pulled without coupling to the strength member, the cable jacket will stretch. When the jacket relaxes, it may bunch up the fibers underneath the jacket, which may result in degraded fiber performance.

Conduit/Inner duct

Use the following guidelines when installing cable in a rigid conduit:

Ensure the conduit system does not exceed minimum bend radius.

Do not pull the cable through pull boxes or junction boxes unless the cable's bend radius can be maintained through the use of conduit or inner duct

Avoid the use of elbows if possible and use an elbow only if the cable's long- term bend radius can be maintained. Never pull cable "through" an elbow. Pull the cable out of the elbow and “back-feed” it into the conduit exiting the elbow for a second pull.

Inner duct is semi-rigid plastic tubing commonly used in fiber optic installations to subdivide the duct and to provide for future cable pulls. Proper size and installation of the inner duct is critical for ease of cable installation.

If additional cables, specifically larger, bulkier cables, are to be installed in the same conduit, install the fiber optic cable inside an inner duct for mechanical protection Eliminate sharp edges.

OEM must provide FLUKE test/Pentascan report with 25 years warranty certification.

27.3 GENERAL

RJ 45 data outlets are proposed to be provided for Computers, networking, telephones, Wi-Fi, etc. as per requirement in rooms and other areas at various floors in all the blocks / buildings .

The Data Outlet points shall be connected to Rack Panel/Computer hub with 4 pair Cat6/6A wiring in recessed conduit / Raceways.

The maximum Length of the Cat 6/6A cable from end user point to the Hub or Edge switches shall not be more than 90Mtr. Beyond this length Fiber Optic Cable shall be used. UPS Power supply to these computers will also run through conduits/ floor trunking.

The Rack Panel/computer hub at various floors will be connected to Main rack of the building/ block with fiber optic cable through conduit or raceways on surface/in recess. The Server is proposed to be located in server rooms in Hospital Block & Medical College . The main server shall be connected to Distribution switch through Optical fiber cable of 40 Gbps and Distribution switch shall be connected to Edge switches of each building/ block with fiber cable of 10 Gbps link in underground HDPE pipe of suitable size in outside connectivity or in cable raceway/conduit inside the buildings. Brick masonry manholes with covers shall be provided at suitable lengths to facilitate easy wire pulling & Maintenance.

The LAN SYSTEM comprises of Passive components and Active Components. The Technical specifications of both the components are given below:

27.4 PASSIVE (STRUCTURED CABLING)

1. Criteria for the Passive Components OEM

- a) OEM should be ISO 9001 ISO 14000 Certified.
- b) All passive network components quoted by the bidder should be from a single OEM only (Copper & Fiber).
- c) The OEM of Passive Components should have supplied to any of the large educational Institutions/Universities to execute a similar project of minimum 5000 Nodes or at least two project of 4000 Nodes each. (Reference details must be provided).
- d) The OEM of passive components should provide UL/ETL certification for the full Cat 6A copper channel link (UL/ETL 4 connector test report) with at least 3 dB NEXT headroom and CAT 6 at least 6dB NEXT head room for entire frequency range specified in ISO/IEC 11801 also the individual copper components and fiber cable should be UL/ETL listed.
- e) Cat 6A performance even when termination is within 15 meters thus ensuring eliminating short resonance for 4-connector channel (UL/ETL Report for 4 Connector need to be submitted).
- f) All the fiber cable should be Bend insensitive Multi mode and single mode as well as Single Mode fiber cable should be Bend insensitive as per G.657.A1 with zero water peak construction, OS2.
- g) The Cat 6A & Cat 6 Cable should be complied with IEC 60332-3-22 features for environment safety.
- h) Cat 6A & Cat 6 Cable should have Publicly available online Repository to check the Genuity and to download factory test reports.
- i) The Cat 6A & Cat 6 Cable Should be ETL Verified and all passive components should be RoHS complied. Declaration of ROHS compliant should clearly be mentioned on data sheets of each Passive Components.
- j) The nominal Outside Cat 6A U/UTP Cable diameter should not be more than 0.29 inches /7.24 mm.
- k) The supplied Passive product must have capability to Upgrade to Intelligent Cabling system without any downtime and they must have their own solution of Intelligence including software. Reference with product data sheet must be provided.
- l) OEM should have technology development program partnership with minimum of 1 Active networking (Switches and Routers) OEM's globally. (Reference required).
- m) Material should have been manufactured in OEM's own manufacturing facilities, not outsourced.
- n) The OEM of Passive Components to be quoted by the bidder should be present in India from at least past 10 years.

27.4.1 Specification for CAT 6A LSZH U/UTP Cable

Standard Compliance
Channel Performance
The Category 6A/ Class EA UTP SCS shall comply with the following standards

a) ISO/IEC 11801:2010
b) EN 50173 Part 1 through Part 5:2010 and 2011
c) ANSI/TIA-568-C
d) IEC 60603-7-4
e IEEE 802.3 applications as outlined in section 2
The Category 6A/ Class EA UTP system should support the following IEEE Ethernet applications
a) 802.3e - 1BASE5
b) 802.3i - 10BASE-T
c) 802.3u - 100BASE-TX, 100BASE-T4
d) 802.3y - 100BASE-T2
e) 802.3z - 1000BASE-X
f) 802.3ab - 1000BASE-T
g) 802.af - Power Over Ethernet (15.4W)
h) 802.3at - Power Over Ethernet Enhancements (25.5W)
i) 802.3az - Energy Efficient Ethernet
Additionally the Category 6A/ Class EA UTP SCS shall be capable of supporting the following Fibre Channel Applications Standards, per Technical Committee 11 of INCITS:
a) 1GFC-BASE-T
b) 2GFC-BASE-T
c) 4GFC-BASE-T
It is critical that guaranteed worst-case values are provided to ensure the SCS can support 1G transmission without risk. "Average value" or "Typical Value" is not acceptable as they do not account for lower performance channels. The proposed Category 6A UTP SCS, when configured as a worst-case 100 metre channel shall provide performance headroom over limits specified by Cat6A
NEXT - Minimum 3 db above the standards;
Should support a minimum of 4 connector Channel with a minimum 3 db guaranteed NEXT
Insertion Loss - 3%
Return Loss - 1.0 db
The SCS must consist of individual components provided by the same manufacturer. "Mix and Match" products are not allowed as there is no guarantee that the overall channel will meet Category 6A Channel requirements if constructed with components from different vendors.

The Category 6A cable and Category 6A channel components shall be manufactured by a single manufacturer. The manufacturer shall warrant the Category 6A channel cable, components, and applications for a period of 20 – 25 years.
The 20 – 25 year warranty shall be a transferable warranty and has component replacement policy in case of manufacturing defect.
The SCS must be tested by an ISP 17025 accredited 3rd Party test facility to EIA/TIA 568C, ISO/IEC 11801 Amendment 1 and for the channel testing must be provided as part of the bid response.
The Category 6A system should support channels that are shorter than 15 meters for 2, 3, 4 connector channels without any minimum length requirements.
Horizontal Cable
The Cable should meet ANSI/TIA 568C.2 Category 6A Specifications
Cables should have TRACKING Number to check the genuineness/ details of the test reports
The cable should consist of Eight 23 AWG copper conductors. Copper Clad Aluminium or any other combinations are not allowed
The Cable should be round in shape
The weight of the cable box of 1000 Feet should not be less than 34.7 lb
The nominal Jacket thickness should be 0.05 inches
The nominal Outside diameter should not be more than 0.285 inches
The cable should support the installation temperature: 0 to 60 0 C
It should support Operating temperature of -20 to 60 0 C
The cable shall be available in Low-Smoke, Zero Halogen (LSZH) compatibility and The LSZH version must comply with the following Fire Safety standards:
1) ISO/IEC 60332-3-22: Vertical Flame Spread
2) ISO/IEC 60754-2: Acidity
3) ISO/IEC 61034-2: Smoke Density
The cable and cordage shall be "True UTP" components that do not include internal or external shields, screened components or drain wires. No Special Grounding requirements.
The horizontal cable shall have a unique print string on the cable jacket. This unique identifier shall also be used for on-line reference to a full set of factory tests that were performed on a sample from the same mater reel. The test parameters shall include NEXT, PSNEXT, Return Loss, Attenuation, ELFEXT and PSELFEXT. The on-line reference must be available on the SCS vendor public website, such that it can be accessed at any time

27.4.2 Specification for Category 6A U/UTP Information Outlets

Standard Compliance

The 8-pin modular (RJ-45) jacks shall comply with IEC 60603-7-4
The Category 6A outlets shall be backward compatible with Category 6 and 5E cords and cables.
The Category 6A outlets shall be of a universal design supporting T568 A & B wiring.
The information outlet shall have a Current Rating of 1.5 A at 20°C
The information outlet must support 90 degree cable termination. As some mounting hardware does not allow for cable entry directly from the rear, this capability is necessary
3rd Party Verification test certificates shall be provided to show compliance to ISO/IEC 11801 Amendment 2 testing for Cat 6A components.
The 8-pin modular (RJ-45) jacks shall comply with IEC 60603-7-4.
The information outlet will have insertion life of 750 cycles minimum.

27.4.3 Specification for CAT 6A LSZH U/UTP RJ45 Patch Cords

Standard Compliance
SCS must support patch cord lengths of 1 meter minimum and equipment cords of 2 meter minimum and The Patch cords shall be available in Stranded and solid core construction
Cords shall be equipped with 8-pin modular plugs on each end.
All cords shall be round, and consist of copper conductors, tightly twisted into individual pairs.
Nominal cordage diameter shall not exceed 7.24 mm.
Plugs shall be designed with an anti-snag latch to facilitate easy removal during move, add and change processes.
The LSZH version must comply with the following Fire Safety standards:
ISO/IEC 60332-3-22: Vertical Flame Spread
ISO/IEC 60754-2: Acidity
ISO/IEC 61034-2: Smoke Density
3rd Party verification of the Fire Safety/ Environmental tests listed above must be provided as part of the bid response.
The cordage shall be UTP components that do not include internal or external shields, screened components or drain wires.
The patch cords will have insertion life of 750 cycles minimum.

27.4.4 Specification for CAT 6A LSZH U/UTP Cable

Sr No.	Details	Specification	Compliance	Cross Reference
1	Standards	The Category 6A/ Class EA UTP SCS shall comply with the following standards a) ISO/IEC 11801:2010 b) EN 50173 Part 1 through Part 5:2010 and 2011 c) ANSI/TIA-568-C d) IEC 60603-7-4		
	Applications	The Category 6A/ Class EA UTP system should support the following IEEE Ethernet applications – a) 802.3ab - 1000BASE-T b) 802.3af - Power Over Ethernet (15.4W) c) 802.3at - Power Over Ethernet Enhancements (25.5W) d) 802.3az - Energy Efficient Ethernet		
	Insertion Loss	3%		
	Near End Cross-Talk	Minimum 3 db above the standards; Should support a minimum of 4 connector Channel with a minimum 3 db guaranteed NEXT		
	Return Loss	1.0 dB		
	The SCS must be tested by 3rd Party test facility to ANSI/TIA 568C, ISO/IEC 11801 Amendment 1 and for the channel testing must be provided as part of the bid response.			
	The Category 6A system should support channels that are shorter than 15 meters for 4 connector channel without any minimum length requirements.			
	CAT 6A LSZH U/UTP Cable			
1	Type	Unshielded Twisted Pair, Category 6A, TIA / EIA 568 C.2		
2	Conductors	Eight 23 AWG Solid bare copper conductors Copper Clad Aluminum or any other combinations are not allowed.		
3	Insulation	Polyethylene or Polyolefin		
4	Jacket	LSZH jacket must complying to: Fire rating IEC60332-3-22 Acid gas IEC 60754-2 Smoke density IEC 61034-2		
5	Pair Separator	Bi-sector type or better		
6	Performance reference	Factory test reports shall be available publicly in OEM website against each cable box.		
7	Packing	Box of 305 meters		
8	Cable Outer Diameter	Not more than 7.28 mm		
9	Bend Radius	4 * Cable Diameter		
10	Impedance	100 Ohms + / - 15 ohms		

11	Dielectric Strength, minimum	1500 Vac; 2500 Vdc		
12	Mutual Capacitance	6.0 NF MAX /100 Mtr.		
13	DC Resistance	7.61 ohms/100 m		
14	DC resistance unbalance	4% max.		
15	ROHS Compliant	ROHS/ELV Compliant		

27.4.5 Specification for Category 6A U/UTP Information Outlets

Sr No.	Details	Specification	Compliance	Cross Reference
1	Type	Electrical performance guaranteed to meet or exceed latest TIA/EIA 568 Category 6A and ISO/IEC Category 6A/Class E specifications		
		The 8-pin modular (RJ-45) jacks shall comply with IEC 60603-7-4		
		The Category 6A outlets shall be backward compatible with Category 6 and 5E cords and cables.		
		The Category 6A outlets shall be of a universal design supporting T568 A & B wiring.		
2	Modular Jack	750 mating cycles		
3	Wire terminal	200 termination cycles		
4	Contact Resistance, maximum:	100 mOhm		
5	Current Rating: (critical for support of IP Video Phones and POE+ devices)	1.5 A @ 20 °C		
6	Dielectric Withstand Voltage, RMS, conductive surface :	1500 Vac @ 60 Hz		
7	Insulation Resistance, minimum	500 MOhm		
8	Flammability Rating:	UL 94 V-0		
9	Safety Standard:	cUL / UL		
10	Conductor Gauge, solid:	22 – 26 AWG		
11	Compliance	ROHS Compliant		

27.4.6 Specification for CAT 6A LSZH U/UTP RJ45 Patch Cords

Sr No.	Details	Specification	Compliance	Cross Reference
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1	Type	Unshielded Twisted Pair, Category 6A, TIA / EIA 568-C.2 & ISO/IEC 11801.		
		Cords shall be equipped with 8-pin modular plugs on each end.		
		SCS must support patch cord lengths of 1 meter minimum and equipment cords of 2 meter.		
2	Plug Protection	Provide anti-snag feature that improves and provides maximum protection from snagging during moves and rearrangements. Patch cords with rubber type hooded boots are not acceptable.		
3	Jacket	The LSZH version must comply with the following Fire Safety standards: ISO/IEC 60332-3-22: Vertical Flame Spread ISO/IEC 60754-2: Acidity ISO/IEC 61034-2: Smoke Density		
4	Safety Standard :	cETL ETL		
5	Plug Retention Force, minimum:	133 N 30 lbf		
6	Operating Temperature Range:	-10 °C to +60 °C		
7	Insertion Life (Minimum)	750 Cycles		
8	Compliance	ROHS 2011 / 65 / EU compliant		
9	The cordage shall be UTP components that do not include internal or external shields, screened components or drain wires.			

27.4.7 Specification for CAT 6A Jack Panel

Sr No.	Details	Specification	Compliance	Cross Reference
1	Type	1U (24 port) or 2U (48 port) panel capable of supporting 24 or 48 unshielded modular 8-pin connectors compliant with IEC 606037-4 while meeting the Channel Performance as specified in Amendment 1 to ISO/IEC 11801:2002		
2	Port arrangement	The ganged adapter style patch panel will utilize increments of six RJ-45 style jacks in a common moulded component.		
		The ganged adapters shall have RJ45 jack in the front and Insulation Displacement Connector (IDC) at the rear of the module.		
3	Cable Management	Termination managers must be provided with the panel. These termination managers provide proper pair positioning, control, and strain relief features to the rear termination area of the panel. Panel shall be supplied with rear cable bundle managers to support cable weight.		

4	Management feature	Panel shall be upgradable to intelligence with simple retro fitting of sensors without network disruption. Single patch cord should not be removed during this upgrade.		
5	Modular Jack	750 mating cycles		
6	Current Rating	1.5 A @ 20 °C		
7	Dielectric Withstand Voltage, RMS	1500 Vac @ 60 Hz		
8	Insulation Resistance, minimum	500 MOhm		
9	Operating Temperature	10°C to 60°C		
10	Approvals	UL cUL		
11	Termination Pattern	T568 A and B;		
12	ROHS Compliant	ROHS/ELV Compliant		

27.4.8 Face Plates:

Sr No.	Details	Specification	Compliance	Cross Reference
1	Type	1-port or 2-port flush-mounted, square faceplates as appropriate should be supplied.		
2	Material	High-impact, flame retardant, UL-rated 94 V-0, thermoplastic		
3	Flammability	UL 94 V-0		
4	Compatibility	Shall be compatible with CAT 5e/CAT 6/CAT 6A information outlets.		

27.4.9 144 CORE SINGLE MODE OUTSIDE PLANT FIBER CABLE

Standard Compliance	Compliance	Cross Reference
Shall be Single mode (OS2), Single Jacket, Single Armour, Gel-free, Stranded loose tube, Bend Insensitive		
Qualification Standards: ANSI/ICEA S-87-640, EN 187105 and Telcordia GR-20		
Standards Compliance: ITU-T G.652.D, ITU-T G.657.A1 (bend insensitive) and TIA492CAAB (OS2)		
Regulatory Compliance: RoHS 2011/65/EU compliant		
No. of Fibers: 144		
No. of Tubes: 12		
Construction Materials		
a) Outer Jacket Material: MDPE / PE		
b) Armour Type: Corrugated Steel		
c) Number of fibers per tube: 12		
d) Jacket Color: Black		
e) Jacket UV Resistance: UV Stabilized		

f) Subunit Type: Gel-free		
g) No. of Rip cords: 2		
h) Water Swellable Tape: Yes		
Dimensions		
a) Cable Diameter: 17.2 mm		
b) Cable Weight: 230 – 240 kg/km		
Physical Specifications		
a) Minimum Bend Radius, loaded: 25.8 cm		
b) Minimum Bend Radius, unloaded: 17.2 cm		
c) Tensile Load, long term, Max: 800 N		
d) Tensile Load, short term, Max: 2700 N		
e) Vertical rise limit, : 340 mtr		
Environmental Specifications		
a) Environmental Space: Aerial, lashed or Buried		
b) Installation Temperature: -30 degree Celsius to +70 degree Celsius		
c) Operating Temperature: -40 degree Celsius to +70 degree Celsius		
d) Storage Temperature: -40 degree Celsius to +75 degree Celsius		
Mechanical Test Specifications		
a) Compression: 44 N/mm (as per IEC 60794-1 E3)		
b) Flex: 35 Cycles (as per IEC 60794-1 E6)		
c) Impact: 6.62 N-m (as per IEC 60794-1 E4)		
d) Water Penetration Test Method: 24 h (as per IEC 60794-1 F5)		
Optical Specifications		
Attenuation, Maximum		
a) 0.22 dB/km @ 1550 nm		
b) 0.27 dB/km @ 1490 nm		
c) 0.31 dB/km @ 1385 nm		
d) 0.34 dB/km @ 1310 nm		
Index of Refraction		
a) 1.467 @ 1310 nm		
b) 1.468 @ 1385 nm		
c) 1.468 @ 1550 nm		
Cabled Cut off Wavelength, maximum: 1260 nm		

Standard Compliance	Compliance (Yes/No)	Remarks
Shall be Singlemode (OS2), Single Jacket, metallicarmor, Gel-free, Stranded Loose tube Fiber.		
Qualification Standards: ANSI/ICEA S-87-640, EN 187105, Telcordia GR-20, Compliance: ITU-T G.652.D, ITU-T G.657.A1 (bend insensitive) and TIA492CAAB (OS2)		
Regulatory Compliance: RoHS 2011/65/EU compliant		
Construction Materials a) Jacket Material: MDPE / PE b) Strength member: Di-electric strength member c) Number of fibers per tube: 12 d) Jacket Color: Black e) Jacket UV Resistance: UV Stabilized f) Subunit Type: 2.5mm Gel-free buffer tubes g) No. of Rip cords:2 h) Water Swellable Tape: Yes i) Armoring: Corrugated Steel tape		
Dimensions a) Cable Diameter: Not more than 12.00 mm b) Cable Weight: 110 – 120kg/km		
Physical Specifications a) Minimum Bend Radius, loaded: 17.5 cm b) Minimum Bend Radius, unloaded: 11.7 cm c) Tensile Load, long term, Max: 800 N or better d) Tensile Load, short term, Max: 2700 N or better e) Vertical Rise: upto700mtr		
Environmental Specifications a) Operating Temperature: -40 degree Celsius to +70 degree Celsius		

Mechanical Test Specifications a) Compression: 44N/mm (as per IEC 60794-1 E3) b) Flex: 35 Cycles (as per IEC 60794-1 E6) c) Impact: 4.1N-m (as per IEC 60794-1 E4) d) Water Penetration Test Method: 24 h (as per IEC 60794-1 F5)		
Optical Specifications Attenuation, Maximum a) 0.22 dB/km @ 1550 nm b) 0.27 dB/km @ 1490 nm		
c) 0.31 dB/km @ 1385 nm d) 0.34 dB/km @ 1310 nm		
Factory Test report: Shall be available publicly against unique tracking ID on cable, at OEM website.		

27.4.11 48/24/12 Sliding Fiber Shelf – For Single Mode & Multimode Fiber

Specifications	Compliance (Yes/No)	Remarks
Shall accommodate 4 coupler plates or 4 pigtail cassettes for a total of 48 fiber terminations in 1U.		
The width shall be 19 inches and height of 1U (1.75 inches), with a maximum of 18 inch depth.		
The shelf/LIU shall be sliding, with front patch cord management and label window.		
The Fiber shelf must be intelligent ready and must support field upgrade to intelligent fiber panels without removal of existing patch cords and without disruption of network services.		
Shall have splice trays to splice minimum 32 fibers.		

27.4.12 144 Fiber Sliding Shelf & splice cassette – For Single Mode Fiber

Specifications	Compliance (Yes/No)	Remarks
Shall accommodate upto 6 coupler plates or 6 pigtail cassettes for a total of 144 fiber terminations.		
The width shall be 19 inches and height of 2U (3.5 inches), with a depth of 18 inch.		
The shelf/LIU shall be sliding, with front patch cord management and label holder.		

Material housing shall be of powder coated steel		
Flammability shall be UL 94 V-0 rated.		
Shelf shall support rear entry as well as side entry of field cables.		
Cable entry points shall be sealed with cable grommets.		
Shall be supplied with 24xLC SM splicing cassettes, fully loaded with pigtails and adapters		
Splice cassettes shall have transparent hinged top cover		
Splice cassettes shall have integrated splice sleeve holders for all 24 fibers.		
Pigtails type shall be G.652.D and G.567.A1, OS2. All pigtails must be color codes as per TIA standard. Shall be UL listed. Max IL shall be less than 0.25dB Min Return loss to be: 55.0 dB.		

27.4.13 12 Fiber LC Single mode Fiber Pigtail Cassette Assembly with Pigtails

Specifications	Compliance (Yes/No)	Remarks
Factory fitted fiber cassette assembly loaded with 6 duplex LC SM adapters and 12xLC SM pigtails		
Pigtail 900 micron tight buffered SM as per G.652.D and G.657.A1, OS2, 1.5 mtr		
Pigtails on each port shall be color coded as per TIA for identification		
LC ports should be supplied with external dust covers.		
Insertion loss: 0.30dB or less		
Return Loss: 55 dB or higher		
Fiber Cassette shall be intelligent ready and should be upgradable to intelligent system without any patch cord removal.		
Safety: UL listed		

27.4.14 LC – LC Single mode LSZH Patch Cords

Standard Compliance	Compliance (Yes/No)	Remarks
Shall be Singlemode (OS2), LC to LC, Fiber patch cords.		
Jacket: Low Smoke Zero Halogen (LSZH) compliant to IEC 603323, IEC 60754-2, IEC 61034-2, IEEE 383, UL 1666, UL 1685		

Standards Compliance: G.652.D, G.657.A1 and OS2 Regulatory Compliance: RoHS 2011/65/EU Environment: Riser rated / LSZH Cable Qualification Standards: ANSI/ICEA S-83-596 and Telcordia GR-409 Optical Components Standard: ANSI/TIA-568-C.3		
General Specifications Connector Color: Blue Connector Interface: LC / SC Operating Temperature: -10 degree Celsius to +60 degree Celsius		
Connector Optical Performance Insertion Loss, Typical: 0.20 dB Return Loss, minimum: 55.0 dB Insertion Loss Change, mating: 0.30 dB Insertion Loss Change, temperature: 0.30 dB		

27.4.15 6/12 CORES INDOOR/OUTDOOR MM OM4 FIBER CABLE

Standard Compliance	Compliance	Cross reference
Shall be Multimode (OM4), Low Smoke Zero Halogen Indoor/Outdoor Metallic armored Cable, 6/12 fiber. Stranded loose tube.		
Qualification Standards: ANSI/ICEA S-104-696 and Telcordia GR-20		
Standards Compliance: TIA-492AAAD (OM4), Bend-Insensitive Multimode Fiber		
Flame Test Compliance: IEC 60332-3, IEC 60754-2, IEC 61034-2, IEEE 383, UL 1666 and UL 1685		
Regulatory Compliance: RoHS 2011/65/EU compliant		
No. of Fibers: 6/12		
Construction Materials		
a) Jacket Material: LSZH		
b) Jacket Color: Black		
c) Subunit Type: Gel-free		
d) Armoring: Corrugated Steel tape		
e) Core/Cladding/buffer diameter: 50 / 125 / 900 μm		
Dimensions		
a) Cable Diameter: 13 mm		
b) Cable Weight: 170 – 180 Kg/Km		
Physical Specifications		

a) Minimum Bend Radius, loaded: 19.5 cm		
b) Minimum Bend Radius, unloaded: 13 cm		
c) Tensile Load, long term, Max: 800 N		
d) Tensile Load, short term, Max: 2700 N		
e) Vertical Rise, Max: 450 m		
Environmental Specifications		
a) Environmental Space: Low Smoke Zero Halogen (LSZH) Lashed and Buried		
b) Installation Temperature: -30 degree Celsius to +60 degree Celsius		
c) Operating Temperature: -40 degree Celsius to +70 degree Celsius		
d) Storage Temperature: -40 degree Celsius to +70 degree Celsius		
Mechanical Test Specifications		
a) Compression: 44 N/mm (as per IEC 60794-1 E3)		
b) Flex: 35 Cycles (as per IEC 60794-1 E6)		
c) Impact: 3.0 N-m (as per IEC 60794-1 E4)		
Optical Specifications		
Attenuation, Maximum		
a) 1.00 dB/km @ 1300 nm		
b) 3.00 dB/km @ 850 nm		

27.4.16 Fiber Optic LC style OM3/OM4 Cassette Assembly with Pigtails

Specifications	Compliance (Yes/No)	Remarks
Factory fitted fiber cassette assembly loaded with 6 duplex LC OM3/OM4 adapters and 12xLC OM3/OM4 pigtails		
Pigtail 900 micron tight buffered OM3/OM4, 1.5 mtr		
Pigtails on each port shall be color coded as per TIA for identification		
LC ports should be supplied with external dust covers.		
Insertion loss: 0.27dB or less		
Return Loss: 20 dB or higher		
Fiber Cassette shall be intelligent ready and should be upgradable to intelligent system without any patch cord removal.		
Safety: UL listed		

27.4.17 Fiber Optic Patch Cables

Specifications	Compliance (Yes/No)	Remarks
LC/UPC – LC/UPC Multimode OM3/OM4 duplex Patch Cord, bend insensitive, 10 feet		
1.6 mm duplex cord		
Operating Temperature: -10 to 60 °C		
Cable retention strength: 11.24 lb @ 0°		
Optical Components Standard ANSI/TIA-568-C.3		
LSZH as per IEC 60332-3		

27.4.18 Fiber Optic Joint Closure (IP 68 Rated)

Standard Compliance	Compliance	Cross Reference
Shall be a butt type enclosure with a dome and base		
The Cable entries should be through the cable ports located in the base.		
The dome and base should be sealed using a clamp with O-ring system. The cable entry ports should be sealed mechanically and using reusable sealing mechanisms instead of heat shrink.		
General Specifications		
a) IP68 Rated		
b) No. of Splice trays: upto 6 nos.		
c) Splice Tray Capacity: upto 144 Fibers		
d) No. of cable entry ports: 4 round ports and 1 oval port.		
The block should be opened and closed repeatedly without removing or replacing the Sealant.		
The closure should have the capability to accommodate loop cables (uncut loose tube cables)		
The cables should be secured to the closure using hose clamps and a cable attachment device.		
The closure should have a basket for storing loose tubes.		
The dome should have pressure valve.		

27.4.19 Single Side 1U Cable Manager

Standard Compliance
Shall be a single sided 1U, 19 Inch Cable Manager
Safety Standard: UL
Regulatory Compliance: RoHS 2011/65/EU
Material Type: Aluminium and Steel

General Specifications
a) Color: Black
b) Rack Units: 1
c) Finish: Powder coated, smooth
Shall have fingers to maintain the patch cord bend radius
The front shall have a hinged door for easy access

27.4.20 42/15/12 U Closed Rack (2 Type of 42 U 800 X 800 & 800 X 1000 & 600 x 600 15/12 U)

Standard Compliance
2 Post 19" 42U Closed rack , with copper & fiber cable management accessories & 19" Closed Wall Mount Rack (15U/12U)
2 Nos. of 1U power distribution box, with 10 x IEC - C13 sockets & with 32Amp MCB- terminating on a IP56 power sockets
1 No. Horizontal PDU with 5/15Amp Universal Sockets with 32Amp MCB
Front mounting PVC Cable managers/ guide
Integral Cable management ducts/ arms (on either side) with covers
Cantilever Tray x 1 (19" / 1U/ 255mm - D)
Cable retention bobbins X 5 (both sides) + Window Molding x 6
Cable Hangers (set of 3) x 2 (Right & left side one set each)
Bar, Earthing 42U
Mounting Hardware (Pack of 10) x 5
IP65 Rated Outdoor if used in outdoor environment (Weather resistant)

27.5 Testing & Commissioning of Passive Components:

All the passive components shall have their Testing reports from the OEM with Batch No. and all standard parameters. There shall be the proper ferruling and Numbering on the Cat 6A/fiber cables. There Shall be proper dressing of the cables and equipment management inside the racks.

The Cat 6A cable installation measurements shall be done through penta scanning with standard parameters and shall have the OEM certification for the installation of all the components.

The optical fiber cable installation shall be checked by the OTDR machine and the reports shall meet all the parameters of the technical data sheet of the Cable and shall have the OEM certification for the installation.

After installation & OEM certification Commissioning of the passive components shall be completed.

27.6 TECHNICAL SPECIFICATIONS FOR ACTIVE COMPONENTS

27.6.1 Next Generation Firewall

S.No	Specifications
1	Industry Certifications and Evaluations
	Firewall solution offered from OEM must be rated as leaders in the latest Magic Quadrant for Enterprise Firewall and NGIPS published by Gartner
2	Hardware Architecture
	The appliance based security platform should be capable of providing NGFW capability (firewall, application visibility, and IPS functionality) and Advance malware, URL filtering in a single appliance
	The appliance should support at least 8 * 10 Gigabit Ethernet SFP+ ports from Day one and should be scalable to additional 8 x 10G or 4 x 40G ports. Required 10G DAC/Transceiver should be loaded from Day-1.
	The appliance hardware should be a multicore CPU architecture with a hardened 64 bit operating system to support higher memory
	Proposed Firewall should not be proprietary ASIC based in nature & should be open architecture based on multi-core cpu's to protect & scale against dynamic latest security threats.
3	Performance & Scalability
	Should support atleast 12Gbps of FW performance throughput (includes FW & Application Visibility)
	Should support at least 10 Gbps of NGFW performance throughput (includes IPS + Application Visibility)
	L7 Firewall and NGFW throughput difference should not be more than 70%
	NG Firewall should support at least 9 million concurrent session
	NG Firewall should support at least 68000 connections per second with Application visibility
4	High-Availability Features
	Firewall should support Active/Standby failover
	Firewall should support etherchannel functionality for the failover control & data interfaces for provide additional level of redundancy
	Firewall should support redundant interfaces to provide interface level redundancy before device failover
	Firewall should support 802.3ad Etherchannel functionality to increase the bandwidth for a segment.
	Firewall should support VXLAN
5	NGFW Firewall Features
	Solution must be capable of passively gathering information about network hosts and their activities, such as operating system, services, open ports, client applications, and vulnerabilities, to assist with multiple activities, such as intrusion event data correlation, elimination of false positives, and policy compliance.
	Firewall should support creating access-rules with IPv4 & IPv6 objects simultaneously

S.No	Specifications
	Firewall should support operating in routed & transparent mode
	Should support Static, RIP, OSPF, OSPFv3 and BGP
	Firewall should support manual NAT and Auto-NAT, static nat, dynamic nat, dynamic pat
	Firewall should support Nat66 (IPv6-to-IPv6), Nat 64 (IPv6-to-IPv4) & Nat46 (IPv4-to-IPv6) functionality
	Firewall should support Multicast protocols like IGMP, PIM, etc
	Should support security policies based on security group names in source or destination fields or both
	Should support capability to limit bandwidth on basis of apps / groups, Networks / Geo, Ports, etc
	Should be capable of dynamically tuning IDS/IPS sensors (e.g., selecting rules, configuring policies, updating policies, etc.) with minimal human intervention.
	Should be capable of automatically providing the appropriate inspections and protections for traffic sent over non-standard communications ports.
	Proposed solution should have capability block BOT/CnC connection (anti-bot) from day one
	Should be able to link Active Directory and/or LDAP usernames to IP addresses related to suspected security events.
	Should be capable of detecting and blocking IPv6 attacks.
	Solution should support full-featured NBA capability to detect threats emerging from inside the network. This includes the ability to establish “normal” traffic baselines through flow analysis techniques (e.g., NetFlow) and the ability to detect deviations from normal baselines. If the functionality not support on the same appliance, vendor can quote separate device for the same.
	The solution must provide IP reputation feed that comprised of several regularly updated collections of poor reputation of IP addresses determined by the proposed security vendor
	Solution must support IP reputation intelligence feeds from third party and custom lists of IP addresses including a global blacklist.
	Should must support URL and DNS threat intelligence feeds to protect against threats
	Should support safe search and YouTube EDU enforcement
	Solution must be capable of passively gathering details unique to mobile devices traffic to identify a wide variety of mobile operating systems, mobile applications and associated mobile device hardware.
	Should support more than 4000 application layer and risk-based controls that can invoke tailored intrusion prevention system (IPS) threat detection policies to optimize security effectiveness.
	Must be capable of providing network-based detection of malware by checking the disposition of known files in the cloud using the SHA-256 file-hash as they transit the network and capability to do dynamic analysis on-premise (if required in future) on purpose built-appliance. License not require from day one.
S.No	Specifications

	NGFW OEM must have its own threat intelligence analysis center and should use the global footprint of security deployments for more comprehensive network protection.
	The detection engine should support capability of detecting and preventing a wide variety of threats (e.g., malware, network probes/reconnaissance, VoIP attacks, buffer overflows, P2P attacks, etc.).
	Should be able to identify attacks based on Geo-location and define policy to block on the basis of Geo-location
	The detection engine should support the capability of detecting variants of known threats, as well as new threats
	The detection engine must incorporate multiple approaches for detecting threats, including at a minimum exploit-based signatures, vulnerability-based rules, protocol anomaly detection, and behavioral anomaly detection techniques. Identify and explain each type of detection mechanism supported.
	Should support Open based Application ID for access to community resources and ability to easily customize security to address new and specific threats and applications quickly
	Proposed Firewall should have URL filtering with 80+ categories and more than 280 million URL database
6	Management
	The management platform must be accessible via a web-based interface and ideally with no need for additional client software
	The management platform must provide a highly customizable dashboard.
	The management platform must be capable of integrating third party vulnerability information into threat policy adjustment routines and automated tuning workflows
	The management platform must be capable of role-based administration, enabling different sets of views and configuration capabilities for different administrators subsequent to their authentication.
	Should support REST API for monitoring and config programmability
	The management platform must provide multiple report output types or formats, such as PDF, HTML, and CSV.
	The management platform must support multiple mechanisms for issuing alerts (e.g., SNMP, email, SYSLOG).
	The management platform must provide robust reporting capabilities, including a selection of predefined reports and the ability for complete customization and generation of new reports.
	The management platform must risk reports like advanced malware, attacks and network
	The management platform must include an integration mechanism, preferably in the form of open APIs and/or standard interfaces, to enable events and log data to be shared with external network and security management applications, such as Security Information and Event Managers (SIEMs), and log management tools.

27.6.2 Core Switch

S.No	Specifications
1	The Switch should support the following ports : 32-port 40G Gigabit Ethernet or 16-port 100G Gigabit Ethernet
2	The Switch should support upto 960G SSD.
3	The Switch should have Redundant Power Supplies
4	The Switch should have Multicore x86 CPU Architecture
5	The Core Switch should have 16GB of DRAM and 16GB of Flash
6	The Switch should have a USB 2.0 slot to load system images and set configurations
7	The Switch should support AES-256 with MAC-Sec 256-bit encryption algorithm available on all models
8	The Switch should support a modern operating system with support for model-driven programmability including NETCONF, YANG, on-box Python
9	The switch should support Software serviceability where patches can be hot plugged into the existing switch OS without needing a full upgrade and reboot
10	The Switch should have at least 1.6Tbps non-blocking switching bandwidth and 1Bpps of forwarding rate.
11	The Switch should support up to 82000 MAC Addresses, 212k IPv4 Routes, 16k QoS ACLs, 4k VLANs IDs and SVIs
12	The switch should support routing protocols such OSPF, BGPv4, IS-ISv4.
13	The switch should support Detection of Unidirectional Links (in case of fiber cut) and to disable them to avoid problems such as spanning-tree loops.
14	The Switch should support Control Plan Policing (CoPP)
15	The switch should support flexible & multiple authentication mechanism, including 802.1X, MAC authentication bypass, and web authentication using a single, consistent configuration.
16	The switch should support TACACS and RADIUS authentication to facilitate centralized control of the switch and restricts unauthorized users from altering the configuration.
17	The Switch should support Rate limiting based on source and destination IP address, source and destination MAC address, Layer 4 TCP/UDP information, or any combination of these fields, using QoS ACLs (IP ACLs or MAC ACLs), class maps, and policy maps.
18	The Switch should support Eight egress queues per port for wired traffic and four egress queues for wireless to enable differentiated management of different traffic types across the stack for wired traffic.

27.6.3 Distribution Switch

S.No	Specifications
S.No	Specifications
1	The Switch should support the following ports : 24-port 1/10/25G Gigabit Ethernet

2	The Switch should have 4 x 40/100G uplink ports.
3	The Switch should have Redundant Power Supplies
4	The Switch should have Multicore x86 CPU Architecture
5	The Switch should have 16GB of DRAM and 16GB of Flash
6	The Switch should have a USB 2.0 slot to load system images and set configurations
7	The Switch should support AES-256 with MAC-Sec 256-bit encryption algorithm available on all models
8	The Switch should support a modern operating system with support for model-driven programmability including NETCONF, YANG, on-box Python
9	The switch should support Software serviceability where patches can be hot plugged into the existing switch OS without needing a full upgrade and reboot
10	The Switch should have at least 1.6Tbps non-blocking switching bandwidth
11	The Switch should support up to 82000 MAC Addresses, 212k IPv4 Routes, 16k QoS ACLs, 4k VLANs IDs and SVIs
12	The switch should support routing protocols such OSPF, BGPv4, IS-ISv4.
13	The switch should support Detection of Unidirectional Links (in case of fiber cut) and to disable them to avoid problems such as spanning-tree loops.
14	The Switch should support Control Plan Policing (CoPP)
15	The switch should support flexible & multiple authentication mechanism, including 802.1X, MAC authentication bypass, and web authentication using a single, consistent configuration.
16	The switch should support TACACS and RADIUS authentication to facilitate centralized control of the switch and restricts unauthorized users from altering the configuration.
17	The Switch should support Rate limiting based on source and destination IP address, source and destination MAC address, Layer 4 TCP/UDP information, or any combination of these fields, using QoS ACLs (IP ACLs or MAC ACLs), class maps, and policy maps.
18	The Switch should support Eight egress queues per port for wired traffic and four egress queues for wireless to enable differentiated management of different traffic types across the stack for wired traffic.

27.6.4 48 Port PoE+ Layer 2 Switch

S.No	Specifications
1.	19" Rack Mountable Switch with support for integrated redundant power supply and operating temperature of -5° to 45°C.
2.	Should have 48 1Gig BaseT RJ45 PoE+ ports plus 4x10G SFP+ ports from day one with 740Watts PoE Budget. Switch should have capability of maintaining the PoE power during a switch reload
3.	Should support for minimum 176 Gbps of switching bandwidth & minimum 130 Mpps forwarding rate
4.	Should support dedicated stacking port separate from uplink ports with 80 Gbps of stacking bandwidth to put minimum 8 switches into a single stack group.
5.	Should support following layer 3 features Static routes, RIPv1 & v2, RIPng, PBR, OSPFv3, PIM-SM, PIM-SSM, VRRP, IS-IS, IP-SLA, VRF, SGT, VXLAN and MACsec-128

6.	Should support IEEE 802.3ad Link Aggregation Control Protocol (LACP) and PAgP.
7.	Should support 16000 MAC Address, 8000 ARP entries, 1500 IPv6 routes, 1500 ACL, 1000 Multicast routes and 1024 VLAN ID's.
8.	It shall have IEEE 802.1s Multiple Spanning Tree Protocol and Per-VLAN Rapid Spanning Tree technology.
9.	Should have functionality by which switch automatically attempts to reactivate a link that is disabled because of a network error.
10.	Should have 6MB packet buffer.
11.	Should support netflow / sflow or equivalent to support SDN technology. Switch should support NETCONF, RESTCONF, YANG, PnP Agent, PnP for automation.
12.	Switch should have feature to protect access ports using port security, 802.1x authentication, TACACS/TACACS+, Radius and storm control
13.	Should support telnet, Enterprise Class CLI, web GUI interface and SNMP v1/v2c/v3.
14.	Should have 2GB DRAM and 4GB Flash memory.
15.	Direct OEM warranty for 5 years with TAC Support

27.6.5 48 Port Layer 2 Switch

S.No	Specifications
1.	19" Rack Mountable Switch with support for integrated redundant power supply and operating temperature of -5° to 45°C.
2.	Should have 48 1Gig BaseT RJ45 ports plus 4x10G SFP+ ports from day one
3.	Should support for minimum 176 Gbps of switching bandwidth & minimum 130 Mpps forwarding rate
4.	Should support dedicated stacking port separate from uplink ports with 80 Gbps of stacking bandwidth to put minimum 8 switches into a single stack group.
5.	Should support following layer 3 features Static routes, RIPv1 & v2, RIPv6, PBR, OSPFv3, PIM-SM, PIM-SSM, VRRP, IS-IS, IP-SLA, VRF, SGT, VXLAN and MACsec-128
6.	Should support IEEE 802.3ad Link Aggregation Control Protocol (LACP) and PAgP.
7.	Should support 16000 MAC Address, 8000 ARP entries, 1500 IPv6 routes, 1500 ACL, 1000 Multicast routes and 1024 VLAN ID's.
8.	It shall have IEEE 802.1s Multiple Spanning Tree Protocol and Per-VLAN Rapid Spanning Tree technology.
9.	Should have functionality by which switch automatically attempts to reactivate a link that is disabled because of a network error.
10.	Should have 6MB packet buffer.

11.	Should support netflow / sflow or equivalent to support SDN technology. Switch should support NETCONF, RESTCONF, YANG, PnP Agent, PnP for automation.
12.	Switch should have feature to protect access ports using port security, 802.1x authentication, TACACS/TACACS+, Radius and storm control
13.	Should support telnet, Enterprise Class CLI, web GUI interface and SNMP v1/v2c/v3.
14.	Should have 2GB DRAM and 4GB Flash memory.
15.	Direct OEM warranty for 5 years with TAC Support

27.6.6 24 Port PoE+ Layer 2 Access Switch

S.No	Specifications
1.	19" Rack Mountable Switch with support for integrated redundant power supply and operating temperature of -5° to 45°C.
2.	Should have 24 1Gig BaseT RJ45 ports plus 4x10G SFP+ ports from day one with PoE budget of 370Watts. Switch should have capability of maintaining the PoE power during a switch reload.
3.	Should support for minimum 128 Gbps of switching bandwidth & minimum 95 Mpps forwarding rate
4.	Should support dedicated stacking port separate from uplink ports with 80 Gbps of stacking bandwidth to put minimum 8 switches into a single stack group.
5.	Should support following layer 3 features Static routes, RIPv1 & v2, RIPv6, PBR, OSPFv3, PIM-SM, PIM-SSM, VRRP, IS-IS, IP-SLA, VRF, SGT, VXLAN and MACsec-128
6.	Should support IEEE 802.3ad Link Aggregation Control Protocol (LACP) and PAgP.
7.	Should support 16000 MAC Address, 8000 ARP entries, 1500 IPv6 routes, 1500 ACL, 1000 Multicast routes and 1024 VLAN ID's.
8.	It shall have IEEE 802.1s Multiple Spanning Tree Protocol and Per-VLAN Rapid Spanning Tree technology.
9.	Should have functionality by which switch automatically attempts to reactivate a link that is disabled because of a network error.
10.	Should have 6MB packet buffer.
11.	Should support netflow / sflow or equivalent to support SDN technology. Switch should support NETCONF, RESTCONF, YANG, PnP Agent, PnP for automation.
12.	Switch should have feature to protect access ports using port security, 802.1x authentication, TACACS/TACACS+, Radius and storm control
13.	Should support telnet, Enterprise Class CLI, web GUI interface and SNMP v1/v2c/v3.
14.	Should have 2GB DRAM and 4GB Flash memory.
15.	Direct OEM warranty for 5 years with TAC Support

27.6.7 Authentication, Authorization, and Accounting (AAA)

S.No	Specifications
1	The Solution should provide a highly powerful and flexible attribute-based access control solution that combines authentication, authorization, and accounting (AAA); profiling; and guest management services on a single platform.
2	It should allow enterprises to authenticate and authorize users and endpoints via wired, wireless, and VPN with consistent policy throughout the campus
3	Provides complete guest lifecycle management by empowering sponsors to on-board guests
4	Solution should be scalable enough to support 250,000 endpoints in the network. Currently needed license for 7000 endpoints for AAA and BYOD, Profiling from day one.
5	Delivers customizable self service portals as well as the ability to host custom web pages to ease device and guest on-boarding, automate endpoint secure access and service provisioning, and enhance the overall end-user experience inside business-defined workflows
6	Offers comprehensive visibility of the network by automatically discovering, classifying, and controlling endpoints connected to the network to enable the appropriate services per endpoint
7	Should capability of addresses vulnerabilities on user machines through periodic evaluation and remediation to help proactively mitigate network threats such as viruses, worms, and spyware
8	Should capability to enforces security policies by blocking, isolating, and repairing noncompliant machines in a quarantine area without requiring administrator attention
9	Offers a built-in monitoring, reporting, and troubleshooting console to assist helpdesk operators and administrators streamline operations
10	Should capability to allows you to get finer granularity while identifying devices on your network with Active Endpoint Scanning
11	Augments network-based profiling by targeting specific endpoints (based on policy) for specific attribute device scans, resulting in higher accuracy and comprehensive visibility of what is on your network
12	Manages endpoint access to the network with the Endpoint Protection Service, which enables administrators to specify an endpoint and select an action - for example, move to a new VLAN, return to the original VLAN, or isolate the endpoint from the network entirely - all in a simple interface
13	Utilizes standard RADIUS protocol for authentication, authorization, and accounting (AAA).
14	Supports a wide range of authentication protocols, including PAP, MS-CHAP, Extensible Authentication Protocol (EAP)-MD5, Protected EAP (PEAP), EAP-Flexible Authentication via Secure Tunneling (FAST), and EAP-Transport Layer Security (TLS).

S.No	Specifications
15	Offers a rules-based, attribute-driven policy model for creating flexible and business-relevant access control policies. Provides the ability to create fine-grained policies by pulling attributes from predefined dictionaries that include information about user and endpoint identity, posture validation, authentication protocols, profiling identity, or other external attribute sources. Attributes can also be created dynamically and saved for later use. Posture validation service not required from day one.
16	Provides a wide range of access control mechanisms, including downloadable access control lists (dACLs), VLAN assignments, URL redirect, and Security Group Access (SGA) tagging.

17	Should have predefined device templates for a wide range of endpoints, such as IP phones, printers, IP cameras, smartphones, and tablets.
18	It should allow Administrators to create their own device templates. These templates can be used to automatically detect, classify, and associate administrative-defined identities when endpoints connect to the network. Administrators can also associate endpoint-specific authorization policies based on device type.
19	The Solution should have capability to collect endpoint attribute data via passive network telemetry, querying the actual endpoints, or alternatively from the infrastructure via device sensors on switches.
20	Solution should allow end users to interact with a self-service portal for device on-boarding, providing a registration vehicle for all types of devices as well as automatic supplicant provisioning and certificate enrollment for standard PC and mobile computing platforms.
21	Should have full guest lifecycle management, whereby guest users can access the network for a limited time, either through administrator sponsorship or by self-signing via a guest portal. Allows administrators to customize portals and policies based on specific needs of the enterprise.
22	Should support and capability to verifies endpoint posture assessment for PCs connecting to the network. Works via either a persistent client-based agent or a temporal web agent to validate that an endpoint is conforming to a company's posture policies. Provides the ability to create powerful policies that include but are not limited to checks for the latest OS patches, antivirus and antispymware software packages with current definition file variables (version, date, etc.), registries (key, value, etc), and applications. Solution should support auto-remediation of PC clients as well as periodic reassessment to make sure the endpoint is not in violation of company policies. This functionality not require from day one.
23	Should support and capability to allows administrators to quickly take corrective action (Quarantine, Un-Quarantine, or Shutdown) on risk-compromised endpoints within the network. This helps to reduce risk and increase security in the network. This functionality not require from day one.
24	Enables administrators to centrally configure and manage profiler, posture, guest, authentication, and authorization services in a single web-based GUI console, greatly simplifying administration by providing consistency in managing all these services. Posturing services not needed from day one.
25	Includes a built-in web console for monitoring, reporting, and troubleshooting to assist help-desk and network operators in quickly identifying and resolving issues. Offers comprehensive historical and real-time reporting for all services, logging of all activities, and real-time dashboard metrics of all users and endpoints connecting to the network.
26	Should support consistent policy in centralized and distributed deployments that allows services to be delivered where they are needed
27	Solution should have capability to determine whether users are accessing the network on an authorized, policy-compliant device.
28	Solution should have capability to establish user identity, location, and access history, which can be used for compliance and reporting.

S.No	Specifications
29	Solution should have capability to assign services based on the assigned user role, group, and associated policy (job role, location, device type, and so on).
30	Solution should have capability to grant authenticated users with access to specific segments of the network, or specific applications and services, or both, based on authentication results.

31	Solution should have capability which allows users to add a device on a portal, where the device goes through a registration process for network access. Should allow users to mark as lost any device that you have registered in the network, and blacklist the device on the network, which prevents others from unauthorized network access when using the blacklisted device. Should have capability to reinstate a blacklisted device to its previous status in Device Portal, and regain network access without having to register the device again in the Devices Portal. Should also support removing any device in the enterprise network temporarily, then register the device for network access again later.
32	The portal used for Device registration should be customizable, allowing to customize portal theme by changing text, banners, background color, and images
33	Should provide a Registered Endpoints Report which provides information about a list of endpoints that are registered through the device registration portal by a specific user for a selected period of time. The report should provide the following details •Logged in Date and Time •Portal User (who registered the device) •MAC Address •Identity Group •Endpoint Policy •Static Assignment •Static Group Assignment •Endpoint Policy ID •NMAP Subnet Scan ID •Device Registration Status
34	Solution should classify a client machine, and should support client provisioning resource policies to ensure that the client machine is set up with an appropriate agent version, up-to-date compliance modules for antivirus and antispysware vendor support, and correct agent customization packages and profiles, if necessary
35	Solution should support receiving updated endpoint profiling policies and the updated OUI database as a feed from the OEM database.
36	Should support native supplicant profiles to enable users to bring their own devices into network. When the user logs in, based on the profile that you associate with that user's authorization requirements, solution should provide the necessary supplicant provisioning wizard needed to set up the user's personal device to access the network. This should be supported over Microsoft windows, Apple Mac and iOS and Android devices.
37	When endpoints are discovered on the network, they can be profiled dynamically based on the configured endpoint profiling policies, and assigned to the matching endpoint identity groups depending on their profiles.
38	Should support using a simple filter that you can use to filter endpoints. The quick filter filters endpoints based on field descriptions, such as the endpoint profile, MAC address, and the static status that is assigned to endpoints when they are created in the Endpoints page.
39	Should support an advanced filter that you can preset for use later and retrieve, along with the filtering results. The advanced filter filters endpoints based on a specific value associated with the field description. You can add or remove filters, as well as combine a set of filters into a single advanced filter.

S.No	Specifications
40	Should support importing endpoints from a comma-separated values (CSV) file in which the list of endpoints appears with the MAC address and the endpoint profiling policy details separated by a comma.

41	Support for importing endpoints from LDAP server. Should allow to import MAC addresses and the associated profiles of endpoints securely from an LDAP server. Should support an LDAP server to import endpoints and the associated profiles, by using either the default port 389, or securely over SSL, by using the default port 636.
42	Should support multiple Admin Group Roles and responsibilities like HelpDesk Admin, Identity Admin, Monitoring Admin, Network Device Admin, Policy Admin, RBAC Admin, Super Admin and System Admin
43	Should support Role-based access policies which are access control policies which allow you to restrict the network access privileges for any user or group. Role-based access policies are defined when you configure specific access control policies and permissions. These admin access policies allow you to customize the amount and type of access on a per-user or per-group basis using specified role-based access permission settings that apply to a group or an individual user.
44	Should support Identity source sequences which defines the order in which the solution will look for user credentials in the different databases. Solution should support the following databases: •Internal Users •Internal Endpoints •Active Directory •LDAP •RSA •RADIUS Token Servers •Certificate Authentication Profiles
45	Must be able to differentiate policy based on device type + authentication
46	Should have Ability to authenticate at least one phone and multiple users on the same switchport without interrupting service
47	Solution should support MAB and can further utilize identity of the endpoint to apply the proper rules for access. MacAddressBypass is typically used for devices which do not support 802.1x
48	Solution must support Non 802.1x technology on assigned ports and 802.1x technology on open use ports
49	Solution should provide support policy enforcement through VPN gateways
50	Solution must allow users access to the network in a worst case scenario in case of AAA server outages or any other reasons like WAN failure.
51	Should support authenticating Machines and users connected to the same port on the switch in a single authentication flow
52	Should support authenticating IP phones and users connected behind IP phones on the same physical port.
S.No	Specifications
53	Solution should have profiling capabilities integrated into the solution in order to detect headless host. The profiling features leverage the existing infrastructure for device discovery. Should support the use of attributes from the following sources or sensors: * Profiling using MAC OUIs * Profiling using DHCP information * Profiling using RADIUS information * Profiling using HTTP information * Profiling using DNS information * Profiling using NetFlow information * Profiling using SPAN/Mirrored traffic
54	Soution should support troubleshooting authentication issues by triggering session reauthentication to follow up with an attempt to reauthenticate again.

55	Should support session termination with port shutdown option to block an infected host that sends a lot of traffic over the network.
56	Should support the functionality to force endpoint to reacquire IP address that do not support a supplicant or client to generate a DHCP request after a vlan change.
57	Troubleshooting & Monitoring Tools
58	Should support tools to run SHOW command on the network device.
59	Should support evaluation of the configuration of the device with the standard configuration.
60	Should support TCP dump utility & also support saving a TCP dump file.
61	Solution should support schedule reports to run and re-run at specific time or time intervals & send and receive email notifications once the reports are generated.
62	Solution should have capability to administrate devices through TACACS+ from day one
63	Minimum HW requirement for appliance are : 1 – Intel Xenon 2.60 GHz E5-2640 prosessor, minimum 64GB RAM and 4*600GB 10K RPM SAS HDD and 6 x 1G NIC

27.6.8 Network Management System (NMS)

S.No	Specification
1	NMS has to be preferably from the same OEM as of Switches, Wireless LAN Controllers and Wireless Access Points.
2	Management system should provide a single integrated solution for comprehensive lifecycle management of the Wired and Wireless LAN (of same OEM) and should support rich visibility into end-user connectivity and application performance assurance issues
3	Management system should be licensed for proposed network devices which should have flexibility to be shared among wire and wireless devices like switches and Wireless access Points etc. of same OEM. Management system should have scalability to manage 1000 managed devices
4	The NMS solution should be dedicated hardware based appliance which should have 10 Core Physical CPUs, 25MB cache, 64 GB memory, 4 x 900GB RAID10 and 320 MBps I/O bandwidth with 1500 device Lic. from Day-1. NMS and other network active devices are from same OEM for better integration and manageability.
S.No	Specification
5	The solution should support fault, configuration, accounting, performance, and security management for complete network and compute environments
6	The solution should support discovery and classifies application-visibility readiness in network device hardware and software
7	The solution should support Integration with the Enterprise SDN Controller, provides the ability to automate new device deployment using Zero Touch Provisioning capabilities.
8	The solution should support speeds up to provisioning of services such as Performance Routing (PfR) and simplifies quality-of-service (QoS) configuration and monitoring for WAN connectivity

9	The solution should support compliance engine, which provides the ability to specify the network configuration and perform an audit of the network devices against the configuration archive or the device configuration. The audit report identifies devices that are out of compliance. Administrator can remediate the devices that are out of compliance with the desired configuration. This engine also helps with generating reports for EoL/EoS/PCI for network devices.
10	The solution should support customize alarms based on the operational needs. Customizable syslog based alarms provides the ability to custom create new alarms and prioritize operator response

27.6.9 Wireless LAN Controller

S.No	Sepecification
1	Must be compliant with IEEE CAPWAP or equivalent for controller-based WLANs.
2	Should have at least 2 x 10 Gigabit Ethernet interface.
3	Should support both centralized as well as distributed traffic forwarding architecture with L3 roaming support from day 1. Should have IPv6 ready from day one.
4	Controller should have hot-swappable internal redundant power supplies.
5	Controller should support minimum 20000 concurrent devices.
6	WLAN controller should have scalability to support 1500 Access points from day 1 without any hardware change. Controller should be provided with 500AP lic. From Day-1.
7	Should be rack-mountable. Required accessories for rack mounting to be provided.
8	WLAN controller should provide Application visibility with both traffic forwarding mode i.e when traffic coming to controller and when traffic moving locally from Ap to connected access switch. Admin should have option to create policies to allow or deny access based on applications.
9	WLC should support AP License Migration from one WLC to another

S.No	Sepecification
10	Should support minimum 4000 VLANs
11	Must support stateful switchover between active and standby controller in a sub second time frame.
12	WLC should support L2 and L3 roaming for IPv4 and IPv6 clients
13	WLC should support guest-access functionality for IPv6 clients.
14	Should support IEEE 802.1p priority tag.
15	Should ensure WLAN reliability by proactively determining and adjusting to changing RF conditions.
16	Should provide real-time radio power adjustments based on changing environmental conditions and signal coverage adjustments.

17	Should support automatic radio channel adjustments for intelligent channel switching and realtime interference detection.
18	Should support client load balancing to balance the number of clients across multiple APs to optimize AP and client throughput.
19	Should support policy based forwarding to classify data traffic based on ACLs
20	WLC should support PMIPv6 and EoGRE tunnels on northbound interface
21	Should support flexible DFS to prevent additional 20/40 Mhz channels from going unused
22	Should support dynamic bandwidth selection among 20Mhz, 40 Mhz and 80Mhz channels, ensuring one access point on 20Mhz and another on 80 Mhz channel connected on the same controller at same WLAN group.
23	Should support minimum 500 WLANs
24	Should support dynamic VLAN assignment
25	Should support Hot Spot 2.0
26	To deliver optimal bandwidth usage, reliable multicast must use single session between AP and Wireless Controller.
27	Should able to do dynamic channel bonding based on interference detected on particular channel.
28	Must support coverage hole detection and correction that can be adjusted on a per WLAN basis.
29	Must support RF Management with 40 MHz and 80 Mhz channels with 802.11n & 802.11ac
30	Should provide visibility to Network airtime in order to set the airtime policy enforcement
31	Must support dynamic Airtime allocation on per WLAN, per AP, Per AP group basis.
32	Must be able to restrict the number of logins per user.
33	Should support web-based authentication to provide a browser-based environment to authenticate clients that do not support the IEEE 802.1X supplicant.
34	WLC should support web based authentication in different traffic forwarding modes i.e Central switching and Local switching when traffic move locally from AP to connected switch.
35	Should support port-based and SSID-based IEEE 802.1X authentication.
36	Should support MAC authentication to provide simple authentication based on a user's MAC address.
37	WLC should be able to exclude clients based on excessive/multiple authentication failure.
38	Shall support AES or TKIP encryption to secure the data integrity of wireless traffic
39	Shall support the ability to classify over 20 different types of interference with in 5 to 30 seconds.
40	Shall able to provide an air quality index for ensuring the better performance
S.No	Sepecification
41	Shall able to provide real time chart showing interference per access point on per radio and perchannel basis.
42	Should support AP location-based user access to control the locations where a wireless user can access the network
43	Should support Public Key Infrastructure (PKI) to control access
44	Must be able to set a maximum per-user bandwidth limit on a per-SSID basis.
45	WLC Shall support WIDS/WIPS, and spectral analysis from day 1.

46	WLC should detect if someone connect a Rogue Access Point in network and able to take appropriate action to contain rogue Access point.
47	In case of Access point connected in remote locations over WAN, containment should happen even if WAN is down.
48	WLC should detect and protect an Ad-hoc connection when a connected user forming a network with other system without an AP or try enabling bridging between two interface
49	WLC should detect if a user try to impersonate a management frame.
50	WLC should detect and take appropriate containment action if a smartphone user using tethering to connect other device.
51	WLC should detect and protect if a user try to spoof mac address of valid client or AP for unauthorized access/authentication.
52	WLC should detect if a user trying to do internet sharing through a valid system to an unauthorized device.
53	Should support SNMPv3, SSHv2 and SSL for secure management.
54	Should support encrypted mechanism to securely upload/download software image to and from Wireless controller.
55	Should provide visibility between a wired and wireless network using IEEE 802.1AB Link Layer Discovery Protocol (LLDP) and sFlow/equivalent.
56	Should support AP Plug and Play (PnP) deployment with zero-configuration capability
57	Should support AP grouping to enable administrator to easily apply AP-based or radio-based configurations to all the APs in the same group
58	Should support selective firmware upgrade APs, typically to a group of APs minimize the impact of up-gradation
59	Should have a suitable serial console port.
60	Should have Voice and Video Call Admission and Stream prioritization for preferential QOS
61	Controller should support deep packet inspection for all user traffic across Layer 4-7 network to analyses information about applications usage, peak network usage times for all access points from day one with different traffic forwarding modes i.e central switching with WLC and local switching when traffic move locally from AP to connected switch.
62	Should be able to do application visibility for application running behind HTTP proxy.
63	Support profiling of wireless devices based on known protocols like http and dhcp to identify clients
64	Should support visibility and control based on the type of applications

27.6.10 Wireless Indoor Access Points

S. No.	Specification
1	Access Points proposed must include radios for 2.4 GHz and 5 GHz with 802.11ac Wave 2.
2	An access point must include a standard OEM provided Mounting brackets for mounting on Ceiling or Roof top.
3	Access Point shall support console port that uses Standard Port (RJ-45) type connection
4	Should have two RJ-45 auto-sensing 10/100/1000 Mbps LAN port .

5	Access Point should have USB port for future requirement.
6	Must have atleast 3 dBi Antenna gain on each radios
7	Must support 4x4 MIMO with 3 spatial streams.
8	Must provide dynamic dual 5 ghz radio mode for high density requirement from day 1.
9	Must Support minimum aggregate data rate of 5 Gbps on dual 5ghz mode with 160 mhz channel support and standard 256 QAM modulation.
10	Must support minimum of 22dbm of transmit power in both 2.4Ghz and 5Ghz radios. And should follow the local regulatory Norms.
11	Must support AP enforced load-balance between 2.4Ghz and 5Ghz band.
12	Must incorporate radio resource management for power, channel and performance optimization
13	Must have -97 dB or better Receiver Sensitivity.
14	Must support Proactive Key Caching and/or other methods for Fast Secure Roaming.
15	Must support Management Frame Protection.
16	Should support locally-significant certificates on the APs using a Public Key Infrastructure (PKI).
17	Access Points must support Hardware-based encrypted user data and management traffic between controller and Access point for better security.
18	Must support the ability to serve clients and monitor the RF environment concurrently.
19	Same model AP that serves clients must be able to be dedicated to monitoring the RF environment.
20	Must be plenum-rated (UL2043).
21	Must support 16 WLANs per AP for SSID deployment flexibility.
22	Access Point Must continue serving clients when link to controller is down. It should also have option to authenticate user through Radius server directly from Access Point during link unavailability to controller.
23	Must support telnet and/or SSH login to APs directly for troubleshooting flexibility.
24	Must support Power over Ethernet, local power(DC Power), and power injectors.
25	802.11e and WMM
26	Must support Reliable Multicast to Unicast conversion to maintain video quality at AP level
27	Must support QoS and Video Call Admission Control capabilities.
28	Access Point should 802.11 DFS certified

27.6.11 Wireless Outdoor Access Points

S.No	Specification
1	Access Points proposed must include radios for 2.4 GHz and 5 GHz with 802.11ac Wave 2.
2	An access point must include a standard OEM provided Mounting brackets for mounting on Ceiling or Roof top.

3	Access Point shall support console port that uses Standard Port (RJ-45) type connection
4	Should have 1x RJ-45 auto-sensing 10/100/1000 Mbps LAN port and 1x Built-in Gigabit SFP port for direct fibre uplink.
5	Must have atleast 4 dBi Antenna gain on each radios
6	Must support 3x3 MIMO for both 802.11ac and 802.11n client
7	Must Support data rate of 1.3 Gbps on 5ghz .
8	Must support minimum of 29 dbm of transmit power in both 2.4Ghz and 5Ghz radios. And should follow the local regulatory Norms.
9	Must support AP enforced load-balance between 2.4Ghz and 5Ghz band.
10	Must incorporate radio resource management for power, channel and performance optimization
11	Must have -97 dB or better Receiver Sensitivity.
12	Must support Proactive Key Caching and/or other methods for Fast Secure Roaming.
13	Must support Management Frame Protection.
14	Should support locally-significant certificates on the APs using a Public Key Infrastructure (PKI).
15	Access Points must support Hardware-based encrypted user data and management traffic between controller and Access point for better security.
16	Must support the ability to serve clients and monitor the RF environment concurrently.
17	Same model AP that serves clients must be able to be dedicated to monitoring the RF environment.
18	Must support 16 WLANs per AP for SSID deployment flexibility.
19	Access Point Must continue serving clients when link to controller is down. It should also have option to authenticate user through Radius server directly from Access Point during link unavailability to controller.
20	Must support telnet and/or SSH login to APs directly for troubleshooting flexibility.
21	Must support Power over Ethernet, local power(AC/DC Power), and power injectors.
22	802.11e and WMM
23	Must support Reliable Multicast to Unicast conversion to maintain video quality at AP level
24	Must support QoS and Video Call Admission Control capabilities.
25	Access Point should 802.11 DFS certified
26	The Access point shall be IP67 and NEMA rated
27	The Access point shall support operating temperature of -40 to 65°C
28	The equipment shall support up to 100 MPH sustained winds & 165 MPH wind gusts.

27.6.12 Router

S.No	SPECIFICATION
1	It should support broadband aggregation for voice, video, data, and mobility services with QoS scaling to a large number of queues per device.
2	Router should have 8 nos. of 10/100/1000 Base-T ports. 4 nos. SFP based ports.
3	Router should have 4 nos. SFP based ports.

4	Router should have 4x10 Gigabit SFP+ ports from day 1
5	Router should have minimum 8 GB RAM from day 1.
6	Router should have DES, 3DES and AES Standards through dedicated encryption module/processor. Should support IPSec with IKEv2 and Suite-B Encryption
7	Router shall have hot swappable 1:1 redundant internal power supply
8	Router should have a minimum performance of 15 Mpps and 10 Gbps of bandwidth, Scalable to 20 Gbs in future.
9	Router should support static Routes, OSPFv2, OSPFv3, BGP4, MBGP, BFD, Policy based routing, IPv4 and IPv6 tunneling, MPLS LDP, MPLS L3VPN, MPLS L2VPN , MPLS TE, FRR Link & Node Protection, LDP, MPLS Static label, MPLS VRF-aware static labels, LDP - Session Protection, LDP - Graceful Restart,
10	MPLS L2VPN Pseudo wire Redundancy with TE/FRR protection, Support for QinQ to Ethernet/VLAN Ethernet/IP interworking, MPLS VPN - Carrier Supporting Carrier (CsC), CsC with IPv4 BGP label distribution (RFC 3107)
11	Router should support IGMP v1/v2/v3 and PIM multicast routing
12	Should support other IP Services like GRE tunnel, IPv4 tunnel, IPv6 tunnel, Virtual Router Redundancy Protocol (VRRP), Network Address Translation (NAT), Access Control Lists (ACLs)
13	Shall have 802.1p class of service, IP differentiated service code point (DSCP) and IP precedence,
14	Routers should support marking, classification, policing and shaping, Hierarchical QoS for Traffic Management inspections, QoS classification with TCP Application traffic. The router shall provide up to 16k queues for deployment of per-user per-application per-port QoS.
15	Router should support SSHv2, SNMPv2c, SNMPv3, NTPv3 and NTPv4
16	Routers should support AAA using RADIUS and TACACS+
17	Support for accounting of traffic flows for network planning and security purposes. Router shall provide application recognition through analysis of flows.
18	Support for accounting of traffic flows for network planning and security purposes. Router shall provide application recognition through analysis of flows.
19	Router should support monitoring of network traffic with application level insight with deep packet visibility into web traffic, RTP-Based VoIP traffic and cRTP
20	Router shall have traffic load balancing capability on dual WAN Links based on based on advanced criteria, such as reachability, delay, loss, jitter and bandwidth utilization.
21	Router / Router's Operating System should be tested and certified for EAL 4 or above under Common Criteria Certification
22	Router should be IPv6 Certified/IPv6 logo ready
23	Router should have direct OEM TAC support and hardware replacement warranty for 5 Years.

27.7 Testing & Commissioning:

All Active components shall have the OEM test reports and shall have the OEM warranty/ Guarantee of 5 years. All equipment's installation shall be considered completed after verifying all the features of the system as mentioned in the specifications and as per the standards.

All equipment shall be replaced if there is any fault in the hardware or in software within two to three hours. The Agency shall have the spares of the main equipments in the stock so that the work of the complex shall remain smooth & undisturbed. All equipment's installation shall be considered completed after verifying all the features of the system as mentioned in the specifications in the Tender and as per the standards.

4.2 Specifications

4.2.1 Standard or Pre-Approved Products

Furnish materials and equipment that are the standard products of a manufacturer regularly engaged in the manufacture of such products and which essentially duplicate items that have been in satisfactory use for at least 6 months prior to bid opening.

4.2.2 Nameplates

Secure to each major item of equipment the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate.

4.2.3 Piping system

Provide a piping system complete with pipe, pipe fittings, valves, strainers, expansion loops, pipe hangers, inserts, supports, anchors, guides, sleeves, and accessories with this specification and the drawings. Pipe shall be designed to observe limits on flow velocity, pressure drop, and gauge pressure associated with the pipe type and characteristics. Provide, install and test the piping. Provide piping flow rates below 5 feet per second. Piping shall be Type L or Type M copper tubing, ASTM B-88, with 95-5 tin-antimony soldered joints. As cold water piping supplying the SWH system is of CPVC, it shall be replaced within 4 m of the SWH system with copper to avoid bulging and rupture due to proximity to the higher temperatures of the solar system.

4.2.4 Pipe Insulation

Furnish interior pipe insulation and coverings such as Armaflex, Insul-Tube, Rubatex, or approved equivalent. Provide outside array piping insulation with a capability of withstanding 250 degrees F, except that piping insulation within .5m of collector connections shall be capable of withstanding 400 degrees F. Protect outside piping insulation from water damage and ultraviolet degradation with a suitable outer coating manufactured for this purpose (aluminum, sunlight resistant PVC or approved equal).

4.2.5 Calibrating Balancing Valves (for multiple collector banks)

Provide calibrated balancing valves suitable for 125 psig and 250 degrees F service as per requirements.

4.2.6 Pressure Gauges

Provide pressure gauges with throttling type needle valve or a pulsation dampener and hutoff valve. Furnish a 100 mm minimum dial size.

4.2.7 Thermometers

Supply thermometers with wells and separable bronze sockets.

4.2.8 Pipe Hangers and Supports

Support and hang piping so that the weight of the piping is not supported by drywall, siding, or other building members not designed to bear load. Support piping so that thermal expansion and contraction of pipe lengths is accommodated.

4.2.9 Valves

Provide valves compatible with the piping. Ball valves shall be used for shutoff, with full port, bronze body, bronze ball and Teflon seat. Bronze hose-end gate valves shall be used for draining low points of piping.

4.3 Collector Subsystem

4.3.1 Solar Collector Construction

The type of solar collector proposed shall be compatible with the proposed system type. Collectors shall be selected based on optimal cost and performance. Depending on the temperature requirements of the system, collector may be unglazed (low temperature), single or double glazed (mid temperature), or evacuated tube (high temperature) with selective or painted absorber surfaces. Furnish collectors of weather-tight construction and with an aluminum casing. Provide aluminum or stainless steel mounting brackets and hinges. Furnish stainless steel assembly hardware including all bolts, washers, and nuts. Install collectors such that tubes on the absorber plate drain by gravity. Provide cover glazing completely replaceable from the front of the collector without disturbing the piping or adjacent collectors.

4.3.2 Collector Warranty

Provide a minimum 10-year warranty against the following: failure of manifold or riser tubing, joints or fittings; degradation of absorber plate selective surface; rusting or discoloration of collector hardware; and embitterment of header manifold seals. Include with the warranty full repair or replacement of defective materials or equipment.

4.3.3 Solar Collector Performance

Plot thermal performance on the thermal efficiency curve in accordance with ASHRAE 93 showing the product of glazing transmittance and plate absorptivity and also the thermal loss coefficient (btu/hr/F) of the solar collector. Show manufacturer's recommended volumetric flow rate and the design pressure drop at the recommended flow rate. Indicate the manufacturer's recommendations for the number of collectors to be joined per bank while providing for balanced flow and for thermal expansion considerations.

4.4 Solar Collector Array

4.4.1 Net Absorber Area and Array Layout

Collector array shall be oriented so that all collectors face the same direction. Space collectors arranged in multiple rows so that no shading from other collectors is evident between 1000 hours and 1400 hours solar time on December 21. Collectors should be south-facing and a tilt equal to the local latitude, but other orientations may be considered for approval. Indicate minimum spacing between rows.

4.4.2 Piping

Connect interconnecting array piping between solar collectors, in a reverse-return configuration with approximately equal pipe length for any possible flow path. Indicate flow rate through the collector array.

Provide each collector bank isolated by valves, with a pressure relief valve and with the capability of being drained. Locate manually operated air vents at system high points, and pitch array piping a minimum of 0.25 inch per foot so that piping can be drained by gravity. Supply calibrated balancing valves at the outlet of each collector bank as indicated.

4.4.3 Supports for Solar Collector Array

Provide support structure for the collector array of aluminum, stainless steel, or other corrosion resistant approved material. Furnish a support structure, which secures the collector array at the proper tilt angle with respect to horizontal and orientation with respect to true south. Consideration should be made to mounting collectors parallel to the pitched roofs. The collector tilt angle may vary by +/- 25 degrees, and the azimuthal angle may vary by +/-45% from the optimal tilt and azimuth. Provide a support structure that will withstand the static weight of filled collectors and piping, wind, seismic, and other anticipated loads without damage. For heavy systems, such as integral storage collectors, provide structural reinforcement for the roof across at least four rafters and provide verification that the structural modifications proposed are satisfactory. Provide a support structure which allows access to all equipment for maintenance, repair, and replacement. Neoprene or EPDM washers shall separate all dissimilar

metals. Depending on system type, supports for solar array could terminate in ballast blocks to avoid roof penetrations.

4.4.4 Pumps

Provide electrically-driven, single-stage, centrifugal type circulating pumps. Support pumps on a concrete foundation or mounting intended for the purpose, or by the piping on which installed if appropriate to the size. Construct the pump shaft of corrosion resistant alloy steel with a mechanical seal. Provide stainless steel impellers and casings of bronze. Pumps shall be installed with isolation valves so the pump can be serviced without draining the system.

4.4.5 Heat Transfer Fluid

Heat transfer fluid shall be compatible with all materials in the system. The nature and amount of heat transfer fluid will depend on the type of system proposed and the freeze conditions encountered at the site. Any anti-freeze, conditioners or corrosion inhibitors added to the heat transfer fluid must be non-toxic and intended for use in potable water systems.

4.4.6 Tempering Valve

All systems installed under this procurement action **MUST** have a tempering or mixing valve to limit the temperature of the hot water supplied to the plumbing fixtures. The tempering valve is to be located downstream of the electric water heater and is to be set to a temperature suitable for the application.

4.4.7 ELECTRICAL WORK

Provide electric motor-driven equipment complete with motor, motor starters, and controls. Provide electrical equipment and wiring in accordance with NFPA 70. Furnish motor starters complete with thermal overload protection and other appurtenances necessary for the motor control specified. Provide each motor of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor.

4.4.8 PAINTING AND FINISHING

Furnish equipment and component items, with the factory applied manufacturer's standard finish

4.5 INSTALLATION

Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from sheetrocked or suspended ceilings. Keep interior and ends of new piping thoroughly cleaned of foreign matter. Keep piping systems clean during installation by means of plugs or other approved methods. Discharge storage tank pressure and temperature relief valves into floor drains. Horizontal runs should be flat and vertical runs should be plumb. Install any multiple pipes in an order which does not require them to cross or interfere with each other or other building systems. Provide air vents with threaded plugs or caps. Install control and sensor wiring in conduit.

4.6 System Flushing and Disinfection

Flush and disinfect the piping system.

4.7 Collector Subsystem

4.7.1 Collector Array

Install solar collector array at the proper tilt angle, orientation, and elevation above roof. Install the solar collectors with the ability to be removed for maintenance, repair, or replacement.

4.7.2 Array Piping

Install collector array piping in a reverse-return configuration so that path lengths of collector supply and return are of approximately equal length. Install air vents in the high points of the collector array piping. Provide proper pitch for draining of collector array.

4.7.3 Array Support

Install array support in accordance with the recommendations of the collector manufacturer.

4.7.4 Pipe Expansion

Provide for the expansion and contraction of supply and return piping with changes in the direction of the run of pipe or by expansion loops. Do not use expansion joints in the system piping.

4.7.5 Valves

Install ball valves at the inlet and outlet of each bank of manifold collectors. Install calibrated balancing valves at the outlet of each collector bank and mark final settings on each valve. Install a union adjacent to each ball valve. Balance flow through the collector piping with at least one balancing valve left in the open position. Locate tempering mixing valve downstream of auxiliary water heater to control hot water delivery temperature.

4.7.6 Roof Penetrations

All roof penetrations shall be made permanently waterproof. Contractor shall provide a five year warranty on materials and labor, including consequential damages, for any roof leaks due to or arising out of the solar water heating system installation.

4.8 INSPECTION AND TESTING

4.8.1 Instructions

Provide instructions for each system type. Include in these instructions a system schematic, and wiring and control diagrams showing the complete layout of the solar system. Prepare condensed operating instructions explaining preventative maintenance procedures, balanced flow rates, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system, in typed form, framed as specified above, and posted beside the diagrams. Post the framed instructions before acceptance testing of each system.

4.8.2 Acceptance Testing and Final Inspection

Maintain a written record of the results of all acceptance tests, to be submitted in booklet form. Provide the following tests:

4.8.3 Hydrostatic Test

Hydrostatically test each system. Isolate valving and instrumentation not suitable for the intended test pressure.

4.8.4 Operational Test

Operationally test each system over a period of 48 consecutive hours with sufficient solar insolation to cause activation of the solar energy system during daylight hours.

4.8.5 Overall System Operations

Demonstrate each solar energy system will operate properly while unattended for a period of at least 72 hours. As required by system design, demonstrate the system controller will start the pumps after being warmed by the sun, and that it will properly shut down during cloudy weather or in the evening over a

minimum of three complete cycles. It is permissible to manipulate the temperature of the storage tank by the introduction of cold water.

4.8.6 Temperature Sensor Diagnostics

As required by system design, demonstrate the controller will correctly identify open and short circuits on both the solar collector temperature sensor circuit and the storage tank sensor circuit.

4.9 FIELD TRAINING

Provide a field training course for operation and maintenance staff members after the system is functionally complete. Include in the training a discussion of the system design and layout and demonstrate routine operation, maintenance and troubleshooting procedures.

Sub-work – HVAC System Part I -

General

1.1 INTRODUCTION

1.1.1 Scope

- 1.1.1.1 These specifications cover the following types of air-conditioning, and ventilation:
- i. Central air-conditioning System
 - ii. Mechanical ventilation system.
 - iii. VRV / VRF System

- 1.1.1.2 Central air-conditioning system included in these specifications is by means of centrifugal type compressors. Therefore, only vapor compression type refrigeration equipment's are covered herein along with VRF system.

1.1.1.3 These General Specifications cover the equipment's and materials for the system, their testing and/or inspection as may be necessary before their dispatch from their respective works, their delivery at site, all preparatory works, assembling, installation and adjustments, commissioning, final testing, putting in to operation, equipment capacity computation and handing over of the complete system.

1.1.2 Related Documents:

These Specifications shall be read in conjunction with the General conditions of contract. These Specifications shall also be read in conjunction with the schedule of work, drawings and other documents connected with the work.

1.1.3 Terminology:

The definition of terms used in these specifications shall be in accordance with IS:3615 "Glossary of terms used in refrigeration and air-conditioning". Some of the commonly used terms are defined in Appendix 'A'.

1.1.4 Site Information:

The tenderer should, in his own interest, visit the site and familiarize himself with the site conditions before tendering. For any Clarification, tenderer may discuss with the Engineer-in-Charge.

1.1.5 Heat Load Calculations & Equipment Selection:

The successful tenderer or the associated contractor for the HVAC work should carry out the heat load calculations of all the areas, AHU/FCU wise after award of work for summer and monsoon seasons. He should compare the heat loads as per items of work and he should bring out any variations in the heat load calculations to the notice of Engineer-in-charge after award of the work. Otherwise, he should submit written confirmation about the correctness of heat load and sufficiency of equipment selected.

1.2 Conformity With Statutory Acts, Rules, Standards and Codes:

- i. All components shall conform to relevant Indian Standard Specifications, wherever existing, amended to date.
- ii. All electrical works shall be carried out in accordance with the provisions of Indian Electricity Act, 2003 and Indian Electricity Rules, 1956 amended to date. They shall also conform to CPWD General Specifications for Electrical works, Part-I: Internal, 1994 and Part-II: External, 1994 and Part IV (Sub-station) 1983, amended to date.

1.3 Safety Codes And Labour Regulations

i. All the safety procedures outlined in the safety codes listed shall be complied with. ii. In respect of all labor employed directly or indirectly on the work for the performance of the air conditioning contractor's part of work, the contractor at his own expense, will arrange for the safety provisions as per the statutory provisions, B.I.S. recommendations, factory act, workman's compensation act, CPWD code and instructions issued from time to time. Failure to provide such safety requirements would make the tenderer liable for penalty for Rs.2000/- for each violation. In addition, the Engineer-in-charge shall be at liberty to make arrangements and provide facilities as aforesaid and recover the cost from the contractor. iii. The contractor shall provide necessary barriers, warning signals and other safety measures while laying pipelines, ducts cables etc. or wherever necessary so as to avoid accident. He shall also indemnify CPWD against claims for compensation arising out of negligence in this respect. Contractor shall be liable, in accordance with the Indian Law and Regulations for any accident occurring due to any cause. The department shall not be responsible for any accident occurred or damage incurred or claims arising there from during the execution of work. The contractor shall provide all insurance including third party insurance as may be necessary to cover the risk. No extra payment would be made to the contractor due to the above provisions thereof.

1.4 Works To Be Arranged By The Department:

Unless otherwise specified in the tender documents, the following works shall be arranged by the Department:

- i. Space for accommodating all the equipment's and components involved in the work,
- ii. False ceiling and/or return air enclosure excluding return air duct wherever provided as required,

- iii. Make up water tank for condenser water
- iv. Power supply, Water supply and Drain points

1.5 Works To Be Done By The Contractor:

Unless otherwise mentioned in the tender documents, the following works shall be done by the contractor and therefore, their cost shall be deemed to be included in their tendered cost- whether specifically indicated in the schedule of work or not:

- i. Foundations for equipment's including foundation bolts and vibration isolation spring/pads,
- ii. Support columns and beams for cooling towers,
- iii. Suspenders, brackets and floor/wall supports for suspending/supporting ducts and pipes.
- iv. Suspenders and/or cable trays for laying the cables,
- v. Excavation and refilling of trenches in soil wherever the pipes are to be laid directly in ground, including necessary base treatment and supports.
- vi. Sealing of all floor slab/ wall openings provided by the Department or contractor for pipes and cables, from fire safety point of view, after laying
- vii. of the same.
- viii. Painting of all exposed metal surfaces of equipment's and components with appropriate color as per Para 1.13.
- ix. Making openings in the Walls/Floors/Slabs or modification in the existing openings wherever provided for carrying pipe line, ducts, cables etc.
- x. Providing wooden/ metallic frames for fixing grills/diffusers.
- xi. Under deck insulation of top floor slab, if top floor is air-conditioned and if specified in schedule of work.
- xii. Making good all damages caused to the structure during installation and restoring the same to their original finish.

1.6 Power Supply, Water Supply and Drainage

1.6.1 POWER SUPPLY

- i. It shall be provided by the contractor for installation.
- ii. a) The power supply for testing and commissioning of the complete installation shall be made available by the Department free of charge to the contractor. For this purpose, the power supply shall be given at the main incomer unit of the main electrical panel (provided by the contractor) through U.G. cable, or bus trunking arrangement as specified in the contract. The termination of this feeder in the main incomer unit shall be the responsibility of the contractor and nothing extra shall be paid on this account.
- iii. Where the power supply has to be arranged by the Department at more than one point as per the terms of the contract, the termination of all such power feeders in the incomer of respective control panels (provided by the contractor) shall be the responsibility of the contractor.
- iv. The contractor shall not use the power supply for any other purpose than that for which it is intended for. No major fabrication work shall be done at site. Power shall be used only for welding/cutting works. The power supply shall be disconnected in case of such default and the contractor shall then have to arrange the required power supply at his cost.

1.6.2 Water Supply:

- i. Water supply shall be arranged by the contractor for installation.
- ii. Water shall be made available by the Department free of charge in makeup water tank near the cooling tower, AC plant room, AHU room, expansion tank, hot water generator, air washer, etc. as required for testing and commissioning. Further connection from makeup water tank to cooling tower shall be carried out by the contractor and shall be separately measured & paid for as per contract.
- iii. Water analysis should be obtained of the water available at site and if required water softening plant may be provided.

1.6.3 DRAINAGE

- i. Drain traps in A.C. plant room, AHU room, Air washer room, hot water generator and near cooling tower shall be arranged by the department.
- ii. All drainage arrangements from the drain traps in the A.C. plant room, AHU room, air washer room, hot water generator room etc. to the drain line shall be arranged by the Department required.

iii. Piping Connections from the equipment to the drain trap including providing valves at the drain points shall be done by the contractor. These items of work shall be separately measured and paid as per contract.

1.7 Machinery for Erection:

All tools and tackles required for unloading, handling of equipment's and materials at site, their assembly, erection, testing and commissioning shall be the responsibility of the contractor.

1.8 Completeness of the Tender, Submission Drawings and Commencement of Work of Programme, Approval of Works

i. **Completeness of the Tender:** All sundry equipment's, fittings, assemblies, accessories, hardware items, foundation bolts, supports, termination lugs for electrical connections, cable glands, junction boxes and all other items which are useful and necessary for proper assembly and efficient working of the various equipment's and components of the work shall be deemed to have been included in the tender, irrespective of the fact whether such items are specifically mentioned in the tender or not.

ii. **Submission of Program:**

Within fifteen days from the date of receipt of the letter of acceptance, the successful tenderer shall submit his program for submission of drawings, supply of equipment, installation, testing, commissioning and handing over of the installation to the Engineer-in-Charge. This program shall be framed keeping in view the building progress. Items like ducting, piping etc. that directly affect the building progress shall be given priority.

iii. **Submission of Drawings:**

The contractor shall submit the drawings to the Engineer-in-Charge as per Para 1.18.2 for approval before start of work.

iv. **Commencement of Work:**

The contractor shall commence work as soon as the drawings submitted by him are approved.

1.9 Dispatch of Materials to Site and Their Safe Custody:

The contractor shall dispatch material to site in consultation with the Engineer-in-Charge. Watch & ward however, shall be the responsibility of contractor. Program of dispatch of material shall be framed keeping in view the building progress. Safe custody of all machinery and equipment supplied by the contractor shall be the responsibility of the contractor till final taking over by the department.

1.10 Co-Ordination with Other Agencies:

The contractor shall co-ordinate with all other agencies involved in the work so that the work of other agencies is not hampered due to delay in his work. Ducting, piping, cabling or any other work, which directly affect the progress of building work, shall be given priority.

1.11 Quality of Materials and Workmanship:

i. The components of the installation shall be of such design so as to satisfactorily function under all conditions of operation.

ii. The entire work of manufacture/fabrication, assembly and installation shall conform to sound engineering practice. The entire installation shall be such as to cause minimum transmission of noise and vibration to the building structure.

iii. All equipment's and materials to be used in work shall be manufactured in factories of good repute having excellent track record of quality manufacturing, performance and proper after sales service.

1.12 Care of the Building:

Care shall be taken by the contractor during execution of the work to avoid damage to the building. He shall be responsible for repairing all such

damages and restoring the same to the original finish at his cost. He shall also remove all unwanted and waste materials arising out of the installation from the site of work from time to time.

1.13 Colour Scheme for the Equipment's and Components

- i. Color scheme for equipment like chilling unit, pumps, AHUs, cooling tower etc. shall be as per manufacturer's standard colour scheme.
- ii. The scheme of color code painting of pipe work services for air conditioning installation shall be as per National building code and is indicated below:

Description	Ground Colour	Lettering	First Colour band
Condenser water piping	Sea Green	CB	French Blue
Chilled water piping	Sea Green	Black	Black
Drain Pipe	Black	White	
Vent	White	Black	
Valves and pipeline fittings	White with Black Handles	Black	
Belt guard	Black & Yellow diagonal strips		
Machine bases, Inertia Base Plinth	Charcoal grey		

- iii. Color bands shall be 150mm wide, superimposed on ground color to distinguish type and condition of fluids. The spacing of band shall not exceed 4.0m.
- iv. In addition to the color 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:

Chilled water	:	CHW
Condenser water	:	CDW
Condensate	:	C

1.14 Inspection and Testing

1.14.1 Initial Inspection & Testing

- i. Initial inspection of materials & equipment's at manufacturer's works will be done by the engineer-in-charge or his representative. For item/ equipment requiring initial inspection at manufacturer's works, the contractor will intimate the date of testing of equipment's at the manufacturer's works before dispatch. The contractor shall give sufficient advance notice regarding the dates proposed for such tests to the department's representative(s) to facilitate his presence during testing. The Engineer-in-charge at his discretion may witness such testing. Equipment's will be inspected at the manufacturer/ authorized dealer's premises, before dispatch to the site by the contractor.
- ii. The department also reserves the right to inspect the fabrication job at factory and the successful tenderer has to make arrangements for the same.
- iii. The materials duly inspected by engineer-in-charge or his authorized representative shall be dispatched to site by the contractor.

1.14.2 Final Inspection & Testing

Final Inspection & testing will be done by the Engineer-in-Charge or his representative.

Items required to be tested at Factory before dispatch to site:

All AHUs, Cooling Coils, Factory fabricated ducts, pre- insulated pipes, electrical panels shall be tested in the factory before dispatch.

Other materials will be received against approved samples/test certificates/dimensional checking/ compliance with approved drawings etc.

1.14.3 Safety Measures

All equipment's shall incorporate suitable safety provisions to ensure safety of the operating personnel at all times. The initial and final inspection reports shall bring out explicitly the safety provisions incorporated in every equipment.

1.15 Running In Period & Date Of Acceptance

- i. After the installation work has been completed by the contractor, he will conduct tests and make adjustments as may be necessary to satisfy himself that the plant including low side equipment's is capable of continuous running. There after he will offer to the departments a running-in period of 7 days subject to a minimum aggregate of 120 hrs at his cost. The duty cycle of the plant during this running in period shall be same as that specified in the tender documents. In case of multiple compressor installations, all the compressors should be run by rotation. The plant will be operated and a log of all parameters will be maintained during this period. The contractor will be free to carry out necessary adjustments etc. during this period without stopping the plant. Record of inside conditions will be made during this period to check the same are as per NIT requirements. The plant will be said to have successfully completed the running-in-period, if no break down or abnormal/ unsatisfactory operation of any machinery occurs during this period. After this the plant will be made available for beneficial use. After the plant has operated without any major break down/ trouble and inside conditions are maintained as per NIT requirements for the above specified running in period, it shall be taken over by the department subject to guarantee clause mentioned below. This date of taking over of plant after trouble free operation during the running in period shall be the date of acceptance.
- ii. Any loss of refrigerant or oil during the running in period shall be made good by the contractor free of charge.
- iii. Capacity test of the chilling unit & other major equipment's shall be carried out as and when conditions become stabilized as per details given under Appendix 'G'.
- iv. Seasonal testing may be carried out as & when outside conditions become suitable.

1.16 Guarantee:

- i. The contractor shall guarantee the complete system to maintain the specified conditions under all conditions of ambience and internal loads subject to the condition that designed outside conditions & designed internal loads are not exceeded. Also the inlet / outlet temperatures at the specified flow of water in the chiller unit shall be guaranteed.
- ii. All equipment's shall be guaranteed for a period of 12 months from the date of acceptance and taking over of the installation by the Department against unsatisfactory performance and/or breakdown due to defective design, material, manufacture, workmanship or installation. The equipment or component or any part thereof so found defective during the guarantee period shall be repaired or replaced free of cost to the satisfaction of the Engineer-in-charge. In case it is felt by the department that undue delay is being caused by the contractor in doing this, the same will be got done by the department at the risk & cost of the contractor. The decision of Engineer-in-charge in this regard shall be final.
- iii. Any leakage of refrigerant and/or oil due to defective design, manufacture and workmanship installation during the guarantee period shall be made good by the contractor free of charge.

1.17 Payment Terms:

1.17.1 The following percentage of contract rates shall be payable against the stages of work shown herein:

S.No.	Stage of work	Machinery & Equipment	All other items
i.	After initial inspection (wherever specified) & delivery at site in good condition on pro-rata basis	80%	70%
ii.	On completion of pro-rata installation	10%	20%
iii.	On commissioning and completion successful running in period	5%	5%
iv.	On completion of major seasonal test	5%	5%

When the major seasonal test cannot be carried out at the time of commissioning due to reasons not attributable to the Contractor, the installation shall be handed over to the Department for beneficial use after successful completion of a trial run of 7 days, subject to a minimum aggregate running period of 120 hours, as specified in Clause 1.15.

The balance payment shall be released to the Contractor upon submission of a Bank Guarantee in the prescribed format from a scheduled bank for an amount equivalent to the balance payment due. The Bank Guarantee shall initially remain valid for a period of six (6) months and shall be extended, if required, until the successful completion of the major seasonal test.

The Bank Guarantee furnished under this clause shall be separate from and in addition to the Performance Bank Guarantee submitted under the Contract and shall not be construed as a substitute for the Performance Bank Guarantee..

1.17.2 The following shall be considered major seasonal test for the purpose of the above payment terms:

- i) Air-conditioning system : Summer and monsoon

1.18 Tender Drawings, Drawings for Approval & Completion Drawings

1.18.1 Tender Drawings:

The drawings appended with the tender documents are intended to show the areas to be conditioned, space allotted for various equipment's, tentative duct, cable and pipe routes. The equipment's offered shall be suitable for installation in the spaces shown in these drawings.

1.18.2 Drawings for approval on award of The Work:

The contractor shall prepare & submit three sets of following drawings and get them approved from the Engineer-in-charge before the start of the work. The approval of drawings however does not absolve the contractor not to supply the equipment's/ materials as per agreement, if there is any contradiction between the approved drawings and agreement.

- i. Layout drawings of the equipment's to be installed in various rooms such as plant room, AHU rooms, cooling tower and other equipment's
- ii. Drawings including section, showing the details of erection of entire equipment's including their foundations, water basin for the cooling towers/air washers, etc.
- iii. Plumbing drawings showing the layout of entire piping, dia. & length of pipes, valves and isometric drawings showing connections to various equipment's
- iv. Ducting drawings showing sizes, locations of dampers, grilles & diffusers
- v. Electrical wiring diagrams for all electrical equipment's and controls including the sizes and capacities of the various cables and equipment's
- vi. Dimensioned drawings of all electrical and control panels.
- vii. Drawings showing the details of all insulations and vapour barrier works
- viii. Drawings showing details of supports for pipes, cable trays, ducts etc.
- ix. Any other drawings relevant to the work.

1.18.3 Completion Drawings:

Three sets of the following laminated drawings shall be submitted by the contractor while handing over the installation to the Department. Out of this one of the sets shall be laminated on a hard base for display in the A.C. Plant room. In addition, one set will be given on compact disc.

- i. Plant installation drawings giving complete details of all the equipment's, including their foundations.
- ii. AHU room installation drawings.
- iii. Plumbing layout drawings, including insulation giving sizes and lengths of all the pipes and the sizes and locations of all types of valves, and including isometric drawings for the entire piping including the pipe connection to the various equipment's and insulation details wherever required.
- iv. Duct layout drawings with their sizes and locations, and sizes and locations of all dampers, grills & diffusers.
- v. Line diagram and layout of all electrical control panels giving switchgear ratings and their disposition, cable feeder sizes and their layout.
- vi. Control wiring drawings with all control components and sequence of operations to explain the operation of control circuits.

1.19 After Sales Services:

The contractor shall ensure adequate and prompt after sales service in the form of maintenance, spares and personnel as and when required and shall minimize the breakdown period. In case of equipment supplied by other manufacturers the firm shall furnish a guarantee from the manufacturer for the same before the plant is taken over.

1.20 Documents to be Furnished on Completion of Installation

Three sets of the following documents shall be furnished to the department by the contractor on completion of work:

- i. Completion drawings as per 1.18.3
- ii. sets of manufacturer's technical catalogues of all equipment's and accessories
- iii. Operation and maintenance manual of all major equipment's, detailing all adjustments, operation and maintenance procedure.

1.21.1 CPWD General Specifications for Heating, Ventilation & Air-Conditioning (HVAC) - 2017

Any additional item of work, if taken up subsequently, shall also confirm to the relevant CPWD specifications mentioned above.

1.21.2 Specifications as per BOQ/ Additional Specifications will supersede the CPWD Specifications.

1.21.3 Variation of Quantities with reference to BOQ Quantities:

The BOQ quantities are estimated quantities. The work will be executed as per approved drawings based on actual site requirements. The actual quantities may differ from BOQ quantities. The work will be executed as per actual quantities with plus/ minus deviation as permitted under conditions of the contract.

1.21.4 Wherever an item is not covered by the CPWD Specifications, the same will be as per Manufacturers specifications/ specifications as approved by the Engineer-in-Charge.

1.21.5 This is a turnkey job.

Even if certain items are not included in the BOQ, but are required for comprehensive completion of the job, the AC Contractor will do the same without any extra cost.

1.21.6 Air Conditioning work to be carried out with proper workmanship so that cutting of holes in the walls etc. to be made well in advance after due approval from the Engineer- in- charge at site. For carrying out HVAC piping works core cutting is to be carried out with proper planned manner by the contractor. The main contractor should be responsible for coordination work and making good and proper finishing.

1.21.7 For Operation & Maintenance Appendix H of CPWD General Specifications for Heating, Ventilation & Air-Conditioning (HVAC) - 2017

1.22 The Date of manufacturing of equipment/ machinery /material shall be less than one year from the date of supply of material at site.

1.23.1 BASIS OF DESIGN

Project : IISER Berhampur

1.23.2 LOCATION

Site location. : Berhampur, Orissa

Latitude. : 19.936°N

Longitude : 84.58°E

Altitude. : 26 meters.

1.23.3 OUTDOOR DESIGN CONDITIONS

Summer: Dry bulb 42 Deg C (107.6 Deg F) & RH 36%

Monsoon Dry bulb 33.3 Deg C (92 Deg F) & FRH 86%

	Dry Bulb Temp.	Wet Bulb Temp.	%RH	Due Point Temp	Grains/Pond
Summer	107.60	83.00	35.70	35.70	130.40
Monsoon	92.00	87.30	83.00	86.00	191.70

Winter	56.00	48.00	54.80	40.00	36.50
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1.23.4 INSIDE DESIGN CONDITIONS FOR AC AREAS

Inside Conditions.

Following indoor design conditions for centrally air conditioned spaces are proposed.

Summer & Monsoon: As tabulated below.

Winter: No heating proposed, however if hot water is circulated. Heating can be achieved

Laboratory Block

Space	Inside Conditions		Outdoor Air Ventilation Rate
	Temp °C (°F)	Relative Humidity %	
Laboratory	24 ± 1°C (75 ± 2°F)	55 % ± 10% (No humidification proposed)	10 CFM / Person +0.18CFM /sqft. Or Min 1ACH. or Earth science, Bio labs, chemistry & X ray - Min 10ACH. Labs with exhaust hoods indicated – Min requirement Plus additional exhaust hood requirement (Variable fresh air intake & exhaust) or 100% fresh air where ever required.

Space	Inside Conditions		Outdoor Air Ventilation Rate
	Temp °C (°F)	Relative Humidity %	
Office Space	24 ± 1°C (75 ± 2°F)	55 % ± 10% (No humidification proposed)	5 CFM / Person + 0.06 CFM / Sqft.
Server / UPS rooms	24 ± 1°C (75 ± 2°F)	55 % ± 10% (No humidification proposed)	1 ACH

Corridor	26 ± 1°C (78 ± 2°F)	55 % ± 10% (No humidification proposed)	Corridors: Min - 1ACH, shall be positively pressurized as compared to atrium / outside & negative as compared to Labs.
Toilet (Public)	Passive cooling	Passive cooling	7 ACH, Exhaust from each toilet will be exhausted through heat recovery unit on terrace, as air-conditioned air from corridor will suck air from corridor. Door under cut of 40 mm or double louvered air transfer grilles shall be provided in main entrance door to the Toilet for achieving the desired result.
Services Plant Rooms:	Passive cooling	Passive cooling	20-25 ACPH

Lecture Theatre Block, Admin Block & Auditorium.

Space	Inside Conditions		Outdoor Air Ventilation Rate
	Temp °C (°F)	Relative Humidity %	
Lecture Hall/	24 ± 1°C	55 % ± 10%	5 CFM / Person + 0.06 CFM / Sqft
Lecture rooms & Auditorium/ Admin block/ Office Space / Library	(75 ± 2°F)	(No humidification proposed)	
Atrium	Ambient	Ambient	Not Air conditioned - Passive cooling. No dedicated provision made, Ventilation through doors/ windows
Toilet (Public)	Ambient	Ambient	7 ACH, Exhaust from each toilet will be left into plumbing shaft on each floor

1.23.5 System Description

Air conditioning system designed to provide **summer & Monsoon** thermal environmental control with optimum operating cost. Proposed Research Centre building & additional buildings coming up nearby shall be air conditioned using common central plant.

Academic block, Sports complex & Auditorium Block shall be air conditioned using central chilled water plant. Air conditioning shall be provided by a central variable flow chilled water recirculation system for maximum energy conservation.

The central air conditioning system shall consist of water chilling units associated with chilled water pumps with variable frequency drive, condensing water pumps, air handling units **with** variable frequency drive, treated outdoor air units, fan coil units, chilled / condensing water piping with valves, air distribution system with grilles & diffusers, electrical panel, wiring, control wiring and earthing.

1.23.6 Estimated refrigeration load summary

Estimated Refrigeration load summary							
SNo.	Description	Area	Area	Cooling Load			
		Sqft	Sqm	Estimated	@Div	Proposed Capacity	
1	Auditorium Block	19,581	1,820	150.43	80%	120	
2	Sports Complex	40,224	3,738	237.86	80%	190	
3	Academic Block	3,99,258	37,106	2327	80%	1862	1862
	Grand Total	405277	37665	2743		2172	1862
	Proposed Capacity for each chiller (3 Working)						621
	Say						650
	Say					4# x 650TR	
For Phase 1 we are proposing 4 Chillers of 500TR Capacity (3W+1S)							

For details refer to Heat load Summary & AHU details Annexures attached.

1.23.7 Building management system - HVAC equipment's shall have one point control through BMS, refer the Input Output Summary Table.

1.23.8 VRF / VRV system of 102HP is proposed for Guest House, Refer to annexure attached for details.

1.23.9 Smoke Control / Smoke Evacuation system and Staircase / Lift Pressurization

Staircase/ Lift Well/ Lift Lobby & atrium Pressurization: As per NBC for buildings above 15 mtrs to be done.

In Academic building there are **14 lift wells, 5 Lift lobbies & two stairwells** that are pressurized. The stair wells on periphery of building shall have 1sqm opening on every landing.

The Corridors of Academic block are considered as escape route so shall have a Corridor Smoke management system for all floors designed @ 12 ACPH.

Auditorium shall have smoke exhaust system for any eventuality.

Annexure – Heat Load Summary - IISER Bpur - Academic Block																		
Sr. No.	Floor	Area description	Area	CFM/ person	CFM/ Sqft	OC C	ACH	FA	Eqp load	Light load	Cooling Load		SELECTED		TOTAL	EQ. SELECTED		AHU
			Sqft			#	CFM	CFM	W	W	TR	CFM		CFM	CFM	TR	AHU	TYPE
1	Lvl-1	BACK OF THE HOUSE FACILITIES-0	1308	5	0.06	10	1	300	654	1426	5.8	2293		2300	7500	19.3	8000	F/M-2
2	Lvl-1	ADMINISTRATION	1136	5	0.06	8	1	261	568	1239	4.8	1818		1900				
3	Lvl-1	ADMINISTRATION-1	1136	5	0.06	8	1	261	568	1239	4.8	1818		1900				
4	Lvl-1	ADMINISTRATION-2	869	5	0.06	6	1	200	435	948	3.5	1287		1300	1300	3.5		INCL IN AHU-3
5	Lvl-1	AHU ROOM -1	162	5	0.06	0	1	37	81	177	0.7	306		300	300	0.7		INCL IN AHU-1
6	Lvl-1	DISCUSSION ROOM	311	5	0.06	9	1	101	155	339	1.9	619		700	1400	3.8		INCL IN AHU - 2
7	Lvl-1	DISCUSSION ROOM-1	323	5	0.06	9	1	103	161	352	2.0	707		700				
8	Lvl-1	ADMINISTRATION-3	906	5	0.06	6	1	208	453	988	3.9	1540		1600	6000	15.8	6000	F/M-3
9	Lvl-1	ADMINISTRATION-4	1212	5	0.06	9	1	278	606	1321	5.3	2066		2100				
10	Lvl-1	ADMINISTRATION-5	1212	5	0.06	9	1	278	606	1321	5.0	1872		1900	5300	14.4	6000	F/M-4
11	Lvl-1	ADMINISTRATION-6	904	5	0.06	6	1	208	452	985	4.0	1570		1600				
12	Lvl-1	AHU ROOM -2	422	5	0.06	0	1	97	211	460	1.6	615		600	8800	25.0	10000	F/M-1
13	Lvl-1	BACK OF THE HOUSE FACILITIES-1	1171	5	0.06	8	1	269	585	1276	4.3	1395		1400				
14	Lvl-1	BACK OF THE HOUSE FACILITIES	323	5	0.06	3	1	74	161	352	1.4	532		600				

15	Lvl-1	BACK OF THE HOUSE FACILITIES-2	323	5	0.06	3	1	74	161	352	1.4	509		500				
16	Lvl-1	BACK OF THE HOUSE FACILITIES-3	323	5	0.06	3	1	74	161	352	1.4	509		500				
17	Lvl-1	BACK OF THE HOUSE FACILITIES-4	1171	5	0.06	8	1	269	585	1276	4.1	1284		1300				
18	Lvl-1	BACK OF THE HOUSE FACILITIES-5	323	5	0.06	3	1	74	161	352	1.4	509		500				

19	Lvl-1	BACK OF THE HOUSE FACILITIES-6	323	5	0.06	3	1	74	161	352	1.4	509		500				
20	Lvl-1	BACK OF THE HOUSE FACILITIES-7	1171	5	0.06	8	1	269	585	1276	4.4	1469		1500				
21	Lvl-1	BACK OF THE HOUSE FACILITIES-8	323	5	0.06	3	1	74	161	352	1.4	509		500				
22	Lvl-1	BACK OF THE HOUSE FACILITIES-9	338	5	0.06	3	1	78	169	368	1.5	569		600				
23	Lvl-1	OFFICE-1	180	5	0.06	4	1	52	90	196	1.2	499		500	4700	11.9	5000	F/M-5
24	Lvl-1	OFFICE-2	180	5	0.06	4	1	52	90	196	1.0	369		400				
25	Lvl-1	OFFICE-3	182	5	0.06	4	1	53	91	198	1.1	393		400				

Annexure – Heat Load Summary - IISER Bpur - Academic Block

Sr. No.	Floor	Area description	Area	CFM/ person	CFM/ Sqft	OC C	ACH	FA	Eqp load	Light load	Cooling Load		SELECTED		TOTAL	EQ. SELECTED		AHU
			Sqft			#	CFM	CFM	W	W	TR	CFM		CFM	CFM	TR	AHU	TYPE
26	Lvl-1	OFFICE-4	185	5	0.06	4	1	53	93	202	1.1	406		500				
27	Lvl-1	OFFICE-5	180	5	0.06	4	1	52	90	196	1.0	369		400				

28	Lvl-1	OFFICE-6	180	5	0.06	4	1	52	90	196	1.0	369		400	4600	12.2	5000	F/M-6
29	Lvl-1	OFFICE-7	180	5	0.06	4	1	52	90	196	1.0	369		400				
30	Lvl-1	MEETING ROOM	365	5	0.06	10	1	116	182	398	2.6	1067		1100				
31	Lvl-1	MEETING ROOM-1	365	5	0.06	10	1	116	182	398	2.8	1187		1200				
32	Lvl-1	OFFICE-8	180	5	0.06	4	1	52	90	196	0.9	299		300				
33	Lvl-1	OFFICE-9	180	5	0.06	4	1	52	90	196	0.9	299		300				
34	Lvl-1	OFFICE-10	180	5	0.06	4	1	52	90	196	0.9	299		300				
35	Lvl-1	OFFICE-11	180	5	0.06	4	1	52	90	196	1.0	327		400				
36	Lvl-1	OFFICE-12	182	5	0.06	4	1	53	91	198	1.0	322		400	4600	12.2	5000	F/M-6
37	Lvl-1	OFFICE-13	180	5	0.06	4	1	52	90	196	0.9	299		300				
38	Lvl-1	OFFICE-14	180	5	0.06	4	1	52	90	196	0.9	299		300				

39	Lvl-1	OFFICE-15	180	5	0.06	4	1	52	90	196	1.1	415		500	14700	41.0	16000	F/M-7
40	Lvl-1	ADVANCED INSTRUMENTATION	1722	10	0.18	34	1	650	7919	2410	12.1	4457		4500				
41	Lvl-1	ADVANCED INSTRUMENTATION-0	1722	10	0.18	34	1	650	7919	2410	11.9	4249		4300				
42	Lvl-1	ADVANCED INSTRUMENTATION-1	1670	10	0.18	33	1	631	7682	2338	11.4	4046		4100	9200	26.0	10000	F/M-8
43	Lvl-1	ADVANCED INSTRUMENTATION-2	1787	10	0.18	36	1	682	8221	2502	12.0	4181		4300				
44	Lvl-1	ADVANCED INSTRUMENTATION-3	1796	10	0.18	36	1	683	8261	2514	12.1	4195		4300	8800	21.1	10000	F/M-9
45	Lvl-1	ADVANCED INSTRUMENTATION-4	323	10	0.18	6	1	118	1485	452	2.8	1263		1300				
46	Lvl-1	ADVANCED INSTRUMENTATION-5	323	10	0.18	6	1	118	1485	452	2.7	1162		1200				
47	Lvl-1	ADVANCED INSTRUMENTATION-6	323	10	0.18	6	1	118	1485	452	2.7	1162		1200				

48	Lvl-1	LOUNGE	376	5	0.06	8	1	108	188	409	2.4	976		1000				
49	Lvl-1	ADVANCED INSTRUMENTATION-7	311	10	0.18	6	1	116	1430	435	2.4	957		1000				
50	Lvl-1	ADVANCED INSTRUMENTATION-8	300	10	0.18	6	1	114	1381	420	2.3	935		1000				
51	Lvl-1	ADVANCED INSTRUMENTATION-9	578	10	0.18	12	1	224	2658	809	4.3	1613		1700	3800	9.1	4000	F/M-10

Annexure – Heat Load Summary - IISER Bpur - Academic Block

Sr. No.	Floor	Area description	Area	CFM/ person	CFM/ Sqft	OC C	ACH	FA	Eqp load	Light load	Cooling Load		SELECTED		TOTAL	EQ. SELECTED		AHU
			Sqft			#	CFM	CFM	W	W	TR	CFM		CFM	CFM	TR	AHU	TYPE
52	Lvl-1	ADVANCED INSTRUMENTATION-10	323	10	0.18	6	1	118	1485	452	2.4	980		1000				
53	Lvl-1	AHU-3	277	5	0.06	0	1	63	138	301	1.4	621		700	700	1.4		INCL IN AHU-9
54	Lvl-1	ROOM-13	919	5	0.06	7	1	211	459	1002	3.6	1239		1300	1700	4.7	2000	F/M-11
55	Lvl-1	ROOM-14	325	5	0.06	2	1	75	162	354	1.4	562		600	1100	2.4		INCL IN AHU-10
56	Lvl-1	AHU ROOM-4	161	5	0.06	0	1	37	81	176	1.0	482		500				
57	Lvl-1	AHU ROOM-5	335	5	0.06	0	1	77	167	365	1.1	363		400	400	1.1		INCL IN

																		AHU-11
58	Lvl-1	ADVANCED INSTRUMENTATION-11	1788	10	0.18	36	1	682	8226	2504	12.0	4182		4300	9900	25.3	10000	F/M-12

59	Lvl-1	ADVANCED INSTRUMENTATION-12	1788	10	0.18	36	1	682	8226	2504	12.0	4182		4300				
60	Lvl-1	ADVANCED INSTRUMENTATION-13	2325	10	0.18	47	1	889	10696	3255	16.6	6105		6100	6500	16.6	8000	F/M-13
61	Lvl-1	3050 MM WIDE CORRIDOR	2671	5	0.06	19	1	613	1335	1335	7.2	1429		600	600	1.9		INCL IN AHU-1
62	Lvl-1	CORRIDOR-1	4257	5	0.06	30	1	977	2128	4640	13.8	3658		1000	1000	3.1		INCL IN AHU-3
63	Lvl-1	CORRIDOR-2	2451	5	0.06	18	1	563	1226	2672	16.0	6768		600	600	1.9		INCL IN AHU-8
64	Lvl-1	CORRIDOR-3	1783	5	0.06	13	1	409	891	1943	7.9	2764		400	400	1.3		INCL IN AHU-12
65	Lvl-1	LIFT LOBBY-1	377	5	0.06	3	1	86	188	410	1.7	589						
66	Lvl-1	LIFT LOBBY-2	196	5	0.06	1	1	45	98	213	1.0	375						
67	Lvl-1	AHU-6	459	5	0.06	0	1	105	230	501	2.0	843		900	900	2.0		INCL IN AHU-12
68	Lvl-1	AHU-7	340	5	0.06	0	1	78	170	371	1.2	403		400	400	1.2		INCL IN AHU-13
69	Lvl - 2	LABORATORY-1	1383	10	0.18	10	10	3175	6360	1936	31.4	3997		4000	4300	32.3	5000	F/M-14
70	Lvl - 2	LABORATORY-2	1212	10	0.18	10	10	2782	5573	1696	27.8	3695		3700	4100	28.9	4000	F/M-15

71	Lvl - 2	LABORATORY-3	1212	10	0.18	10	10	2782	5573	1696	27.8	3695		3700	4100	28.9	4000	F/M-16
72	Lvl - 2	LABORATORY-4	581	10	0.18	4	10	1334	2673	813	13.4	1806		1900	2300	14.5	2500	F/M-17
73	Lvl - 2	DISCUSSION ROOM-1	168	5	0.06	5	1	55	84	183	1.1	393		400	400			INCL IN AHU-15

Annexure – Heat Load Summary - IISER Bpur - Academic Block																		
Sr. No.	Floor	Area description	Area	CFM/ person	CFM/ Sqft	OCC	ACH	FA	Eqp load	Light load	Cooling Load		SELECTED		TOTAL	EQ. SELECTED		AHU
			Sqft			#	CFM	CFM	W	W	TR	CFM		CFM	CFM	TR	AHU	TYPE
74	Lvl -2	DISCUSSION ROOM-2	180	5	0.06	5	1	57	90	196	1.1	378		425	425	1.1	425	CASSAT TE
75	Lvl -2	DISCUSSION ROOM-3	180	5	0.06	5	1	57	90	196	1.1	378		425	425	1.1	425	CASSAT TE
76	Lvl -2	DISCUSSION ROOM-4	180	5	0.06	5	1	57	90	196	1.1	378		425	425	1.1	425	CASSAT TE
77	Lvl -2	DISCUSSION ROOM-5	180	5	0.06	5	1	57	90	196	1.1	378		425	425	1.1	425	CASSAT TE
78	Lvl -2	DISCUSSION ROOM-6	180	5	0.06	5	1	57	90	196	1.1	378		400	400	1.1		INCL IN AHU-16
79	Lvl -2	DISCUSSION ROOM-7	180	5	0.06	5	1	57	90	196	1.1	378		400	400	1.1		INCL IN AHU-17
80	Lvl -2	DISCUSSION ROOM-8	180	5	0.06	5	1	57	90	196	1.1	378		400	3400	9.5	4000	F/M-18
81	Lvl -2	DISCUSSION ROOM-9	180	5	0.06	5	1	57	90	196	1.1	378		400				
82	Lvl -2	DISCUSSION ROOM-10	180	5	0.06	5	1	57	90	196	1.1	378		400				

83	Lvl -2	DISCUSSION ROOM-11	180	5	0.06	5	1	57	90	196	1.1	378		400				
84	Lvl -2	DISCUSSION ROOM-12	180	5	0.06	5	1	57	90	196	1.1	378		400				
85	Lvl -2	DISCUSSION ROOM-13	180	5	0.06	5	1	57	90	196	1.1	378		400				
86	Lvl -2	DISCUSSION ROOM-14	168	5	0.06	5	1	55	84	183	1.1	385		400				
87	Lvl -2	FACULTY ROOM-1	180	5	0.06	3	1	47	90	196	1.0	401		450	7200	17.9	8000	F-M-22
88	Lvl -2	FACULTY ROOM-2	180	5	0.06	3	1	47	90	196	0.8	284		300				
89	Lvl -2	FACULTY ROOM-3	180	5	0.06	3	1	47	90	196	0.8	284		300				

90	Lvl -2	FACULTY ROOM-7	180	5	0.06	3	1	47	90	196	0.9	312		350				
91	Lvl -2	FACULTY ROOM-8	180	5	0.06	3	1	47	90	196	0.8	289		300				
92	Lvl -2	FACULTY ROOM-4	180	5	0.06	3	1	47	90	196	0.8	284		300				
93	Lvl -2	FACULTY ROOM-5	180	5	0.06	3	1	47	90	196	0.8	284		300				
94	Lvl -2	FACULTY ROOM-9	178	5	0.06	3	1	47	89	194	0.9	299		300				
95	Lvl -2	FACULTY ROOM-10	175	5	0.06	3	1	47	88	191	0.9	299		300				
96	Lvl -2	FACULTY ROOM-6	180	5	0.06	3	1	47	90	196	0.8	284		300				
97	Lvl -2	DISCUSSION ROOM-15	180	5	0.06	5	1	57	90	196	1.0	319		400				

Annexure – Heat Load Summary - IISER Bpur - Academic Block

Sr. No.	Floor	Area description	Area	CFM/ person	CFM/ Sqft	OCC	ACH	FA	Eqp load	Light load	Cooling Load	SELECTED	TOTAL	EQ. SELECTED	AHU
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			Sqft			#	CFM	CFM	W	W	TR	CFM		CFM	CFM	TR	AHU	TYPE
98	Lvl -2	DISCUSSION ROOM-16	180	5	0.06	5	1	57	90	196	1.0	319		400				
99	Lvl -2	DISCUSSION ROOM-17	180	5	0.06	5	1	57	90	196	1.0	319		400				
100	Lvl -2	DISCUSSION ROOM-18	180	5	0.06	5	1	57	90	196	1.0	319		400				
101	Lvl -2	LABORATORY-12	1212	10	0.18	9	10	2782	5573	1696	27.1	3223		3300	3300	27.1	4000	F/M-21
102	Lvl -2	LABORATORY-13	1212	10	0.18	9	10	2782	5573	1696	27.1	3166		3300	3300	27.1	4000	F/M-23
103	Lvl -2	DISCUSSION ROOM-19	180	5	0.06	5	1	57	90	196	1.0	319		400	1700	4.2		INCL IN AHU-22
104	Lvl -2	DISCUSSION ROOM-20	180	5	0.06	5	1	57	90	196	1.0	319		400				
105	Lvl -2	DISCUSSION ROOM-21	180	5	0.06	5	1	57	90	196	1.0	319		400				
106	Lvl -2	DISCUSSION ROOM-22	168	5	0.06	5	1	55	84	183	1.1	421		500				
107	Lvl -2	ROOM-1	579	5	0.06	12	1	164	289	631	2.8	866		1100	1100	3.17	1100	CASSATTE
108	Lvl -2	LABORATORY-5	1198	10	0.18	9	1	306	5509	1677	7.0	3129		3200	3200	7.0	4000	F/M-19
109	Lvl -2	LABORATORY-6	596	10	0.18	4	1	147	2742	835	3.5	1604		1600	1600	3.5	2000	F/M-20

110	Lvl -2	OFFFICE-1	176	5	0.06	4	1	52	88	192	1.1	439		500	4600	10.2	5000	F/M-24
111	Lvl -2	OFFFICE-2	179	5	0.06	4	1	52	89	195	1.1	440		500				
112	Lvl -2	OFFFICE-3	180	5	0.06	4	1	52	90	196	1.1	440		500				
113	Lvl -2	OFFFICE-4	180	5	0.06	4	1	52	90	196	1.1	440		500				
114	Lvl -2	OFFFICE-5	180	5	0.06	4	1	52	90	196	1.1	440		500				

115	Lvl -2	OFFFICE-6	180	5	0.06	4	1	52	90	196	1.1	440		500	4700	12.1	5000	F/M-26				
116	Lvl -2	OFFFICE-7	180	5	0.06	4	1	52	90	196	1.1	440		500								
117	Lvl -2	OFFFICE-8	180	5	0.06	4	1	52	90	196	1.1	440		500								
118	Lvl -2	OFFFICE-9	178	5	0.06	4	1	52	89	194	1.3	556		600								
119	Lvl -2	OFFFICE-10	180	5	0.06	4	1	52	90	196	1.2	485		500								
120	Lvl -2	OFFFICE-11	180	5	0.06	4	1	52	90	196	1.0	369		400								
121	Lvl -2	OFFFICE-12	180	5	0.06	4	1	52	90	196	1.0	387		400								
122	Lvl -2	OFFFICE-13	185	5	0.06	4	1	53	93	202	1.1	403		500	4200	11.9	5000	F/M-27				
123	Lvl -2	OFFFICE-14	180	5	0.06	4	1	52	90	196	1.0	369		400								
Annexure – Heat Load Summary - IISER Bpur - Academic Block																						
Sr. No.	Floor	Area description	Area	CFM/ person	CFM/ Sqft	OCC	ACH	FA	Eqp load	Light load	Cooling Load		SELECTED						TOTAL	EQ. SELECTED		AHU
			Sqft			#	CFM	CFM	W	W	TR	CFM		CFM					CFM	TR	AHU	TYPE
124	Lvl -2	OFFFICE-15	180	5	0.06	4	1	52	90	196	1.0	369		400					4200	11.9	5000	F/M-27
125	Lvl -2	OFFFICE-16	180	5	0.06	4	1	52	90	196	1.0	369		400								
126	Lvl -2	MEETING -1	323	5	0.06	9	1	103	161	352	2.2	839		900								
127	Lvl -2	MEETING -2	323	5	0.06	9	1	103	161	352	2.0	699		700	4200	11.9	5000	F/M-27				
128	Lvl -2	OFFFICE-17	180	5	0.06	4	1	52	90	196	0.9	299		300								
129	Lvl -2	OFFFICE-18	180	5	0.06	4	1	52	90	196	0.9	299		300								
130	Lvl -2	OFFFICE-19	180	5	0.06	4	1	52	90	196	0.9	299		300								
131	Lvl -2	OFFFICE-20	180	5	0.06	4	1	52	90	196	1.0	331		400								
132	Lvl -2	OFFFICE-21	180	5	0.06	4	1	52	90	196	0.9	316		400								
133	Lvl -2	OFFFICE-22	180	5	0.06	4	1	52	90	196	0.9	299		300								

134	Lvl -2	OFFFICE-23	180	5	0.06	4	1	52	90	196	0.9	299		300	4100	10.9	4000	F/M-28
135	Lvl -2	OFFFICE-24	168	5	0.06	3	1	45	84	183	0.9	369		400				
136	Lvl -2	ROOM-3	995	5	0.06	20	1	279	498	1085	5.4	1957		2000				
137	Lvl -2	DISCUSSION ROOM-23	241	5	0.06	7	1	78	121	263	1.6	570		600				
138	Lvl -2	DISCUSSION ROOM-24	179	5	0.06	5	1	57	89	195	1.0	319		400				
139	Lvl -2	DISCUSSION ROOM-25	168	5	0.06	5	1	55	84	183	1.1	422		500	11900	29.5	12000	F/M-29
140	Lvl -2	LABORATORY-7	1212	10	0.18	10	1	318	5573	1696	7.1	3121		3200				
141	Lvl -2	DISCUSSION ROOM-26	168	5	0.06	5	1	55	84	183	1.1	422		500				
142	Lvl -2	DISCUSSION ROOM-27	179	5	0.06	5	1	57	89	195	1.0	338		400				
143	Lvl -2	LABORATORY-8	1212	10	0.18	26	1	478	5573	1696	9.2	3416		3500				
144	Lvl -2	LABORATORY-9	596	10	0.18	13	1	237	2742	835	4.8	1884		1900				
145	Lvl -2	DISCUSSION ROOM-28	179	5	0.06	5	1	57	89	195	1.0	350		400				
146	Lvl -2	DISCUSSION ROOM-29	179	5	0.06	5	1	57	89	195	1.0	319		400				
147	Lvl -2	DISCUSSION ROOM-30	179	5	0.06	5	1	57	89	195	1.0	319		400				
148	Lvl -2	DISCUSSION ROOM-31	179	5	0.06	5	1	57	89	195	1.2	436		500	7200	18.7	8000	F/M-30
149	Lvl -2	FACULTY ROOM-11	180	5	0.06	3	1	47	90	196	1.2	540		600				
Annexure – Heat Load Summary - IISER Bpur - Academic Block																		
Sr. No.	Floor	Area description	Area	CFM/ person	CFM/ Sqft	OCC	ACH	FA	Eqp load	Light load	Cooling Load		SELECTED		TOTAL	EQ. SELECTED		AHU
			Sqft			#	CFM	CFM			TR	CFM		CFM		TR	AHU	TYPE

150	Lvl - 2	FACULTY ROOM-12	180	5	0.06	3	1	47	90	196	1.0	423		500				
151	Lvl - 2	FACULTY ROOM-13	180	5	0.06	3	1	47	90	196	1.0	423		500				
152	Lvl - 2	FACULTY ROOM-14	180	5	0.06	3	1	47	90	196	1.1	423		500				
153	Lvl - 2	FACULTY ROOM-15	180	5	0.06	3	1	47	90	196	1.1	423		500				
154	Lvl - 2	FACULTY ROOM-16	180	5	0.06	3	1	47	90	196	1.1	423		500				
155	Lvl - 2	LOUNGE	457	5	0.06	13	1	147	229	498	3.0	998		1000				
156	Lvl - 2	FACULTY ROOM-17	180	5	0.06	3	1	47	90	196	0.9	282		300				
157	Lvl - 2	FACULTY ROOM-18	180	5	0.06	3	1	47	90	196	0.9	282		300				
158	Lvl - 2	FACULTY ROOM-19	180	5	0.06	3	1	47	90	196	0.9	282		300				
159	Lvl - 2	FACULTY ROOM-20	180	5	0.06	3	1	47	90	196	1.0	314		400				
160	Lvl - 2	FACULTY ROOM-21	168	5	0.06	3	1	45	84	183	0.9	285		300				
161	Lvl - 2	FACULTY ROOM-22	180	5	0.06	3	1	47	90	196	0.9	282		300				
162	Lvl - 2	FACULTY ROOM-23	180	5	0.06	3	1	47	90	196	1.1	398		400	3100	8.6	3000	F/M-31
163	Lvl - 2	ROOM-2	576	5	0.06	4	1	132	288	627	2.7	866		900				
164	Lvl - 2	ROOM-4	328	5	0.06	2	1	75	164	358	1.7	566		600				
165	Lvl - 2	ROOM-5	1007	5	0.06	7	1	231	504	1098	4.4	1368		1400				

166	Lvl - 2	DISCUSSION ROOM-32	180	5	0.06	5	1	57	90	196	1.5	574		600	5400	13.9	6000	F/M-33
167	Lvl - 2	DISCUSSION ROOM-33	180	5	0.06	5	1	57	90	196	1.3	458		500				
168	Lvl - 2	DISCUSSION ROOM-34	180	5	0.06	5	1	57	90	196	1.3	458		500				
169	Lvl - 2	DISCUSSION ROOM-35	180	5	0.06	5	1	57	90	196	1.3	488		500				
170	Lvl - 2	LABORATORY-10	1212	10	0.18	9	1	308	5573	1696	7.0	2745		2800				
171	Lvl - 2	LABORATORY-11	1212	10	0.18	9	1	308	5573	1696	7.0	2744		2800	5900	14.8	6000	F/M-34
172	Lvl - 2	DISCUSSION ROOM-36	180	5	0.06	5	1	57	90	196	1.3	476		500				
173	Lvl - 2	DISCUSSION ROOM-37	180	5	0.06	5	1	57	90	196	1.3	458		500				

174	Lvl -2	DISCUSSION ROOM-38	180	5	0.06	5	1	57	90	196	1.5	577		600				
175	Lvl -2	ROOM-6	1240	5	0.06	10	1	285	620	1351	5.6	1952		2000	3900	11.7	4000	F/M-35

Annexure – Heat Load Summary - IISER Bpur - Academic Block

Sr. No.	Floor	Area description	Area	CFM/ person	CFM/ Sqft	OCC	ACH	FA	Epp load	Light load	Cooling Load		SELECTED		TOTAL	EQ. SELECTED		AHU
			Sqft			#	CFM	CFM			TR	CFM		CFM	CFM	TR	AHU	TYPE
176	Lvl -2	ROOM-7	1240	5	0.06	10	1	285	620	1351	4.8	1400		1500				
177	Lvl -2	LIFT LOBBY-1	377	5	0.06	3	1	86	188	410	2.0	592						
178	Lvl -2	LIFT LOBBY-2	196	5	0.06	1	1	45	98	213	1.2	375						
179	Lvl -2	CORRIDOR-1	2614	5	0.06	19	1	600	1307	2849	8.6	2015		600	600	1.9		INCL IN AHU-18

180	Lvl -2	CORRIDOR-2	2805	5	0.06	20	1	644	1403	3058	8.3	1720		700	700	2.2		INCL IN AHU-22
181	Lvl -2	CORRIDOR-3	1741	5	0.06	12	1	400	870	1898	5.2	1076		400	400	1.3		INCL IN AHU-29
182	Lvl -2	CORRIDOR-4	5113	5	0.06	37	1	1174	2557	5573	19.1	4818		1200	1200	3.8		INCL IN AHU-30
183	Lvl -2	CORRIDOR-5	1647	5	0.06	12	1	378	824	1796	6.0	1576		900	900	2.8		INCL IN AHU33&34
184	Lvl -2	AHU ROOM-1	422	5	0.06	0	1	97	211	460	1.8	617		700	700	1.8		INCL IN AHU -25
185	Lvl -2	AHU ROOM-2	162	5	0.06	0	1	37	81	177	0.9	309		300	300	0.9		INCL IN AHU-14
186	Lvl -2	AHU ROOM-3	388	5	0.06	0	1	89	194	423	1.7	631		600	600	1.8		INCL IN AHU-28
187	Lvl -2	AHU ROOM-4	130	5	0.06	0	1	30	65	142	0.8	297		300	300	0.8		INCL IN AHU-29
188	Lvl -2	AHU ROOM-5	277	5	0.06	0	1	63	138	301	1.6	616		600	600	1.6		INCL IN

																		AHU-30
189	Lvl -2	AHU ROOM-6	184	5	0.06	0	1	42	92	201	1.3	557		600	600	1.3		INCL IN AHU-31
190	Lvl -2	AHU ROOM-7	334	5	0.06	0	1	77	167	364	1.3	361		400	400	1.3		INCL IN AHU-32
191	Lvl -2	AHU ROOM-8	461	5	0.06	0	1	106	230	502	2.2	843		900	900	2.2		INCL IN AHU-34

192	Lvl -2	AHU ROOM-9	339	5	0.06	0	1	78	169	369	1.3	402		400	400	1.3		INCL IN AHU- 35
193	Lvl-3	ROOM-1	1383	5	0.06	10	1	317	691	1507	6.5	2321		2400	2900	7.5	3000	F/M- 36
194	Lvl-3	ROOM-2	1521	5	0.06	11	1	349	761	1658	6.7	2317		2400	4300	12.0	5000	F/M- 38
195	Lvl-3	DISCUSSION ROOM	285	5	0.06	8	1	91	143	311	1.7	531		600				
196	Lvl-3	ROOM-3	820	5	0.06	6	1	188	410	894	3.6	1220		1300				
Annexure – Heat Load Summary - IISER Bpur - Academic Block																		
Sr. No.	Floor	Area description	Area	CFM/ person	CFM/ Sqft	OCC	ACH	FA	Eqp load	Light load	Cooling Load		SELECTED		TOTAL	EQ. SELECTED		AHU
			Sqft			#	CFM	CFM	W	W	TR	CFM		CFM	CFM	TR	AHU	TYPE
197	Lvl-3	ROOM-4	581	5	0.06	4	10	1334	291	633	12.9	1220		1300	1300	12.9	1500	F/M- 37
198	Lvl-3	ROOM-5	806	5	0.06	6	1	185	403	878	3.7	1271		1300	2400	7.1	2500	F/M- 39
199	Lvl-3	ROOM-6	596	5	0.06	4	10	1369	298	650	13.2	1211		1300	1300	13.2	1500	F/M- 40
200	Lvl-3	ROOM-7	903	5	0.06	6	1	207	451	984	4.0	1366		1400	7800	21.6	8000	F/M- 48
201	Lvl-3	ROOM-8	903	5	0.06	6	1	207	451	984	4.0	1366		1400				
202	Lvl-3	ROOM-9	1517	5	0.06	11	1	348	759	1654	7.1	2512		2600				
203	Lvl-3	LABORATORY-3	1079	10	0.18	8	1	274	4964	1511	6.3	2510		2600	2600	6.3	3000	F/M- 49
204	Lvl-3	LABORATORY-4	1094	10	0.18	8	1	277	5034	1532	6.4	2535		2600	2600	6.4	3000	F/M- 52
205	Lvl-3	FACULTY ROOM- 1	180	5	0.06	3	1	47	90	196	1.1	398		400	7000	18.8	8000	F/M- 41

206	Lvl-3	FACULTY ROOM-2	180	5	0.06	3	1	47	90	196	0.9	284		300				
207	Lvl-3	FACULTY ROOM-3	180	5	0.06	3	1	47	90	196	0.8	284		300				
208	Lvl-3	FACULTY ROOM-20	180	5	0.06	3	1	47	90	196	0.9	315		300				
209	Lvl-3	FACULTY ROOM-21	180	5	0.06	3	1	47	90	196	0.8	289		300				
210	Lvl-3	FACULTY ROOM-4	180	5	0.06	3	1	47	90	196	0.8	284		300				
211	Lvl-3	FACULTY ROOM-5	180	5	0.06	3	1	47	90	196	0.8	284		300				
212	Lvl-3	FACULTY ROOM-22	178	5	0.06	3	1	47	89	194	0.9	299		300				
213	Lvl-3	FACULTY ROOM-23	174	5	0.06	3	1	15	87	190	0.6	279		300				
214	Lvl-3	FACULTY ROOM-6	180	5	0.06	3	1	47	90	196	0.8	284		300				
215	Lvl-3	LABORATORY-1	1220	10	0.18	9	10	2802	5613	1708	27.3	3219		3300	3300	27.3	4000	F-M-42
216	Lvl-3	DISCUSSION ROOM-1	180	5	0.06	5	1	57	90	196	1.0	324		400	3200	8.1		INCL IN AHU - 41
217	Lvl-3	DISCUSSION ROOM-2	180	5	0.06	5	1	57	90	196	1.0	324		400				
218	Lvl-3	DISCUSSION ROOM-3	180	5	0.06	5	1	57	90	196	1.0	324		400				
219	Lvl-3	DISCUSSION ROOM-4	180	5	0.06	5	1	57	90	196	1.0	324		400				
220	Lvl-3	DISCUSSION ROOM-5	180	5	0.06	5	1	57	90	196	1.0	324		400				
221	Lvl-3	DISCUSSION ROOM-6	180	5	0.06	5	1	57	90	196	1.0	324		400				
222	Lvl-3	DISCUSSION ROOM-7	180	5	0.06	5	1	57	90	196	1.0	324		400				

Annexure – Heat Load Summary - IISER Bpur - Academic Block																		
Sr. No.	Floor	Area description	Area	CFM/ person	CFM/ Sqft	OCC	ACH	FA	Eqp load	Light load	Cooling Load		SELECTED		TOTAL	EQ. SELECTED		AHU
			Sqft			#	CFM	CFM	W	W	TR	CFM		CFM	CFM	TR	AHU	TYPE
223	Lvl-3	DISCUSSION ROOM-8	180	5	0.06	5	1	57	90	196	1.0	324		400				
224	Lvl-3	LABORATORY-2	1203	10	0.18	9	10	2762	5534	1684	27.1	3304		3400	3400	27.1	4000	F/M-43
225	Lvl-3	ROOM -16	897	5	0.06	6	1	206	449	978	3.7	1367		1400	3500	9.7	4000	F/M-44

226	Lvl-3	FACULTY ROOM-24	180	5	0.06	3	1	47	90	196	0.9	310		300				
227	Lvl-3	FACULTY ROOM-25	180	5	0.06	3	1	47	90	196	0.8	284		300				
228	Lvl-3	FACULTY ROOM-26	180	5	0.06	3	1	47	90	196	0.8	284		300				
229	Lvl-3	FACULTY ROOM-27	180	5	0.06	3	1	47	90	196	1.0	401		400				
230	Lvl-3	DISCUSSION ROOM-25	180	5	0.06	5	1	57	90	196	1.2	440		500	4100	10.4	4000	F/M-45
231	Lvl-3	DISCUSSION ROOM-26	180	5	0.06	5	1	57	90	196	1.0	324		400				
232	Lvl-3	DISCUSSION ROOM-27	180	5	0.06	5	1	57	90	196	1.0	324		400				
233	Lvl-3	DISCUSSION ROOM-28	180	5	0.06	5	1	57	90	196	1.2	440		500				
234	Lvl-3	ROOM -17	2135	5	0.06	15	1	490	1067	2327	7.4	2244		2300	2300	7.4	2500	F/M-46
235	Lvl-3	ROOM -18	1885	5	0.06	13	1	433	943	2055	6.5	1985		2000	2000	6.5	2000	F/M-47
236	Lvl-3	OFFICE-1	176	5	0.06	3	1	47	88	192	1.1	478		500	4800	12.7	5000	F/M-50
237	Lvl-3	OFFICE-2	176	5	0.06	3	1	47	88	192	0.9	347		400				
238	Lvl-3	OFFICE-3	176	5	0.06	3	1	47	88	192	1.0	367		400				
239	Lvl-3	OFFICE-4	183	5	0.06	3	1	48	91	199	1.0	388		400				

240	Lvl-3	OFFICE-5	175	5	0.06	3	1	47	88	191	0.9	346		400	4300	12.5	5000	F/M-51
241	Lvl-3	ROOM-10	1708	5	0.06	11	1	392	854	1861	6.4	2160		2200				
242	Lvl-3	ROOM-11	1708	5	0.06	11	1	392	854	1861	5.9	1841		1900				
243	Lvl-3	OFFICE-6	176	5	0.06	3	1	47	88	192	0.8	277		300				
244	Lvl-3	OFFICE-7	185	5	0.06	3	1	48	93	202	0.9	319		300				
245	Lvl-3	OFFICE-8	182	5	0.06	3	1	48	91	198	0.9	306		300				
246	Lvl-3	OFFICE-9	180	5	0.06	3	1	47	90	196	0.8	282		300				
247	Lvl-3	OFFICE-10	180	5	0.06	3	1	47	90	196	0.8	282		300				
248	Lvl-3	OFFICE-11	166	5	0.06	3	1	45	83	181	1.0	390		400				
Annexure – Heat Load Summary - IISER Bpur - Academic Block																		

Sr. No.	Floor	Area description	Area	CFM/ person	CFM/ Sqft	OCC	ACH	FA	Eqp load	Light load	Cooling Load		SELECTED		TOTAL	EQ. SELECTED		AHU
			Sqft			#	CFM	CFM	W	W	TR	CFM		CFM	CFM	TR	AHU	TYPE
249	Lvl-3	ROOM-12	993	5	0.06	7	1	228	497	1083	4.8	2060		2100	4900	11.2	5000	F/M-53
250	Lvl-3	DISCUSSION ROOM-9	242	5	0.06	7	1	79	121	264	1.7	645		700				
251	Lvl-3	DISCUSSION ROOM-10	179	5	0.06	5	1	57	89	195	1.1	377		400				
252	Lvl-3	DISCUSSION ROOM-11	168	5	0.06	5	1	55	84	183	1.2	438		500				
253	Lvl-3	LABORATORY-5	1212	10	0.18	9	1	308	5573	1696	7.6	3494		3500	11900	26.5	12000	F/M-54
254	Lvl-3	DISCUSSION ROOM-12	168	5	0.06	5	1	55	84	183	1.2	477		500				
255	Lvl-3	DISCUSSION ROOM-13	179	5	0.06	5	1	57	89	195	1.1	395		400				
256	Lvl-3	LABORATORY-6	1212	10	0.18	9	1	278	5573	1696	7.3	3487		3500				

257	Lvl-3	LABORATORY-7	596	10	0.18	4	1	137	2742	835	3.9	1911		2000				
258	Lvl-3	DISCUSSION ROOM-14	179	5	0.06	5	1	41	89	195	0.9	318		400				
259	Lvl-3	DISCUSSION ROOM-15	180	5	0.06	5	1	57	90	196	1.0	293		300				
260	Lvl-3	DISCUSSION ROOM-16	180	5	0.06	5	1	57	90	196	1.1	378		400				
261	Lvl-3	DISCUSSION ROOM-17	180	5	0.06	5	1	57	90	196	1.2	494		500	500	1.2		INCL IN AHU - 54
262	Lvl-3	FACULTY ROOM-7	180	5	0.06	3	1	47	90	196	1.2	540		600	7400	18.1	8000	F/M-55
263	Lvl-3	FACULTY ROOM-8	180	5	0.06	3	1	47	90	196	1.0	423		500				
264	Lvl-3	FACULTY ROOM-9	180	5	0.06	3	1	47	90	196	1.0	423		500				
265	Lvl-3	FACULTY ROOM-10	180	5	0.06	3	1	47	90	196	1.0	423		500				
266	Lvl-3	FACULTY ROOM-11	180	5	0.06	3	1	47	90	196	1.0	423		500				
267	Lvl-3	FACULTY ROOM-12	180	5	0.06	3	1	47	90	196	1.0	423		500				
268	Lvl-3	LOUNGE	458	5	0.06	13	1	148	229	500	2.9	1015		1000				
269	Lvl-3	FACULTY ROOM-13	180	5	0.06	3	1	47	90	196	0.8	289		300				
270	Lvl-3	FACULTY ROOM-14	180	5	0.06	3	1	47	90	196	0.8	289		300				
271	Lvl-3	FACULTY ROOM-15	180	5	0.06	3	1	47	90	196	0.8	289		300				
272	Lvl-3	FACULTY ROOM-16	168	5	0.06	3	1	45	84	183	0.9	310		300				

273	Lvl-3	FACULTY ROOM-17	180	5	0.06	3	1	47	90	196	0.9	315		300	2900	8.0	3000 .0	F/M-56
274	Lvl-3	FACULTY ROOM-18	180	5	0.06	3	1	47	90	196	0.8	289		300				
Annexure – Heat Load Summary - IISER Bpur - Academic Block																		
Sr. No.	Floor	Area description	Area	CFM/ person	CFM/ Sqft	OCC	ACH	FA	Eqp load	Light load	Cooling Load		SELECTED		TOTAL	EQ. SELECTED		AHU
			Sqft			#	CFM	CFM	W	W	TR	CFM		CFM	CFM	TR	AHU	TYPE
275	Lvl-3	FACULTY ROOM-19	180	5	0.06	3	1	47	90	196	1.0	405						
276	Lvl-3	ROOM-19	576	5	0.06	4	1	132	288	627	2.4	890		900				
277	Lvl-3	ROOM-20	328	5	0.06	3	1	75	164	358	1.5	582		600				
278	Lvl-3	ROOM -13	1007	5	0.06	7	1	231	504	1098	3.9	1408		1400	1800	5.1	2000	F/M-57
279	Lvl-3	LABORATORY-8	1213	5	0.06	9	1	278	606	1322	4.5	1516		1600	3900	10.2	4000	F/M-58
280	Lvl-3	DISCUSSION ROOM-18	176	5	0.06	5	1	57	88	192	1.4	573		600				
281	Lvl-3	DISCUSSION ROOM-19	180	5	0.06	5	1	57	90	196	1.2	458		500				
282	Lvl-3	DISCUSSION ROOM-20	180	5	0.06	5	1	57	90	196	1.2	458		500				
283	Lvl-3	DISCUSSION ROOM-21	180	5	0.06	5	1	57	90	196	1.2	488		500				
284	Lvl-3	LABORATORY-9	1213	5	0.06	9	1	278	606	1322	4.5	1516		1600	3400	9.0	4000	F/M-59
285	Lvl-3	DISCUSSION ROOM-22	180	5	0.06	5	1	57	90	196	1.2	476		500				
286	Lvl-3	DISCUSSION ROOM-23	180	5	0.06	5	1	57	90	196	1.2	458		500				
287	Lvl-3	DISCUSSION ROOM-24	180	5	0.06	5	1	57	90	196	1.4	574		600				

288	Lvl-3	ROOM -14	1240	5	0.06	9	1	285	620	1351	5.2	1932		2000	4200	11.3	4000	F/M-60
289	Lvl-3	ROOM -15	1240	5	0.06	9	1	285	620	1351	4.4	1380		1400				

290	Lvl-3	CORRIDOR-1	4782	5	0.06	34	1	1098	2391	5212	15.0	3830		1100	1100	3.4		INCL IN AHU-39
291	Lvl-3	CORRIDOR-2	2798	5	0.06	20	1	642	1399	3049	7.9	1693		700	700	2.2		INCL IN AHU-41
292	Lvl-3	CORRIDOR-3	2077	5	0.06	15	1	477	1038	2264	6.7	1800		500	500	1.6		INCL IN AHU-44
293	Lvl-3	CORRIDOR-4	5420	5	0.06	39	1	1244	2710	5908	17.6	4718		1300	1300	4.1		INCL IN AHU-45
294	Lvl-3	CORRIDOR-5	1741	5	0.06	12	1	400	870	1898	5.1	1172		400	400	1.3		INCL IN AHU-54
295	Lvl-3	CORRIDOR-6	5121	5	0.06	37	1	1176	2560	5582	17.9	5256		1200	1200	3.8		INCL IN AHU-55
296	Lvl-3	CORRIDOR-7	1640	5	0.06	12	1	377	820	1787	5.6	1572		400	400	1.3		INCL IN AHU58&59
297	Lvl-3	LIFT LOBBY-1	377	5	0.06	3	1	86	188	410	1.7	589						

Annexure – Heat Load Summary - IISER Bpur - Academic Block

Sr. No.	Floor	Area description	Area	CFM/person	CFM/Sqft	OCC	ACH	FA	Eqp load	Light load	Cooling Load		SELECTED		TOTAL	EQ. SELECTED		AHU
			Sqft			#	CFM	CFM	W	W	TR	CFM	CFM	CFM	CFM	TR	AHU	TYPE
298	Lvl-3	LIFT LOBBY-2	196	5	0.06	3	1	50	98	213	1.1	379						

299	Lvl-3	LIFT LOBBY-3	212	5	0.06	3	1	53	106	231	1.1	392						
300	Lvl-3	CORRIDOR	1118	5	0.06	8	1	257	5143	1565	6.2	2481		300	300	0.9		INCL IN AHU-44
301	Lvl-3	AHU ROOM-1	420	5	0.06	0	1	96	1930	587	2.2	1010		1000	1000	2.2		INCL IN AHU-48
302	Lvl-3	AHU ROOM-2	162	5	0.06	0	1	37	747	227	1.0	473		500	500	1.0		INCL IN AHU-36
303	Lvl-3	AHU ROOM-3	298	5	0.06	0	1	68	1371	417	1.9	947		1000	1000	1.9		INCL IN

																		AHU-45
304	Lvl-3	AHU ROOM-4	387	5	0.06	0	1	89	1782	542	2.5	1243		1200	1200	2.5		INCL IN AHU-53
305	Lvl-3	AHU ROOM-5	130	5	0.06	0	1	30	599	182	0.8	431		400	400	0.8		INCL IN AHU-54
306	Lvl-3	AHU ROOM-6	277	5	0.06	0	1	63	1272	387	1.8	895		900	900	1.8		INCL IN AHU-55
307	Lvl-3	AHU ROOM-7	184	5	0.06	0	1	42	846	258	1.4	753		800	800	1.4		INCL IN AHU-56
308	Lvl-3	AHU ROOM-8	335	5	0.06	0	1	77	167	365	1.1	365		400	400	1.1		INCL IN AHU-57
309	Lvl-3	AHU ROOM-9	461	5	0.06	0	1	106	2118	645	2.7	1319		1300	1300	2.7		INCL IN AHU-59
310	Lvl-3	AHU ROOM-10	340	5	0.06	0	1	78	1564	476	1.7	745		800	800	1.7		INCL IN AHU-60
311	Lvl-4	LABORATORY-1	1383	10	0.18	10	10	3175	6360	1936	32.0	4395		4400	4700	32.8	5000	F/M-61
312	Lvl-4	LABORATORY-2	1213	10	0.18	9	10	2784	5578	1698	27.8	3684		3700	4100	28.8	4000	F/M-62

313	Lvl-4	DISCUSSION ROOM-1	168	5	0.06	5	1	55	84	183	1.0	337		400				
314	Lvl-4	DISCUSSION ROOM-2	180	5	0.06	5	1	57	90	196	1.0	320		425	425	1.1	425	CASSATTE
315	Lvl-4	DISCUSSION ROOM-3	180	5	0.06	5	1	57	90	196	1.0	320		425	425	1.1	425	CASSATTE
316	Lvl-4	DISCUSSION ROOM-4	180	5	0.06	5	1	57	90	196	1.0	320		425	425	1.1	425	CASSATTE
317	Lvl-4	DISCUSSION ROOM-5	180	5	0.06	5	1	57	90	196	1.0	320		425	425	1.1	425	CASSATTE
318	Lvl-4	DISCUSSION ROOM-6	180	5	0.06	5	1	57	827	252	1.3	501		500	500	1.3		INCL IN AHU-63
Annexure – Heat Load Summary - IISER Bpur - Academic Block																		

Sr. No.	Floor	Area description	Area	CFM/ person	CFM/ Sqft	OCC	ACH	FA	Eqp load	Light load	Cooling Load		SELECTED		TOTAL	EQ. SELECTED		AHU
			Sqft			#	CFM	CFM	W	W	TR	CFM		CFM	CFM	TR	AHU	TYPE
319	Lvl-4	DISCUSSION ROOM-7	180	5	0.06	5	1	57	827	252	1.3	501		500	500	1.3		INCL IN AHU-64
320	Lvl-4	DISCUSSION ROOM-8	180	5	0.06	5	1	57	827	252	1.3	501		500	1200	3.3		INCL IN AHU-65
321	Lvl-4	DISCUSSION ROOM-9	180	5	0.06	5	1	57	90	90	1.0	290		300				
322	Lvl-4	DISCUSSION ROOM-10	180	5	0.06	5	1	57	90	196	1.0	320		400				
323	Lvl-4	LABORATORY-3	1213	10	0.18	9	10	2784	606	1322	26.1	2460		2500	3000	27.4	3000	F/M-63
324	Lvl-4	LABORATORY-4	581	10	0.18	4	10	1334	291	633	12.6	1220		1300	1800	13.8	2000	F/M-64

325	Lvl-4	FACULTY ROOM-1	181	5	0.06	3	1	48	90	197	1.1	454		500	6800	16.4	8000	F/M-65
326	Lvl-4	FACULTY ROOM-2	180	5	0.06	3	1	47	90	196	1.0	423		500				
327	Lvl-4	FACULTY ROOM-3	180	5	0.06	3	1	47	90	196	1.0	423		500				
328	Lvl-4	FACULTY ROOM-4	180	5	0.06	3	1	47	90	196	1.0	423		500				
329	Lvl-4	FACULTY ROOM-5	180	5	0.06	3	1	47	827	252	1.3	605		600				
330	Lvl-4	FACULTY ROOM-6	180	5	0.06	3	1	47	827	252	1.3	605		600				
331	Lvl-4	FACULTY ROOM-7	180	5	0.06	3	1	47	827	252	1.1	485		500				
332	Lvl-4	FACULTY ROOM-8	180	5	0.06	3	1	47	827	252	1.1	470		500				
333	Lvl-4	FACULTY ROOM-9	180	5	0.06	3	1	47	90	196	0.8	289		300				
334	Lvl-4	FACULTY ROOM-10	180	5	0.06	3	1	47	90	196	0.8	289		300				
335	Lvl-4	FACULTY ROOM-11	180	5	0.06	3	1	47	90	196	1.0	401		400	6200	16.6	8000	F/M-67
336	Lvl-4	FACULTY ROOM-12	180	5	0.06	3	1	47	90	196	0.8	284		300				
337	Lvl-4	FACULTY ROOM-13	180	5	0.06	3	1	47	90	196	0.8	284		300				
338	Lvl-4	FACULTY ROOM-14	180	5	0.06	3	1	47	90	196	0.9	315		300				
339	Lvl-4	FACULTY ROOM-15	180	5	0.06	3	1	47	90	196	1.0	405		400				
340	Lvl-4	FACULTY ROOM-16	180	5	0.06	3	1	47	90	196	0.8	284		300				

341	Lvl-4	FACULTY ROOM-17	180	5	0.06	3	1	47	90	196	0.8	284		300				
342	Lvl-4	FACULTY ROOM-18	180	5	0.06	3	1	47	90	196	0.8	284		300				
343	Lvl-4	DISCUSSION ROOM-11	180	5	0.06	5	1	57	90	196	1.0	319		400				
344	Lvl-4	DISCUSSION ROOM-12	180	5	0.06	5	1	57	90	196	1.0	319		400				
Annexure – Heat Load Summary - IISER Bpur - Academic Block																		
Sr. No.	Floor	Area description	Area	CFM/ person	CFM/ Sqft	OCC	ACH	FA	Eqp load	Light load	Cooling Load		SELECTED		TOTAL	EQ. SELECTED		AHU
			Sqft			#	CFM	CFM	W	W	TR	CFM		CFM	CFM	TR	AHU	TYPE
345	Lvl-4	DISCUSSION ROOM-13	180	5	0.06	5	1	57	90	196	1.0	319		400				
346	Lvl-4	DISCUSSION ROOM-14	180	5	0.06	5	1	57	90	196	1.0	319		400				
347	Lvl-4	DISCUSSION ROOM-15	180	5	0.06	5	1	57	90	196	1.0	319		400				
348	Lvl-4	DISCUSSION ROOM-16	180	5	0.06	5	1	57	90	196	1.0	319		400				
349	Lvl-4	DISCUSSION ROOM-17	180	5	0.06	5	1	57	90	196	1.0	319		400				
350	Lvl-4	DISCUSSION ROOM-18	168	5	0.06	5	1	55	84	183	1.1	421		500	500	1.1		INCL IN AHU-68
351	Lvl-4	LABORATORY-5	1212	10	0.18	9	10	2782	606	1321	25.6	2116		2200	2100	25.6	2500	F/M-66
352	Lvl-4	LABORATORY-6	1208	10	0.18	9	10	2774	604	1317	25.2	1919		2000	2500	26.4	2500	F/M-68
353	Lvl-4	ROOM-1	577	5	0.06	4	1	132	288	629	2.3	864		900	6700	17.9	8000	F/M-69
354	Lvl-4	ROOM-2	897	5	0.06	6	1	206	449	978	3.4	1175		1200				

355	Lvl-4	FACULTY ROOM-19	180	5	0.06	3	1	47	90	196	1.0	401		400				
356	Lvl-4	FACULTY ROOM-20	180	5	0.06	3	1	47	90	196	0.8	284		300				
357	Lvl-4	FACULTY ROOM-21	180	5	0.06	3	1	47	90	196	0.8	284		300				
358	Lvl-4	FACULTY ROOM-22	180	5	0.06	3	1	47	90	196	0.8	284		300				
359	Lvl-4	FACULTY ROOM-23	180	5	0.06	3	1	47	90	196	0.8	284		300				

360	Lvl-4	FACULTY ROOM-24	180	5	0.06	3	1	47	90	196	0.8	284		300				
361	Lvl-4	FACULTY ROOM-25	180	5	0.06	3	1	47	827	252	1.1	466		500				
362	Lvl-4	FACULTY ROOM-26	180	5	0.06	3	1	47	827	252	1.1	466		500				
363	Lvl-4	FACULTY ROOM-27	180	5	0.06	3	1	47	90	196	0.8	284		300				
364	Lvl-4	FACULTY ROOM-28	180	5	0.06	3	1	47	90	196	0.8	284		300				
365	Lvl-4	FACULTY ROOM-29	180	5	0.06	3	1	47	90	196	0.8	284		300				
366	Lvl-4	FACULTY ROOM-30	168	5	0.06	3	1	45	84	183	1.0	389		400				
367	Lvl-4	ROOM-3	1160	5	0.06	8	1	266	580	1264	4.7	1711		1800	9400	23.3	10000	F/M-70
368	Lvl-4	ROOM-4	229	5	0.06	2	1	53	1054	321	1.4	689		700				
369	Lvl-4	ROOM-5	426	5	0.06	3	1	98	1960	597	2.3	1014		1100				
370	Lvl-4	ROOM-6	563	5	0.06	4	1	129	281	613	2.3	877		900				
Annexure – Heat Load Summary - IISER Bpur - Academic Block																		
Sr. No.	Floor	Area description	Area	CFM/person	CFM/Sqft	OCC	ACH	FA	Eqp load	Light load	Cooling Load	SELECTED	TOTAL	EQ. SELECTED	AHU			

			Sqft			#	CFM	CFM	W	W	TR	CFM		CFM	CFM	TR	AHU	TYPE
371	Lvl-4	DISCUSSION ROOM-19	180	5	0.06	5	1	57	90	196	1.2	440		500				
372	Lvl-4	DISCUSSION ROOM-20	180	5	0.06	5	1	57	90	196	1.0	324		400				
373	Lvl-4	DISCUSSION ROOM-21	180	5	0.06	5	1	57	90	196	1.0	324		400				
374	Lvl-4	DISCUSSION ROOM-22	180	5	0.06	5	1	57	90	196	1.0	324		400				
375	Lvl-4	DISCUSSION ROOM-23	180	5	0.06	5	1	57	90	196	1.0	324		400				
376	Lvl-4	DISCUSSION ROOM-24	180	5	0.06	5	1	57	90	196	1.0	324		400				
377	Lvl-4	DISCUSSION ROOM-25	180	5	0.06	5	1	57	90	196	1.0	324		400				
378	Lvl-4	DISCUSSION ROOM-26	168	5	0.06	5	1	55	84	183	1.1	427		500	1140	3.84	1140	CASSATTE
379	Lvl-4	MEETING-1	541	5	0.06	15	1	172	271	590	3.3	1154		1140				

380	Lvl-4	MEETING-2	597	5	0.06	17	1	192	299	651	3.4	1087		1100	1100	3.17	1100	CASSATTE
381	Lvl-4	MEETING-3	597	5	0.06	17	1	192	299	651	3.4	1087		1100	1100	3.17	1100	CASSATTE
382	Lvl-4	MEETING-4	597	5	0.06	17	1	192	299	651	3.4	1082		1100	1100	3.17	1100	CASSATTE
383	Lvl-4	FACULTY ROOM-31	180	5	0.06	3	1	47	90	196	1.3	598		600	8700	20.9	10000	F/M-76
384	Lvl-4	FACULTY ROOM-32	180	5	0.06	3	1	47	90	196	1.1	481		500				
385	Lvl-4	FACULTY ROOM-33	180	5	0.06	3	1	47	90	196	1.1	481		500				

386	Lvl-4	FACULTY ROOM-34	180	5	0.06	3	1	47	90	196	1.1	481		500				
387	Lvl-4	FACULTY ROOM-35	180	5	0.06	3	1	47	90	196	1.1	481		500				
388	Lvl-4	FACULTY ROOM-36	180	5	0.06	3	1	47	90	196	1.1	481		500				
389	Lvl-4	LOUNGE	457	5	0.06	10	1	132	229	498	2.8	1107		1100				
390	Lvl-4	FACULTY ROOM-37	180	5	0.06	3	1	47	90	196	0.9	347		400				
391	Lvl-4	FACULTY ROOM-38	180	5	0.06	3	1	47	90	196	0.9	347		400				
392	Lvl-4	FACULTY ROOM-39	180	5	0.06	3	1	47	90	196	0.9	347		400				
393	Lvl-4	FACULTY ROOM-40	168	5	0.06	3	1	45	84	183	0.9	329		400				
394	Lvl-4	FACULTY ROOM-41	168	5	0.06	3	1	45	84	183	0.9	329		400				
395	Lvl-4	FACULTY ROOM-42	168	5	0.06	3	1	45	84	183	1.0	446		500				
Annexure – Heat Load Summary - IISER Bpur - Academic Block																		
Sr. No.	Floor	Area description	Area	CFM/ person	CFM/ Sqft	OCC	ACH	FA	Eqp load	Light load	Cooling Load		SELECTED		TOTAL	EQ. SELECTED		AHU
			Sqft			#	CFM	CFM	W	W	TR	CFM		CFM	CFM	TR	AHU	TYPE
396	Lvl-4	FACULTY ROOM-43	180	5	0.06	3	1	47	90	196	1.1	463		500	3400	7.6	4000	F/M-77
397	Lvl-4	FACULTY ROOM-44	180	5	0.06	3	1	47	90	196	1.1	463		500				
398	Lvl-4	ROOM-7		578	5	0.06	4	1	133	289	630	2.6	1066		1100			
399	Lvl-4	ROOM-8		328	5	0.06	2	1	75	164	358	1.6	672		700			

400	Lvl-4	ROOM-9	960	5	0.06	7	1	220	4415	1344	5.6	2659		2700	3100	6.9	3000	F/M-78
401	Lvl-4	LABORATORY-7	1213	10	0.18	9	1	308	606	1322	5.3	1915		2000	4900	11.8	5000	F/M-79
402	Lvl-4	DISCUSSION ROOM-27	180	5	0.06	5	1	57	90	196	1.4	632		700				
403	Lvl-4	DISCUSSION ROOM-28	180	5	0.06	5	1	57	827	252	1.5	697		700				
404	Lvl-4	DISCUSSION ROOM-29	180	5	0.06	5	1	57	827	252	1.5	697		700				
405	Lvl-4	DISCUSSION ROOM-30	180	5	0.06	5	1	57	90	196	1.3	546		600				
406	Lvl-4	LABORATORY-8	1213	10	0.18	10	1	318	606	1322	5.4	1933		2000	5000	12.4	5000	F/M-80
407	Lvl-4	DISCUSSION ROOM-31	180	5	0.06	5	1	57	90	196	1.3	534		600				
408	Lvl-4	DISCUSSION ROOM-32	180	5	0.06	5	1	57	90	196	1.3	516		600				
409	Lvl-4	DISCUSSION ROOM-33	180	5	0.06	5	1	57	90	196	1.4	632		700				
410	Lvl-4	ROOM-10	1240	5	0.06	9	1	285	620	1351	5.7	2337		2400	4600	12.0	5000	F/M-81
411	Lvl-4	ROOM-11	1240	5	0.06	9	1	285	620	1351	4.9	1786		1800				
412	Lvl-4	LIBRARY	10027	5	0.06	219	1	2900	5014	10930	46.6	12267		12300	12700	48.0	15000	F/M-72
413	Lvl-4	LIBRARY-1	9452	5	0.06	206	1	2731	4726	10302	50.6	15145		15400	15400	50.8	16000	F/M-73
414	Lvl-4	SITTING	9461	5	0.06	206	1	2733	4731	10313	53.1	16544		16600	19000	60.8	20000	F/M-74
415	Lvl-4	AHU-1	419	5	0.06	0	1	96	209	456	1.4	401		400	400	1.4		INCL IN AHU-72

416	Lvl-4	AHU-2	162	5	0.06	0	1	37	81	177	0.9	306		300	300	0.9		INCL IN AHU -61
417	Lvl-4	AHU-3	298	5	0.06	0	1	68	149	325	1.7	646		700	700	1.7		INCL IN AHU -70
418	Lvl-4	AHU-4	836	5	0.06	0	1	192	418	911	2.7	710		700	700	2.7		INCL IN AHU -74

Annexure – Heat Load Summary - IISER Bpur - Academic Block																		
Sr. No.	Floor	Area description	Area	CFM/ person	CFM/ Sqft	OCC	ACH	FA	Eqp load	Light load	Cooling Load		SELECTED		TOTAL	EQ. SELECTED		AHU
			Sqft			#	CFM	CFM	W	W	TR	CFM		CFM	CFM	TR	AHU	TYPE
419	Lvl-4	AHU-5	130	5	0.06	0	1	30	65	142	1.4	696		700	700	1.4		INCL IN AHU -75
420	Lvl-4	AHU-6	277	5	0.06	0	1	63	138	301	1.7	621		700	700	1.7		INCL IN AHU -76
421	Lvl-4	AHU-7	184	5	0.06	0	1	42	92	201	1.3	565		600	600	1.3		INCL IN AHU -77
422	Lvl-4	AHU-8	334	5	0.06	0	1	77	167	364	1.3	364		400	400	1.3		INCL IN AHU -78
423	Lvl-4	AHU-9	461	5	0.06	0	1	106	230	502	2.2	851		900	900	2.2		INCL IN AHU -80
424	Lvl-4	AHU-10	340	5	0.06	0	1	78	170	371	1.3	403		400	400	1		INCL IN AHU -81
425	Lvl-4	3050 WIDE CORRIDOR-1	3360	5	0.06	24	1	772	1680	3663	10.5	2347		800	800	2.5		INCL IN AHU -65
426	Lvl-4	3050 WIDE CORRIDOR-2	3124	5	0.06	22	1	717	1562	3405	9.2	1901		800	800	2.5		INCL IN AHU -67
427	Lvl-4	3050 WIDE CORRIDOR-3	7820	5	0.06	56	1	1796	3910	8524	32.5	9040		1800	1800	5.6	2000	F/M-71

428	Lvl-4	3050 WIDE CORRIDOR-4	5096	5	0.06	36	1	1170	2548	5555	16.7	3752		1200	1200	3.8		INCL IN AHU69&70
429	Lvl-4	CORRIDOR-5	5281	5	0.06	38	1	1213	2641	5756	20.4	5202		1300	1300	4.1		INCL IN AHU-76
430	Lvl-4	CORRIDOR-6	1638	5	0.06	12	1	376	7533	2293	8.0	2760		400	400	1.3		INCL IN AHU79&80

431	Lvl-4	LIFT LOBBY-1	385	5	0.06	3	1	88	1772	539	2.6	920						
432	Lvl-4	LIFT LOBBY-2	212	5	0.06	2	1	49	106	231	1.3	401						
433	Lvl-4	LIFT LOBBY-3	196	5	0.06	2	1	45	98	213	1.3	388						
434	Lvl-5	FACULTY ROOM-1	168	5	0.06	3	1	45	84	183	1.2	441		500	9300	26.2	10000	F/M-90
435	Lvl-5	FACULTY ROOM-2	180	5	0.06	3	1	47	90	196	1.0	342		400				
436	Lvl-5	FACULTY ROOM-3	180	5	5.00	3	1	47	90	196	1.0	342		400				
437	Lvl-5	FACULTY ROOM-4	180	5	0.06	3	1	47	90	197	1.0	343		400				
438	Lvl-5	FACULTY ROOM-5	180	5	0.06	3	1	47	90	196	1.0	342		400				
439	Lvl-5	FACULTY ROOM-6	180	5	0.06	3	1	47	90	196	1.0	342		400				

Annexure – Heat Load Summary - IISER Bpur - Academic Block

Sr. No.	Floor	Area description	Area	CFM/ person	CFM/ Sqft	OCC	ACH	FA	Eqp load	Light load	Cooling Load		SELECTED		TOTAL	EQ. SELECTED		AHU
			Sqft			#	CFM	CFM	W	W	TR	CFM		CFM	CFM	TR	AHU	TYPE
440	Lvl-5	FACULTY ROOM-7	180	5	0.06	3	1	47	90	196	1.0	342		400				

441	Lvl-5	FACULTY ROOM-8	180	5	0.06	3	1	47	90	196	1.0	342		400				
442	Lvl-5	FACULTY ROOM-9	180	5	0.06	3	1	47	90	196	1.0	342		400				
443	Lvl-5	FACULTY ROOM-10	180	5	0.06	3	1	47	90	196	1.0	342		400				
444	Lvl-5	FACULTY ROOM-11	179	5	0.06	3	1	47	89	195	1.0	342		400				
445	Lvl-5	FACULTY ROOM-12	180	5	0.06	3	1	47	90	196	1.1	369		400				
446	Lvl-5	ROOM-6	184	5	0.06	35	1	208	92	201	4.9	1545		1600				
447	Lvl-5	ROOM-7	364	5	0.06	49	1	310	182	396	7.1	2233		2300				
448	Lvl-5	ROOM-8	1160	5	0.06	33	1	374	580	1264	7.9	2515		2600	6900	18.8	8000	F/M-91
449	Lvl-5	ROOM-9	230	5	0.06	7	1	76	115	251	1.8	617		700				
450	Lvl-5	ROOM-10	430	5	0.06	12	1	137	215	469	2.8	879		900				
451	Lvl-5	ROOM-11	570	5	0.06	24	1	223	285	622	4.6	1412		1500				
452	Lvl-5	DISCUSSION ROOM-19	180	5	0.06	5	1	57	90	196	1.2	382		400	4000	12.2	4000	F/M-92
453	Lvl-5	DISCUSSION ROOM-20	180	5	0.06	5	1	57	90	196	1.2	382		400				
454	Lvl-5	DISCUSSION ROOM-21	180	5	0.06	5	1	57	90	196	1.2	382		400				
455	Lvl-5	DISCUSSION ROOM-22	180	5	0.06	5	1	57	90	196	1.2	382		400				
456	Lvl-5	DISCUSSION ROOM-23	180	5	0.06	5	1	57	90	196	1.2	382		400				
457	Lvl-5	DISCUSSION ROOM-24	180	5	0.06	5	1	57	90	196	1.2	382		400				
458	Lvl-5	DISCUSSION ROOM-25	180	5	0.06	5	1	57	90	196	1.2	382		400				

459	Lvl-5	DISCUSSION ROOM-26	170	5	0.06	5	1	56	85	185	1.2	369		400				
460	Lvl-5	DISCUSSION ROOM-1	168	5	0.06	5	1	55	84	183	1.4	475		500	500	1.4		INCL IN AHU-89
	Lvl-5	DISCUSSION ROOM-2	180	10	0.18	5	1	82	90	196	1.4	383		400	7800	20.3	8000	F/M-88
	Lvl-5	DISCUSSION ROOM-3	180	10	0.18	5	1	82	90	196	1.4	383		400				
	Lvl-5	DISCUSSION ROOM-4	180	10	0.18	5	1	82	827	252	1.7	564		600				
	Lvl-5	DISCUSSION ROOM-5	180	10	0.18	5	1	82	827	252	1.7	564		600				
	Lvl-5	DISCUSSION ROOM-6	180	5	0.06	5	1	57	90	196	1.2	377		400				
Annexure – Heat Load Summary - IISER Bpur - Academic Block																		
Sr. No.	Floor	Area description	Area	CFM/ person	CFM/ Sqft	OCC	ACH	FA	Eqp load	Light load	Cooling Load		SELECTED		TOTAL	EQ. SELECTED		AHU
			Sqft			#	CFM	CFM	W	W	TR	CFM		CFM		CFM	TR	AHU
466	Lvl-5	DISCUSSION ROOM-7	180	5	0.06	5	1	57	90	196	1.2	377		400				
467	Lvl-5	DISCUSSION ROOM-8	180	5	0.06	5	1	57	90	196	1.1	377		400				
468	Lvl-5	LABORATORY-5	1212	5	0.06	32	10	2782	606	1321	26.8	2685		2700	3100	27.7	3000	F/M-87
469	Lvl-5	LABORATORY-6	1157	5	0.06	32	10	2656	578	1261	25.7	2615		2600	3100	27.1	3000	F/M-89
470	Lvl-5	FACULTY ROOM-13	180	5	0.06	3	1	47	90	196	0.9	342		400	3900			INCL IN
471	Lvl-5	FACULTY ROOM-14	180	8	0.06	3	1	55	90	196	1.0	344		400				AHU-88

472	Lvl-5	FACULTY ROOM-15	180	5	0.06	3	1	47	90	196	0.9	342		400				
473	Lvl-5	FACULTY ROOM-16	180	5	0.06	3	1	15	90	196	0.6	335		400				
474	Lvl-5	FACULTY ROOM-17	180	5	0.06	3	1	47	90	196	0.9	342		400				
475	Lvl-5	FACULTY ROOM-18	180	5	0.06	3	1	47	827	252	1.3	640		700				
476	Lvl-5	FACULTY ROOM-29	180	5	0.06	3	1	47	90	196	1.0	373		400				
477	Lvl-5	FACULTY ROOM-30	180	5	0.06	3	1	47	90	196	0.9	347		400				
478	Lvl-5	FACULTY ROOM-31	180	5	0.06	3	1	47	90	196	0.9	347		400				
479	Lvl-5	FACULTY ROOM-32	180	5	0.06	3	1	47	90	196	0.9	347		400	400	0.9		INCL IN AHU-87
480	Lvl-5	LABORATORY-1	1383	5	0.06	36	10	3175	691	1507	31.7	3867		3900	4100	32.2	4000	F/M-82
481	Lvl-5	LABORATORY-2	1212	5	0.06	32	10	2782	606	1321	27.6	3222		3300	4000	29.0	4000	F/M-83
482	Lvl-5	LABORATORY-3	1212	5	0.06	32	10	2782	606	1321	27.6	3222		3300	3700	28.7	4000	F/M-84
483	Lvl-5	LABORATORY-4	581	5	0.06	12	10	1334	291	633	13.2	1537		1600	2000	14.2	2000	F/M-85
484	Lvl-5	DISCUSSION ROOM-9	168	5	0.06	5	1	55	772	235	1.4	640		700	700	1.4		INCL IN AHU-83
485	Lvl-5	DISCUSSION ROOM-10	180	8	0.06	5	1	70	90	196	1.2	381		425	425	1.1	425	CASSATTE
486	Lvl-5	DISCUSSION ROOM-11	180	5	0.06	5	1	57	90	196	1.1	378		425	425	1.1	425	CASSATTE
487	Lvl-5	DISCUSSION ROOM-12	180	5	0.06	5	1	57	90	196	1.1	378		425	425	1.1	425	CASSATTE
488	Lvl-5	DISCUSSION ROOM-13	180	5	0.06	5	1	57	90	196	1.1	378		425	425	1.1	425	CASSATTE

489	Lvl-5	DISCUSSION ROOM-14	180	5	0.06	5	1	57	90	196	1.1	378		400	400	1.1		INCL IN AHU-84
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Annexure – Heat Load Summary - IISER Bpur - Academic Block																		
Sr. No.	Floor	Area description	Area	CFM/ person	CFM/ Sqft	OCC	ACH	FA	Eqp load	Light load	Cooling Load		SELECTED		TOTAL	EQ. SELECTED		AHU
			Sqft			#	CFM	CFM	W	W	TR	CFM		CFM	CFM	TR	AHU	TYPE
490	Lvl-5	DISCUSSION ROOM-15	180	5	0.06	5	1	57	90	196	1.1	378		400	400	1.1		INCL IN AHU-85
491	Lvl-5	DISCUSSION ROOM-16	180	5	0.06	5	1	57	90	196	1.1	378		400	6700	16.2	8000	F/M-86
492	Lvl-5	DISCUSSION ROOM-17	180	5	0.06	5	1	57	90	196	1.1	378		400				
493	Lvl-5	DISCUSSION ROOM-18	180	5	0.06	5	1	57	90	196	1.1	378		400				
494	Lvl-5	FACULTY ROOM-19	181	5	0.06	3	1	48	90	197	1.2	512		600				
495	Lvl-5	FACULTY ROOM-20	180	5	0.06	3	1	47	90	196	1.1	481		500				
496	Lvl-5	FACULTY ROOM-21	180	5	0.06	3	1	47	90	196	1.1	481		500				
497	Lvl-5	FACULTY ROOM-22	180	5	0.06	3	1	47	90	196	1.1	481		500				
498	Lvl-5	FACULTY ROOM-23	180	5	0.06	3	1	47	90	196	1.1	481		500				
499	Lvl-5	FACULTY ROOM-24	180	5	0.06	3	1	47	90	196	1.1	481		500				
500	Lvl-5	FACULTY ROOM-25	180	5	0.06	3	1	47	90	196	0.9	343		400				
501	Lvl-5	FACULTY ROOM-26	180	5	0.06	3	1	47	90	196	0.9	343		400				

502	Lvl-5	FACULTY ROOM-27	180	5	0.06	3	1	47	90	196	0.9	343		400				
503	Lvl-5	FACULTY ROOM-28	180	5	0.06	3	1	47	90	196	0.9	361		400				
504	Lvl-5	KITCHEN	2751	5	0.06	20	1	632	1376	2999	11.9	4608		4700	HOLD	HOLD	HOLD	HOLD
505	Lvl-5	CAFETARIA	8217	8	0.18	235	1	3242	4109	8957	48.4	12753		12800	13500	50.7	15000	F/M-93
506	Lvl-5	NO ROOM-6	184	5	0.06	5	1	58	92	201	1.3	514		600	9500	29.5	1000	F/M-94

507	Lvl-5	NO ROOM-7	364	5	0.06	30	1	215	182	396	3.9	1141		1200			0	
508	Lvl-5	MEETING ROOM-1	179	5	0.06	5	1	57	89	195	1.1	418		500				
509	Lvl-5	MEETING ROOM-2	180	5	0.06	5	1	57	90	196	1.1	386		400				
510	Lvl-5	VIRTUAL LEARNING	365	5	0.06	30	1	216	182	398	3.9	1120		1200				
511	Lvl-5	SEMINAR MEETING ROOM-1	632	5	10.00	20	1	214	316	688	3.8	1186		1336	1336	4.04	668	2# CASSATTE
512	Lvl-5	SEMINAR MEETING ROOM-2	632	5	0.06	20	1	214	316	688	3.5	968		1336	1336	4.04	668	2# CASSATTE

Annexure – Heat Load Summary - IISER Bpur - Academic Block																		
Sr. No.	Floor	Area description	Area	CFM/ person	CFM/ Sqft	OCC	ACH	FA	Eqp load	Light load	Cooling Load		SELECTED		TOTAL	EQ. SELECTED		AHU
			Sqft			#	CFM	CFM	W	W	TR	CFM		CFM	CFM	TR	AHU	TYPE
513	Lvl-5	ROOM-1	364	10	0.18	30	1	365	1673	509	5.5	1382		1400	4400	14.4		INCL IN AHU-94
514	Lvl-5	ROOM-2	366	10	5.00	30	1	366	183	399	5.0	1048		1100				
515	Lvl-5	ROOM-3	180	5	0.06	3	1	47	90	196	0.9	302		400				
516	Lvl-5	ROOM-4	180	5	0.06	3	1	41	827	252	1.0	462		500				
517	Lvl-5	ROOM-5	354	5	0.06	3	1	81	1628	496	2.1	977		1000				
518	Lvl-5	AHU ROOM-1	162	5	0.06	0	1	37	81	177	0.5	116		200	200	0.5		INCL IN AHU-82
519	Lvl-5	AHU ROOM-2	744	5	0.06	0	1	171	372	811	2.4	689		700	700	2.4		INCL IN AHU-93
520	Lvl-5	AHU ROOM-3	298	5	0.06	0	1	68	149	325	1.4	646		700	700	1.4		INCL IN AHU -91
521	LVL-4	NO ROOM	949	5	0.06	21	1	276	475	1034	4.9	1668		1700	1700	4.9		INCL IN AHU-74
522	LVL-4	NO ROOM-1	3871	5	0.06	84	1	1117	1936	4220	17.9	5255		5300	6800	21.8	8000	F/M-75
523	LVL-4	CORRIDOR-7	2688	5	0.06	59	1	779	1344	2930	15.7	5306		800				

524	Lvl-5	CORRIDOR-4	2800	5	0.06	20	1	643	1400	3052	9.9	3120		700	700	2.2		INCL IN AHU- 88
525	Lvl-5	CORRIDOR-5	3279	5	0.06	23	1	753	1639	3574	12.1	4003		800	800	2.5		INCL IN AHU- 86
526	Lvl-5	CORRIDOR-6	2802	5	0.06	20	1	643	1401	3054	9.9	3115		1200	1200	3.8		INCL IN AHU- 94
527	Lvl-5	CORRIDOR-7	2099	5	0.06	15	1	482	1050	2288	7.1	2074						
528	Lvl-5	LIFT LOBBY-1	376	5	0.06	3	1	86	188	409	1.9	818						
529	Lvl-5	LIFT LOBBY-2	220	5	0.06	2	1	50	110	239	1.3	649						
530	Lvl-5	LIFT LOBBY-3	196	5	0.06	2	1	45	98	213	1.3	613						
531	Lvl - 6	MEETING ROOM-1	635	5	0.06	13	1	179	317	692	3.2	1034		1100	10200	37.3	1200 0	F/M- 95
532	Lvl - 6	MEETING ROOM-2	887	5	0.06	16	1	240	443	966	4.0	1295		1300				
533	Lvl - 6	MEETING ROOM-3	627	5	0.06	13	1	178	314	684								
534	Lvl - 6	ROOM-8	179	5	0.06	2	1	42	89	195	0.9	334		400				
535	Lvl - 6	AHU ROOM	351	5	0.06	0	1	81	175	382	1.5	593		700				
536	Lvl - 6	ROOM-7	176	5	0.06	2	1	42	88	192	0.8	333		400				

Annexure – Heat Load Summary - IISER Bpur - Academic Block																	
Sr. No.	Floor	Area description	Area	CFM/ person	CFM/ Sqft	OCC	ACH	FA	Eqp load	Light load	Cooling Load	SELECTED	TOTAL	EQ. SELECTED		AHU	

			Sqft			#	CFM	CFM	W	W	TR	CFM		CFM	CFM	TR	AHU	TYPE
537	Lvl - 6	ROOM-6	180	5	0.06	2	1	42	90	196	0.9	334		400				
538	Lvl - 6	ROOM-5	179	5	0.06	2	1	42	89	195	0.9	354		400				
539	Lvl - 6	ROOM-4	179	5	0.06	2	1	42	89	195	0.9	366		400				
540	Lvl - 6	ROOM-3	180	5	0.06	2	1	42	90	196	0.9	334		400				
541	Lvl - 6	ROOM-2	180	5	0.06	2	1	42	90	196	0.9	334		400				
542	Lvl - 6	ROOM-1	180	5	0.06	2	1	42	90	196	0.9	334		400				
543	Lvl - 6	SEMINARE MEETING ROOM-1	679	5	0.06	14	1	192	339	740	4.0	1594		1692	1692	4.95	564	3# CASSATTE
544	Lvl - 6	SEMINARE MEETING ROOM-2	656	5	0.06	13	1	183	328	715	3.6	1346		1692	1692	4.95	564	3# CASSATTE
545	Lvl - 6	ROOM-14	179	5	0.06	2	1	42	89	195	0.7	264		300	3900	21.8		INCL IN
546	Lvl - 6	ROOM-13	179	5	0.06	2	1	42	89	195	0.7	264		300				AHU-95
547	Lvl - 6	ROOM-12	179	5	0.06	2	1	42	89	195	0.7	264		300				
548	Lvl - 6	MEETING ROOM-5	179	5	0.06	4	1	52	89	195	1.0	330		400				
549	Lvl - 6	MEETING ROOM-4	179	5	0.06	4	1	52	89	195	0.9	318		400				
550	Lvl - 6	ROOM-11	179	5	0.06	2	1	42	89	195	0.7	264		300				

551	Lvl - 6	ROOM-10	179	5	0.06	2	1	42	89	195	0.7	264		300				
552	Lvl - 6	ROOM-9	168	5	0.06	2	1	40	84	183	0.9	366		400				
553	Lvl - 6	CORRIDOR-1	2073	5	0.06	15	1	476	1037	2260	7.4	2372		500				
554	Lvl - 6	CORRIDOR-2	2694	5	0.06	19	1	619	1347	2937	11.4	4395		700				
555	Lvl - 6	LIFT LOBBY	372	5	0.06	3	1	85	186	406	1.9	819						
556	Lvl - 7	MEETING ROOM-1	653	5	0.06	13	1	183	327	712	3.5	1263		1336	1336	4.04	668	2#CASSATT E
557	Lvl - 7	MEETING ROOM-2	626	5	0.06	13	1	178	313	683	3.2	1075		1100	1100	3.17	1100	CASSATTE
558	Lvl - 7	MEETING ROOM-3	645	5	0.06	13	1	181	322	703	3.2	1106		1128	1128	3.3	564	2#CASSATT E
559	Lvl - 7	OFFICE-15	176	5	0.06	2	1	42	88	192	0.9	387		400	10000	19.2	10000	F/M-96
560	Lvl - 7	AHU ROOM	350	5	0.06	0	1	80	1609	490	2.2	1064		1100				
Annexure – Heat Load Summary - IISER Bpur - Academic Block																		
Sr. No.	Floor	Area description	Area	CFM/ person	CFM/ Sqft	OCC	ACH	FA	Eqp load	Light load	Cooling Load		SELECTED		TOTAL	EQ. SELECTED		AHU
			Sqft			#	CFM	CFM	W	W	TR	CFM		CFM		TR	AHU	TYPE
561	Lvl - 7	OFFICE-14	180	5	0.06	2	1	42	828	252	1.4	691		700				
562	Lvl - 7	OFFICE-13	180	5	0.06	2	1	42	827	252	1.4	710		700				
563	Lvl - 7	OFFICE-12	180	5	0.06	2	1	42	827	252	1.2	606		600				
564	Lvl - 7	OFFICE-11	180	5	0.06	2	1	42	827	252	1.2	574		600				

565	Lvl - 7	OFFICE-10	180	5	0.06	2	1	42	827	252	1.2	574		600				
566	Lvl - 7	OFFICE-9	180	5	0.06	2	1	42	827	252	1.2	574		600				
567	Lvl - 7	SEMINARE MEETING ROOM-1	679	5	0.06	19	1	217	3123	951	5.7	2566		2672	2672	8.2	668	4# CASSATTE
568	Lvl - 7	SEMINARE MEETING ROOM-2	668	5	0.06	19	1	215	334	728	4.5	1734		1692	1692	4.95	564	3# CASSATTE
569	Lvl - 7	OFFICE-8	180	5	0.06	2	1	42	827	252	1.1	504		500	4700	8.6		INCL IN AHU-96
570	Lvl - 7	OFFICE-7	180	5	0.06	2	1	42	827	252	1.1	504		500				
571	Lvl - 7	OFFICE-6	180	5	0.06	2	1	42	827	252	1.1	504		500				
572	Lvl - 7	OFFICE-5	180	5	0.06	2	1	42	827	252	1.1	536		550				
573	Lvl - 7	OFFICE-4	180	5	0.06	2	1	42	90	196	1.0	459		500				
574	Lvl - 7	OFFICE-2	181	5	0.06	2	1	43	90	197	1.0	440		450				
575	Lvl - 7	OFFICE-1	168	5	0.06	2	1	40	84	183	1.0	421		500				
576	Lvl - 7	CORRIDOR-1	2671	5	0.06	20	1	613	1335	2911	8.7	2429		700				
577	Lvl - 7	CORRIDOR-2	2075	5	0.06	20	1	476	1037	2261	7.6	2418		500				
578	Lvl - 7	LIFT LOBBY	372	5	0.06	2	1	85	1713	521	2.5	1297					NA	

Annexure – Heat Load Summary - IISER Bpur - Academic Block																		
Sr. No.	Floor	Area description	Area	CFM/ person	CFM/ Sqft	OCC	ACH	FA	Eqp load	Light load	Cooling Load		SELECTED		TOTAL	EQ. SELECTED		AHU
			Sqft			#	CFM	CFM	W	W	TR	CFM		CFM	CFM	TR	AHU	TYPE
579	LVL-1	CORRIDOR-4	4145	5	0.06	83	1	1161	2072	4518	15.4	3215		1200	1200	3.8		INCL IN AHU-4
580	LVL-1	CORRIDOR-5	4220	5	0.06	84	1	1180	2110	4600	18.0	4731		1200	1200	3.8		INCL IN AHU - 5&6
	LVL-1	CORRIDOR-6	4891	5	0.06	98	1	1370	2446	5332	21.6	5922		1400	1400	4.4		INCL IN AHU-9
582	LVL-1	ENTRANCE FOYER	6253	5	0.06	125	1	1750	3126	6815	23.6	5118		1800	1800	5.6		INCL IN AHU-7
583	LVL-2	CORRIDOR-6	8186	5	0.06	164	1	2294	4093	8923	30.4	6411		2300	3000	11.2	3000	F/M-25
584	LVL-2	CORRIDOR-7	5765	5	0.06	115	1	1613	2883	6284	25.6	7045		1600	1600	5.0		INCL IN AHU26&27
	LVL-3	CORRIDOR-8	4951	5	0.06	99	1	1386	2475	5396	18.7	4091		1400	1400	4.4		INCL IN AHU-48
586	LVL-3	CORRIDOR-9	3152	5	0.06	63	1	882	1576	3435	13.2	3343		900	900	2.8		INCL IN AHU-50
587	Lvl-5	CORRIDOR-1	5086	5	0.06	36	1	1168	2543	5544	19.6	6887		1200	1200	3.8		INCL IN AHU90&91
	Lvl-5	CORRIDOR-2	1273	5	0.06	9	1	292	636	1387	5.9	2442		300	500	1.6		INCL IN AHU-90
589	Lvl-5	CORRIDOR-3	781	5	0.06	6	1	179	391	851	3.0	1060		200				

		Grand Total	3,99,258			5,777		1,56,081	4,27,300	2,54,010	2,327	-						
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Annexure – Heat Load Summary - Heat Load Summary - IISER Bpur Auditorium														
Sr.	Area description	Area	Height	CFM/ person	CFM/ Sqft	OCC		Eqp load		Cooling Load		EQUIP. CTED SELE		
No.		Sqft	Feet			#	CFM	W	W	TR	CFM	TR	AHU	AHU TYPE
1	GREEN ROOM	133	14	5.0	0.06	6	54	67	187	1.0	352	1.1	425	CASSATTE
2	VIP ROOM	133	14	5.0	0.06	6	54	67	127	1.0	335	1.1	425	CASSATTE
3	90 SEATER LECTURE HALL	1513	14	7.5	0.06	91	955	2118	1437	13.7	3062	13.7	3000	F/M
4	90 SEATER LECTURE HALL-1	1513	14	7.5	0.06	91	955	2118	1437	13.7	3062	13.7	3000	F/M
5	ENTRANCE FOYER	6374	28	5.0	0.06	127	2927	3187	6056	41.8	11395	41.8	2# 6000	F/M
6	MAIN HALL	9678	28	5.0	0.06	510	4444	25000	9194	77.0	22503	77.0	3# 8000	F/M

7	PROJECTOR ROOM	237	14	5.0	0.06	2	54	3000	225	2.1	1175	3.84	1140	CASSATTE
		19,581				833	9443	35557	18662	150.4				

Annexure – Heat Load Summary - Heat Load Summary - IISER

Bpur Sports Complex

Sr. No.	FLOOR	Area description	Area	Height	CFM/ person	CFM/ Sqft	OCC	FA	Eqp load	Light load	Cooling Load		Total	TOTAL	TR	AHU	AHU
			Sqft	Feet			#	CFM	W	W	TR	CFM	CFM	CFM			TYPE
1	GF	GAMES ROOM-1	553	14	7.5	0.18	11	183	277	498	2.6	620	668	668	2.02	668	CASSATTE
2	GF	GAMES ROOM-2	553	14	7.5	0.18	11	183	277	498	2.6	620	668	668	2.02	668	CASSATTE
3	GF	GAMES ROOM-3	553	14	7.5	0.18	11	183	277	498	2.6	620	668	668	2.02	668	CASSATTE
4	GF	GAMES ROOM-4	556	14	7.5	0.18	11	184	278	501	2.4	513	564	564	1.65	564	CASSATTE
5	GF	STORE-1	260	14	5.0	0.06	5	73	130	234	1.1	325					
6	GF	STORE-2	173	14	5.0	0.06	3	49	87	156	0.9	347					

Annexure – Heat Load Summary - IISER Bpur Sports Complex

Sr. No.	FLOOR	Area description	Area	Height	CFM/ person	CFM/ Sqft	OCC	FA	Eqp load	Light load	Cooling Load		Total	TOTAL	TR	AHU	AHU
			Sqft	Feet			#	CFM	W	W	TR	CFM	CFM	CFM			TYPE
7	GF	GAMES ROOM-5	558	14	7.5	0.18	11	184	279	503	2.4	526	564	564	1.65	564	CASSATTE
8	GF	GAMES ROOM-6	449	14	7.5	0.18	9	148	224	404	1.9	382	425	425	1.1	425	CASSATTE
9	GF	GAMES ROOM-7	449	14	7.5	0.18	9	148	224	404	1.9	382	425	425	1.1	425	CASSATTE

10	GF	GAMES ROOM-8	558	14	7.5	0.18	11	184	279	503	2.4	476	564	564	1.65	564	CASSATTE
11	GF	GAMES ROOM-9	553	14	7.5	0.18	11	183	277	498	2.6	653	668	668	2.02	668	CASSATTE
12	GF	GAMES ROOM-10	553	14	7.5	0.18	11	183	277	498	2.6	636	668	668	2.02	668	CASSATTE
13	GF	GAMES ROOM-11	553	14	7.5	0.18	11	183	277	498	2.6	636	668	668	2.02	668	CASSATTE
14	GF	GAMES ROOM-12	556	14	7.5	0.18	11	184	278	501	2.4	530	564	564	1.65	564	CASSATTE
15	GF	STORE-3	260	14	5.0	0.06	5	73	130	234	1.3	467					
16	GF	STORE-4	173	14	5.0	0.06	3	49	87	156	0.9	344					
17	GF	GAMES ROOM-13	558	14	7.5	0.18	11	184	279	503	2.4	467	564	564	1.65	564	CASSATTE
18	GF	GAMES ROOM-14	448	14	7.5	0.18	9	148	224	403	1.9	374	425	425	1.1	425	CASSATTE
19	GF	GAMES ROOM-15	448	14	7.5	0.18	9	148	224	403	1.9	374	425	425	1.1	425	CASSATTE
20	GF	GAMES ROOM-16	558	14	7.5	0.18	11	184	279	503	2.6	639	668	668	2.02	668	CASSATTE
21	GF	FIELD	15427	28	20.0	0.18	15	7084	7713	13884	69.7	8676	8700	9700	72.3	2# 5000	F/M-2&5

Annexure – Heat Load Summary - IISER Bpur Sports Complex

Sr. No.	FLOOR	Area description	Area	Height	CFM/ person	CFM/ Sqft	OCC	FA	Eqp load	Light load	Cooling Load		Total	TOTAL	TR	AHU	AHU
			Sqft	Feet			#	CFM	W	W	TR	CFM	CFM	CFM			TYPE
22	FF	SETTING-1	4038	14	7.5	0.06	225	2414	2019	3634	32.4	6157	6200	6200	32.4	6000	F/M-1
23	FF	AHU ROOM-1	260	14	5.0	0.06	5	73	130	234	1.3	454	500			INCL IN AHU-2	

24	FF	AHU ROOM-2	173	14	5.0	0.06	3	49	87	156	0.9	347	400	6000	29.4	6000	F/M-3
25	FF	SETTING-2	3302	14	7.5	0.06	200	2094	1651	2972	28.4	5524	5600				
26	FF	SETTING-3	4037	14	7.5	0.06	225	2414	2019	3633	32.5	6255	6300	6300	32.5	6000	F/M-4
27	FF	AHU ROOM-3	260	14	5.0	0.06	5	73	130	234	1.3	467	500			INCL IN AHU- 5	
28	FF	AHU ROOM-4	173	14	5.0	0.06	3	49	87	156	0.9	344	400	6000	29.3	6000	F/M-6
29	FF	SETTING-4	3228	14	7.5	0.06	200	2081	1614	2905	28.4	5576	5600				
			40,224				1,069	19,365	20,112	36,202	238						

Annexure – Heat load summary - IISER Bpur - Guest House

Sr. No.	Floor	Area description	Area	CFM/ person	CFM/ Sqft	OCC	FA	Eqp load	Light load	Cooling Load		TOTAL		IDU Type	IDU	ODU	
			Sqft			#	CFM	W	W	TR	CFM	CFM	TR		Cap(TR)	Cap(HP)	Ckt #
1	GF	STAFF REST RM &CHANGE RM (Now 100 seater)	171	5	0.06	10	81	86	163	1.6	556	4660	12.72	Cassette 3.18TR x 4# 1165CFM each	12.02	12	Ckt 1
2	GF	ROOM-2 (Now 100 seater)	79	5	0.06	5	39	39	75	0.9	363						
3	GF	HOUSE KEEPING (Now 100 seater)	164	5	0.06	10	79	82	155	1.5	471				19	18	
4	GF	HOUSE KEEPING-1 (Now 100 seater)	499	5	0.06	75	465	250	474	7.8	1860						
5	GF	LAUNDARY	422	5	0.06	4	97	211	401	1.6	511						
6	GF	STORE	252	5	0.06	2	58	126	239	0.9	259						
7	GF	ROOM	335	5	0.06	2	77	167	318	1.1	312	300	1.02	HI-WALL	Part of Ckt 1		
8	GF	STAFF CANTEEN AND LOCKERS	210	5	0.06	2	48	105	199	1.0	385						
9	GF	ROOM-1	79	5	0.06	1	19	39	75	0.6	286	282	0.8	HI-WALL			
10	GF	STORE	250	5	0.06	1	57	125	237	1.1	455						

11	GF	DINING AREA	782	5	0.06	20	241	391	743	4.5	1534	3#512	3.84	CASSATTE	
12	GF	UTILITY	123	5	0.06	2	32	61	117	0.5	114				
13	GF	KITCHEN	494	5	0.06	4	113	247	469	1.8	600				
14	GF	KITCHEN-1	1477	5	0.06	10	339	739	1403	5.8	2074				
15	GF	LIFT LOBBY	165	5	0.06	4	50	82	156	1.0	369				
16	FF	ROOM	79	5	0.06	2	24	39	75	0.7	311	300	1.02	HI-WALL	Part of Ckt 2
17	FF	TWIN SHARING ROOM &DRESS	228	5	0.06	2	52	114	217	1.0	421	424	1.28	HI-WALL	

18	FF	TWIN SHARING ROOM -1 &DRESS	218	5	0.06	2	50	109	208	1.0	376	424	1.28	HI-WALL	
19	FF	TWIN SHARING ROOM -2 &DRESS	228	5	0.06	2	52	114	217	1.1	429	424	1.28	HI-WALL	
20	FF	TWIN SHARING ROOM -3 &DRESS	218	5	0.06	2	50	109	208	1.0	403	424	1.28	HI-WALL	
21	FF	TWIN SHARING ROOM -4 &DRESS	215	5	0.06	2	49	108	204	1.1	478	530	1.59	HI-WALL	
22	FF	TWIN SHARING ROOM -5 &DRESS	218	5	0.06	2	50	109	208	0.9	357	424	1.28	HI-WALL	
23	FF	TWIN SHARING ROOM -6 &DRESS	221	5	0.06	2	51	110	210	1.0	428	424	1.28	HI-WALL	
24	FF	TWIN SHARING ROOM -7 &DRESS	221	5	0.06	2	51	110	210	1.0	431	424	1.28	HI-WALL	
25	FF	TWIN SHARING ROOM -8 &DRESS	229	5	0.06	2	53	115	218	1.1	482	530	1.28	HI-WALL	

Annexure – Heat load summary - IISER Bpur - Guest House

Sr. No.	Floor	Area description	Area	CFM/ person	CFM/ Sqft	OCC	FA	Eqp load	Light load	Cooling Load		TOTAL		IDU Type	IDU	ODU	
			Sqft			#	CFM	W	W	TR	CFM	CFM	TR		Cap(TR)	Cap(HP)	Ckt #
26	FF	SERVICES	79	5	0.06	1	19	39	75	0.7	358						
27	FF	TWIN SHARING ROOM -9 &DRESS	229	5	0.06	2	53	115	218	1.4	644	671	2.01	HI-WALL	15	14	Ckt 3
28	FF	TWIN SHARING ROOM -10 &DRESS	218	5	0.06	2	50	109	208	1.2	548	671	2.01	HI-WALL			
29	FF	TWIN SHARING ROOM -11 &DRESS	228	5	0.06	2	52	114	217	1.3	602	671	2.01	HI-WALL			
30	FF	TWIN SHARING ROOM -12 &DRESS	220	5	0.06	2	50	110	209	1.2	517	530	1.59	HI-WALL			
31	FF	LOUNGE	354	5	0.06	4	84	177	336	1.3	420	441	1.02	CASSATTE			
32	FF	TWIN SHARING ROOM -13 &DRESS	228	5	0.06	2	52	114	217	1.2	502	530	1.59	HI-WALL			
33	FF	TWIN SHARING ROOM -14 &DRESS	220	5	0.06	2	50	110	209	1.1	440	424	1.28	HI-WALL			
34	FF	TWIN SHARING ROOM -15 &DRESS	226	5	0.06	2	52	113	215	1.1	495	530	1.59	HI-WALL			
35	FF	TWIN SHARING ROOM -16 &DRESS	220	5	0.06	2	50	110	209	1.2	530	530	1.59	HI-WALL			
36	FF	LIFT LOBBY	165	5	0.06	4	50	82	156	0.9	321						

37	SF	ROOM-1	79	5	0.06	1	19	39	75	0.6	319	300	1.02	HI-WLL	14	12	Ckt 4
38	SF	SUITE ROOM &DRESSER	228	5	0.06	2	52	114	217	1.0	420	424	1.28	HI-WLL			
39	SF	SUITE ROOM -1	267	5	0.06	4	68	133	254	1.2	412	424	1.28	HI-WLL			
40	SF	SUITE ROOM &DRESSER-2	228	10	0.18	2	61	1049	217	1.4	643	671	2.01	HI-WLL			
41	SF	SUITE ROOM-3	267	10	0.18	4	88	1228	254	1.8	754	800	2.00	FCU			
42	SF	SUITE ROOM-4	268	10	0.18	4	88	1232	255	1.9	762	800	2.00	FCU			
43	SF	SUITE ROOM & DRESSER-5	228	10	0.18	2	61	1049	217	1.4	643	671	2.01	HI-WLL			
44	SF	TWIN SHARING ROOM & DRESS	222	10	0.18	2	60	1020	211	1.5	709	800	2.00	FCU			
45	SF	SUITE ROOM-6	266	10	0.18	4	88	1223	252	1.8	709	800	2.00	FCU	17	16	Ckt 5
46	SF	SUITE ROOM &DRESSER-7	229	10	0.18	2	61	1054	218	1.5	694	671	2.01	HI-WLL			
47	SF	ROOM	79	10	0.18	1	24	361	75	0.9	457	424	1.28	HI-WLL			
48	SF	SUITE ROOM &DRESSER-8	229	5	0.06	2	53	115	218	1.3	593	671	2.01	HI-WLL			
49	SF	SUITE ROOM-9	265	10	0.18	4	88	1221	252	2.0	846	800	2.00	FCU			
50	SF	SUITE ROOM &DRESSER-10	228	10	0.18	2	61	1049	217	1.7	812	800	2.00	FCU			
51	SF	SUITE ROOM-11	267	10	0.18	4	88	1228	254	1.9	801	800	2.00	FCU			

Annexure – Heat load summary - IISER Bpur - Guest House

Sr. No.	Floor	Area description	Area	CFM/ person	CFM/ Sqft	OCC	FA	Eqp load	Light load	Cooling Load		TOTAL		IDU Type	IDU	ODU	
			Sqft			#	CFM	W	W	TR	CFM	CFM	TR		Cap(TR)	Cap(HP)	Ckt #
52	SF	LOUNGE	478	10	0.18	4	126	2198	454	2.8	1218	1218	3.98	CASSATTE			

53	SF	LIFT LOBBY	279	5	0.06	4	70	139	265	1.0	277						
		Total								79.7							
		TFA GF										1236				10	TFA 1
		TFA FF										1236				10	TFA 2
		TFA SF										1236				10	TFA 3
		Grand total														102	

3.0 PART III - Factory Built Air Handling Unit (AHU) and Fan Coil Unit (FCU)

3.21 Scope: This chapter covers the detailed requirements of factory built double skin air handling unit (AHU) and single skin fan coil unit (FCU) for central air- conditioning system as well as for central heating system.

3.22 Factory Built Air Handling Unit (AHU)

3.2.1 Type: The air handling unit shall be of double skin construction, draw through type in sectionalized construction consisting of blower section, coil section, humidification section (where specified), filter section and insulated drain pan. Unless otherwise specified, the unit shall be horizontal type.

3.2.2 Rating:

- i. The capacity of the cooling/ heating coil, the air quantity from the blower fan and static pressure of blower fan shall be as laid down in the tender documents. Where these parameters as calculated by the tenderer exceed the specified values, the coils and the blower fan shall satisfy these calculated values.
- ii. The coil shall be designed for a face velocity of air not exceeding 155 m/min.
- iii. The requisite static pressure demanded by the air circuit shall be developed by the fan at the selected operating speed. The static pressure value shall not in any case be less than 40 mm water gauge in normal cases, not less than 65 mm water gauge where microvee filters are also used and not less than 100 mm water gauge where absolute filters-are also used. The fan motor HP shall be suitable to satisfy these requirements and the drive losses.
- iv. The air outlet velocity from the blower fan shall not exceed 610 m/min.
- v. Noise level at a distance of 2M from AHU shall not exceed 75dBA.

3.2.3 Material and Construction:

3.2.3.1 Housing/Casing

- i. The housing/ casing of the air handling unit shall be of double skin construction. The housing shall be so made that it can be delivered at site in total semi knocked down conditions depending upon the requirements. The main framework shall be of suitable structural sections. The entire framework shall be assembled using mechanical joints to make a sturdy and strong framework for various sections. Framework of air handling units for shall be made of thermal break hollow extruded aluminum profile.
- ii. Double skin panels shall be minimum 25mm thick made of 0.8mm pre- plasticized and prepainted with PVC guard, GSS sheet on outside and 0.6mm galvanized sheet inside with polyurethane foam insulation of density not less than 38 kg/cum injected in between by injection moulding machine. These panels shall be joined and connected to the framework/ supports with soft rubber gasket in between (if necessary) to make the joints airtight and low air leakage potential. The gaskets shall be inserted within groove in extruded aluminum profile of the framework.
- iii. Frame work for each section shall also be joined together to make the joints air tight. Suitable doors with nylon handles and all access panels should be open able with allen key/ suitable locking arrangement. Aluminium die-cast powder coated hinges & latches shall be provided for access to various panels for maintenance. However, AHU in the form of complete single unit shall also be acceptable with access door(s) for maintenance to various sections. The entire housing shall be mounted on galvanized steel channel frame work made out of G.I. sheet of thickness not less than 2mm. For higher capacity AHUs hot dip galvanized steel channel framework made of minimum 3 mm thick G.S. sheet shall be used.

3.2.3.2 Drain Pan: Drainpan shall be made out of minimum 1.25mm stainless steel sheet externally insulated with 10mm thick closed cell Polyethylene foam/ equivalent suitable insulation with necessary dual slope to facilitate fast removal of condensate. Necessary supports will be provided to slide the coil in the drain pan.

3.2.3.3 Cooling / Heating Coil:

- i. The coil shall be made from seamless solid drawn copper tubes. The minimum thickness of tube shall be 0.35 mm for cooling / heating / heating-cum-cooling coils.
- ii. The depth of the coil shall be such as to suit the requirements, viz. re-circulated air applications. The coil row deep shall be as per item of work. In case of 8 rows deep coils, it shall be made of 2x4 rows deep coils with a spacing of 200mm between the two coils, access door and independent drain pan.
- iii. U bends shall be of copper, jointed to the tubes by brazing, soft soldering shall not be used.
- iv. Each section of the coil shall be fitted with flow and return headers to feed all the passes of the coil properly. The headers shall be of copper and shall be complete with water in/out connections, vent plug on top and drain at the bottom. The coil shall be designed to provide water velocity between 0.6 to 1.8m/s in the tubes.
- v. The fins shall be of aluminum. The minimum thickness of the fins shall be 0.15 mm nominal. Then o. of fins shall not be less than 4-5 per cm length of coil. Fins may be of either spiral or plate type. The tubes shall be mechanically expanded to ensure proper thermal contact between fins and tubes. The fins shall be evenly spaced and up right. The fins bent during installation shall be carefully realigned.
- vi. The coil shall be suitable for use with the refrigerant specified or with water as the case may be. Refrigerating coils shall be designed for the maximum working pressure under the operating conditions. Water coils shall be designed for a maximum working pressure of 10kg./sq.cm.
- vii. Shut off and regulating valves at inlet and outlet of water shall be provided.

3.2.3.4 Supply Air Fan And Drive:

- i. The supply air fan shall be AMCA certified centrifugal type with forward/ backward curved blades double inlet double width type. For static pressure upto 65mm forward curved blades shall be used and for higher sizes backward curved blades shall be used.
- ii. The fan housing of Galvanized sheet steel and the impellers shall be fabricated from heavy gauge steel sheet as per approved manufacturer's standard. The side plates shall be die-formed for efficient, smooth airflow and minimum losses. Fan impeller shall be mounted on solid shaft supported to housing using heavy duty ball bearings. Fan housing and motor shall be mounted on a common extruded aluminum base mounted inside the fan section on anti-vibration spring mounts or cushy-foot mount. The fan outlet shall be connected to casing with the help of fire retardant fabric.
- iii. The fan impeller assembly shall be statically and dynamically balanced.
- iv. The fan shall be fitted with V belt drive arrangement consisting of not less than two evenly matched belts. Belts shall be of oil resistant type. Adequate adjustments shall be provided to facilitate belt installation and subsequent belt tensioning by movement of the motor on the slide rails. A readily removable door guard shall be provided.
- v. The fan motor shall be totally enclosed fan cooled squirrel cage induction motor with IP54 protection & selected for quiet running. The motor shall be suitable for operation on $415 \pm 10\%V$, 3phase, 50 Hz, A.C. supply. The motor shall conform to IS: 325. "Three phase induction motors" having class F insulation.
- vi. The fan motor starter shall be as per Para 10.9.

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

3.2.3.5.1 Type Of Filters:

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

3.2.3.5.2 General Construction of Filters:

- i. Each AHU shall be provided with a factory assembled filter section containing pre-filters made of cleanable metal viscous filters made of corrugated aluminum wire mesh, or dry cleanable synthetic filters. These shall be minimum 50 mm thick with a frame work of aluminum.
- ii. The filter area shall be made up of panels of size convenient for handling. The filter panels shall be held snugly within suitable aluminum framework made out of minimum 1.6 mm aluminum sheet with sponge neoprene gaskets by sliding the panels between the sliding channels so as to avoid air leakage.
- iii. In order to indicate the condition of these filters while in operation, a manometer shall be provided to indicate the pressure drop across the fine filters and absolute filters.
- iv. Special filters, if any specified in the tender specifications shall be provided in addition to the above filters. In that event, the latter shall function as pre-filters.
- v. Each filter shall carry test certificate from manufacturer.

3.2.5 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. Y-strainer at the inlet of coil
- v. Motorized pressure independent balance cum control 2 way modulating valve

3.2.6 Controls: These shall be as per details given under chapter 9—Controls.

3.2.7 Insulation: The insulation of casing shall be as per Para 4.2.3.1 (ii) & that of drain pan shall be as per 4.2.3.2.

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

3.23 Fan Coil Units:

3.3.1 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.

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

3.3.3 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 coil circuit should be sized for adequate water velocity but not exceeding 1.8 m/s. The air velocity across the coil shall not exceed 155 m/min.

3.3.4 Fan: This shall consist of two lightweight 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.

3.3.5 Drain Pan: Drain pan shall be fabricated out of minimum 1.00mm 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.

3.3.6 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.

3.3.7 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.

3.3.8 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 SSP 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.

3.3.9 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.

3.24 Insulation: The drain pan shall be insulated as per Para 4.3.5.

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

6.0 PART VI – Ducting:

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

6.22 Material:

6.22.6 Ducts

- i. All ducts shall be fabricated from Galvanized Sheet Steel (GSS) with conforming to IS: 277, to the extent applicable. The steel sheets shall be hot dip galvanized with coating of minimum 120 grams per square meter (GSM) of Zinc.
- ii. The thickness of sheets for fabrication of rectangular ductwork shall be as under. The thickness required corresponding to the longest side of the rectangular section shall be applicable for all the four sides of the ductwork.

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

- iii. All sheet metal connections, partitions and plenums required for flow of air through the filters, fans etc. shall be at least 1.25 mm thick galvanized steel sheets, in case of G.I. sheet and shall be stiffened with 25mm x 25 mm x 3 mm angle iron braces.
- iv. Circular ducts, where provided shall be of thickness as specified in IS: 655 as amended up to date.
- v. All Flat Oval Spiral Ducts and Fittings shall be manufactured by a company whose primary business is the manufacture of Flat Oval Spiral Duct and Fittings.
- vi. All Flat Oval Spiral Duct and Fittings shall be manufactured from 120 gsm galvanized steel of lock forming quality
- vii. All Flat Oval Spiral Ducts should have built in continuous external reinforcement with 4ply Spiral Lock seam at regular intervals of 125mm of maximum length of 3m each.
- viii. The fabrication of Flat Oval Spiral Ducts & Duct Fittings should be as per SMACNA High pressure duct standards, 1985.
- ix. All Flat Oval Spiral Ducts and Duct Fittings shall be joined with Slip Joint Connects of 50mm insertion length and fastened with rivets.

x. Single Wall Flat Oval Spiral-High Pressure, SMACNA 1985

DUCT		FITTINGS	
Major width mm	Gauge	Major width mm	Gauge

upto600	24	Upto600	20
625-900	22	625-900	20
925-1200	22	925-1200	18
1225-1500	20	1225-1500	18
1525-1750	20	1525-1750	16
1775onwards	18	1775onwards	16

6.22.7 Associated Items:

- i. Supply/return air outlets, FA grilles and accessories shall be constructed from extruded aluminum 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 1000mm 40mm x 40mm x 3 mm	35mm x 35mm x 3 mm
	1001mm to 2250mm	
Bracings	More than 2250mm	50mm x 50mm x 3 mm
	Upto 1000mm	25mm x 25mm x 3 mm
	More than 1000mm	40mm x 40mm x 3 mm
Support angles	Upto 1000mm	40mm x 40mm x 3 mm
	1001mm to 2250mm	40mm x 40mm x 3 mm
	More than 2250mm	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-aluminum alloy. Self-tapping screws shall not be used.

6.23 Construction

6.23.6 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 600mm longest side shall be cross broken between flanges by a single continuous breaking. Ducts of size 600mm and above shall be cross broken by single continuous breaking between flanges and bracings. Alternatively, beading at 300mm centers for ducts upto 600mm longest side, and 200 mm centers for ducts above 600mm size shall be provided for stiffening.
- iv. As far as possible, long radius elbows and gradual changes in shape shall be used to maintain uniform velocity accompanied by decreased turbulence, lower resistance and minimum noise. The ratio of the size of the duct to the radius of the elbow shall be normally not less than 1:1.5.

- V. Flanged joints shall be used at intervals not exceeding 2500mm. 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
- Vii. 1.2.5 meters from joints for ducts of size 600mm to 1500mm, and 0.6mm from joints for ducts of size larger than 1500mm. Bracings for ducts larger than 1500mm can alternatively be by/diagonal angles.
- Viii. Plenums for filters shall be complete with suitable access door of size 450mm x450mm.
- ix. 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.

6.23.7 Air Outlet And Inlets (Supply and Return)

- i. All air outlets and intakes shall be made of extruded aluminum sections & shall present a neat appearance and shall be rigid with mechanical joints.
- ii. Square and rectangular wall outlets shall have a flanged frame with the outside edges returned or curved 5 to 7 mm and fitted with a suitable flexible gasket between the concealed face of the flanges and the finished wall face. The core of supply air register shall have adjustable front louvers parallel to the longer side to give upto 22.5 degrees vertical deflection and adjustable back louvers parallel to the shorter side to achieve a horizontal spread air pattern to at least 45 degrees. Return air grilles shall have only front louvers. The outer framework of the grilles shall be made of not less than 1.6 mm thick 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 1.6 mm thick extruded section aluminum sheet. The diffuser assembly shall not be less than 0.80 mm thick extruded aluminum section.
- iv. Circular ceiling outlets/intakes shall have either flush or anti smudge outer cone as specified in the tender specifications. Flush outer cones shall have the lower edge of the cone not more than 5 mm below the underside of the finished ceiling into which it is fitted. Anti-smudge cones shall have the outer cone profile designed to reduce dirt deposit on the ceiling adjacent to the air outlet. The metal sheet used for construction of these shall be minimum 1.6 mm thick extruded aluminum sheet.
- V. Linear diffusers shall have a flanged frame with the outside edges returned 3.5 mm and shall have one to four slots as required. The air quantity through each slot shall be adjustable. The metal sheet used for the construction of these shall be minimum 1.6 mm thick extruded aluminum sheet.
- Vi. Grilles and diffusers constructed of extruded aluminum sections shall have grille bars set straight, or deflected as required. These shall be assembled by mechanical interlocking of components to prevent distortion. These grilles and diffusers shall have a rear set of adjustable blades, perpendicular to the face blades for deflection purposes.
- Vii. All supply air outlets shall be fitted with a volume control device, made of extruded aluminum gate section. The blades of the device shall be mill finish/ block shade pivoted on nylon brushes to avoid rusting & rattling noise, which shall be located immediately behind the outlet and shall be fully adjustable from within the occupied space without removing any access panel. The volume control device for circular cutlets shall be opposed blade radial/shutter type dampers, or two or more butterfly dampers in conjunction with equalizing grid. Opposed blade dampers shall be used for square and rectangular ceiling/ wall outlets and intakes. viii. All the products supplied by contractor should supplement 'in performance by selection curves of product ratings from the manufacturer.

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

6.23.8 Fresh Air Intakes:

- i. Fresh air intake grills shall be made of extruded aluminum 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 aluminum 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 centers where the louver's length is longer than 750mm.
- v. A bird wire screen made of 12 mm mesh in 1.6 mm steel wire held in angle or channel frame shall be fixed to the rear face of the louver frame by screens.

6.23.9 Special Conditions in case of factory fabricated ducts:

- i. **Material:** the GI raw material should be used in Coil-form (instead of sheets) so as to limit the longitudinal joints at the edges only, irrespective of cross section dimensions.
- ii. **Governing Standards:** unless otherwise specified here, the construction, erection, testing and performance of the ducting system shall conform to the SMACNA standards 2005 (Third edition).
- iii. **Duct connectors and accessories:** All the transverse duct connectors (flanges/cleats) and accessories related hardware such as support system shall be zinc coated (galvanized).
- iv. **Selections of GI and Transverse connectors:** Duct constructions shall be in compliance with 1" (250 Pa) w.g. static norms as per SMANCA. All transverse connectors shall be 4bolt system. The specified class of transverse connectors and duct gauge for a given duct dimensions shall be 1" 250 Pa) pressure class. Non-toxic, Ac application grade P.E. or PVC gasket shall be provided between all mating flanges joints. Gasket sizes shall conform to flange manufacturer's specifications.
- v. **Duct Construction:** the fabricated duct dimensions shall be as per approved drawings and all connectors section shall be dimensionally matches to avoid any gaps. Dimensional tolerances – all fabricates dimensions shall with = 1.0 mm of specified dimension. To obtain required perpendicularly, permissible diagonal tolerance shall be = 1.0 mm per meter. Each duct pieces shall be identified by coded sticker, which shall indicate specific part number, job name, drawing number, duct size and gauge.

Duct shall be straight and smooth on the inside. Longitudinal seams shall be airtight and at corners, which shall be either Pittsburgh or snap button punch as per SMACNA practice, to ensure air tightness. Changes in dimensions and shape of duct shall be gradual (between 1:4 and 1:7) turning vanes or air splitters shall be installed in all bends and ducts collars designed permit the air to make the turn without appreciable turbulence. Beading at 300mm centers for ducts up to 600mm longest side, and 200mm centers for ducts above 600mm size shall be provided for stiffening.

6.24 Fire Dampers:

- i. Fire dampers shall be provided in all the supply air ducts and return air ducts (where provided), return air passage in the air-handling unit room and at all floor crossings. Access door will be provided in the duct before each set of fire dampers.
- ii. Fire dampers shall be multi blade louvers type. The blade should remain in the air stream in Open position & shall allow maximum free area to reduce pressure drop & noise in the air passage. The blades and frame shall be constructed with minimum 1.6mm thick galvanized

sheet & shall be factory fitted in a sleeve made out of 1.6mm galvanized sheet of minimum 400mm long. It shall be complete with locking device, motorized actuator & control panel.

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

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

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

vi. Necessary wiring from fire alarm panel up to AHU electric panel shall be provided by the department & further from AHU electric panel to fire damper shall be provided by air conditioning contractor.

6.25 Deleted

6.26 Acoustic Lining and Insulation: This shall be done as per details given in Para 8.8 and 8.9 (Chapter 8).

6.27 Installation of Metallic Duct:

6.27.6 Ducting

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

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

iii. All joints shall be airtight.

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

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

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

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

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

heaters. A manually reset thermostatic safety switch shall be provided near the duct section having heaters. In addition, the heaters must be interlocked with the connected fan motor of the AHU.

6.27.7 Air Outlets and Inlets:

- i. The locations of the air outlets and intakes shall be shown in the tender drawings and necessary openings and the wooden framework for fixing the grilles shall be provided by the air conditioning contractor.
- ii. The location of these outlets/ inlets is subject to change and the approval of the Engineer-in-Charge shall be obtained before finally fixing the grilles/diffusers in position.
- iii. In installing fresh air intakes, no fixing device shall be visible from the face of the frame. Where louvers are to be fixed in masonry or concrete, fixing shall be with either expanding plugs or raw plugs.
- iv. Where the louvers are to be fixed in steel or wood, non-ferrous screws or bolts shall be used.
- v. Supply air outlets and return air intakes shall be anodized/ powder coated aluminum to the desired color to match the surroundings wall/ceiling. The fresh air intakes shall be anodized/ powder coated aluminum as approved by the Engineer-in-Charge. The paint color shall be approved by the Engineer-in-Charge.
- vi. All damages to the finish of the structure during the installation work shall be made good by the air-conditioning contractor before handing over the installation to the Department.

6.28 Balancing:

The entire air distribution system shall be balanced with the help of an anemometer. The measured air quantities at fan discharge and at the various outlets shall be within ± 5 percent of those specified/ quoted. Branch duct adjustments shall be permanently marked after the air balancing is completed so that these can be restored to their correct position if disturbed at any time.

6.29 Measurement:

- i. Duct measurements (for insulated ducts) shall be taken before application of insulation.
- ii. Duct work shall be measured section wise on the basis of external surface area by multiplying the axial length from flange face to flange face for each section by the corresponding duct perimeter in the centre of that section length.
- iii. Uniformly tapering straight sections shall also be measured as in (ii) above. However, for special pieces like tees, bends etc. area computations for surface areas shall be done as per the shape of such pieces.
- iv. The quoted unit rate for external surfaces of ducts shall include all wastage allowances, flanges, gaskets for joints, vibration isolators, bracings, hangers and supports, inspection chambers/access panels, splitter dampers with quadrants and levers for position indication, turning vanes, straightening vanes, and all other accessories required to complete the duct installation as per the specifications. These accessories shall not be separately measured.
- v. Grills and diffusers shall be measured by the cross sectional areas, perpendicular to the airflow, and excluding the flanges.
- vi. Fire dampers shall be measured by their cross sectional area perpendicular to the direction of the airflow. Quoted rates shall include the necessary collars and flanges for mounting, inspection pieces with access door, fusible link/solenoid with wiring, but excluding the fire detectors, etc.

7.0 PART VII - Water Plumbing Work

7.1 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.

7.2 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 2.5 m/sec.
- ii. Butterfly/Ball valves shall be provided at
 - Suction and delivery sides of pumps
 - Inlet and outlet of each condenser, chiller, cooling tower, hot water generator
 - All drain connections from equipments
 - Inlet & outlet of every heat exchanger coil, namely for AHU's, FCU'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 up to 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 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 up to 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.

7.3 Pre Insulated Chilled Water Pipes: The pipe shall be MS ERW as specified in the Piping Section.

7.23.6 Under Ground Piping & Insulation Execution: Underground systems shall be buried in a trench of not less than 600 mm deeper than the top of the pipe & not less than 450mm wider than the combined OD of all piping systems. A minimum thickness of 600mm of compacted backfill over the top of the pipe is desirable. Trench bottom shall have a minimum of 150mm of sand, pea gravel or specified backfill material, consolidated to suit operating weight & to act as a cushion for the piping.

7.23.7 Buried Piping:

The outer protective insulation jacket shall be seamless, extruded, black, UV resistant, highdensity polyethylene (HDPE). For leak identification purpose 2 wire diagnostic wiring shall also be provided. The minimum thickness of the HDPE jacket and PUF shall be as follows:

S.No.	MSPipedia. (mm)	PUFThickness (mm)	Thickness of HDPE Cladding(mm)
1.	20mm	29	2.5
2.	25mm	36	2.5
3.	32mm	31	2.5
4.	40mm	36	2.5
5.	50mm	37	3.0

6.	65mm	39	3.0
7.	80mm	43	3.0
8.	100mm	40	3.2
9.	125mm	39	3.5
10.	150mm	53	4.4
11.	200mm	63	5.0
12.	250mm	57	6.3
13.	300mm	58	7.0
14.	350mm	64	7.8
15.	400mm	68	8.8
16.	450mm	77	9.8
17.	500mm	50	11.1
18.	550mm	65	11.1
19.	600mm	83	12.5
20.	650mm	58	12.5
21.	700mm	82	13.0
22.	750mm	104	15.0
23.	800mm	79	15.0

However the exact thickness could vary marginally for underground piping based on the exact sizes of HDPE pipes available as per the chart given below:

7.23.8 Fittings: Fitting can be fabricated at site over the carrier pipe and correct quantity of PUF shall be poured manually.

7.23.9 Field Joints Insulation: Field joints insulation shall consist of PUF poured manually in a site fabricated GI cladding fixed around the joint.

7.4 Pipe Joints:

Joints in black steel pipes shall be of any of the following types.

- i. Screwed joints and union joints screwed to pipes, upto 25mm size.
- ii. Butt welded joints for pipe sizes above 25mm, electric welding shall be used for sizes 100mm and above.

iii. Flanges joins 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.

7.5 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.

7.6 Strainers:

- i. Strainers shall be of 'Y' type or pot type as specified. 'Y' strainers shall be provided on the inlet side of each air-handling unit and pump in chilled water and condenser water circuit. 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. The strainers shall be designed to the test pressure specified for the gate valves. Filtration area of Y-strainer shall be minimum four times the connecting pipe size.
- ii. They shall be provided with equal size isolating gate valves on either side so that the strainers may be cleaned without draining the system.
- iii. Pot strainer shall be fabricated out of MS sheet and the sizes shall be as under:

Pipesizes(mm)	Pot dia(mm)	PotHeight(mm)	Basketdia (mm)	Basket Height(mm)
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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

Strainers shall have are movable bronze/stainless-steel minimum 1 mm thick screen with 3 mm perforations and permanent magnet. 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
disconnection of the main pipe.

Of screen without

7.7 Instruments:

- i. Pressure gauge of appropriate range and .150 mm. dial size shall be provided at the following locations.
 - Supply and return of all heat exchange equipments.
 - Suction and discharge of all pump sets.
- ii. The pressure gauge shall be duly calibrated before installation and shall be complete with shut off cocks.
- iii. Direct reading industrial type thermometer of appropriate range shall be provided at the inlet and outlet of all heat exchange equipments. The thermometers shall be installed in separate wells.
- iv. Flow meter of orifice type shall be provided for measuring the flow through each condenser and chiller.

7.8 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.

7.9 Flexible Connections:

- i. The Flexible connections shall be flanged type expansion joint. Flanges shall be noncompressible and mechanically strong type and the Neoprene rubber shall be provided in between the flange ends.
- ii. The connections shall work for a temperature range of minus 10°C to 70°C.
- iii. The length and working pressure of bellows shall be as follows:

Nominal (mm) Bore	Length(mm)	Pressure (Bars)

20-25	125	15
32-200	150	15
250-350	200	10

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

7.10 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)

12and15	1.25
20and25	2.00
32,40,50and65	2.50
80,100and125	2.50
150andabove	3.00

i. 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.

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

iii. 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.

iv. 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.

- 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.
- 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. Riser shall have suitable supports at the lowest point.

v. Where pipes are to be buried under ground, the top of the pipes shall be not less than 75cms 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 15cms. 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.

vi. All pipes and their steel supports shall be thoroughly cleaned and given one primer coat of Zinc chromate before being installed.

vii. 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.

viii. 3mm gasket shall be used for flanged joints.

ix. 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.

7.11 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/sqcm 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. Insulation shall be applied to piping only after the completion of the pressure testing to the satisfaction of the Engineer-in-charge.

v. Pressure gauges may be capped off during pressure testing of the installation.

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

7.12 Balancing:

i. After completion of the installation, all water system shall be adjusted and balanced to deliver the water quantities as specified, quoted, or as directed.

ii. Automatic control valves 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.

7.13 Measurement: Measurements of plumbing work shall be on following basis:

i. 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.

ii. 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 as required to complete the piping installation. None of these items will be separately measured nor paid for.

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

8.0 PART VIII - Insulation Work

8.1 Scope: This chapter covers the requirements of thermal insulation for pumps and tanks, ductwork and acoustic lining in ductwork and weather maker rooms. This does not cover exposed roof insulation and under deck insulation work.

8.2 Material Types: As per respective item of the work.

8.3 Material Specifications: As per respective item of the work.

8.4 Insulation Thickness: As per respective item of the work.

8.5 Application of insulation on pumps: As per respective item of the work.

8.6 Application of insulation on expansion tank: As per respective item of the work.

8.7 Measurement Of Insulation:

i. 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.

ii. Duct insulation and acoustic linings shall be measured on the basis of surface area along the centre line 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 perimeters shall be considered.

10.0 PART X - Electrical Work

10.1 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.

10.2 General:

- i. Unless otherwise specified in the tender specifications, all equipments and materials for electrical works shall be suitable for continuous operations on 415V/240V $\pm$ 10%(3phase/ single phase), 50 Hz. AC system. Where the use of high voltage equipments is specified in particular works, all the respective equipments shall be suitable for continuous operation on such specified high voltage.
- ii. All electrical works shall be carried out complying with the Indian Electricity Rules, 1956 as amended to date.
- iii. All parts of electrical works shall be carried out as per appropriate CPWD General specifications for Electrical works, namely, Part I (Internal) 1994, Part II (External) 1994 work, and Part IV (Sub-station), 1982 all as amended to date.
- iv. All materials and components used shall conform to the relevant IS specifications amended to date.

10.3 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-in-charge, but they shall be cubical design, unless otherwise specified and open able from front.
- ii. The capacity of switch gear, starters etc. shall be suitable for the requirements of loads fed/controlled. Starting currents shall be duly considered in case of motor loads.
- iii. Switch boards controlling motors shall house starters for motors, unless otherwise specified. Independent single phasing preventers for each such starter shall be provided. The starter and SPP shall be located adjacent to the controlling switch gear.
 - 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.
 - 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.
- iv. Switchboards shall be fabricated as per specifications indicated in sub-Para above.
- v. The layout of bus bars and cable alleys shall be designed for convenient connections and inter-connections with various switchgears. 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
- vi. Care shall be taken to provide adequate clearances between phase bus bars as well as between phase bus bars, neutral and earth.
- vii. 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.
- viii. 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.
- ix. Identification labels shall be provided against each switchgear and starter compartment, using plastic engraved labels.

- X. Metallic danger board conforming to relevant IS shall be fixed on each electrical switchboard.
- Xi. 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.

10.4 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,
- ii. 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. iii. The number and size of the control cables shall be such as to suit the control system design adopted by the Air-conditioning Contractor.
- iv. 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.
- v. Control cables shall be of adequate cross section to restrict the voltage drop.
 - 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.
 - 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.
 - Control wiring shall correspond to the circuitry/sequence of operations and interlocks approved by Engineer-in-Charge.
 - In cold storage involving temperatures below zero deg. C, polythene cables shall be used instead of PVC cables.

10.5 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 capacities. Above 100 TR reciprocating units and centrifugal/ screw chilling units copper plate earthing shall be provided.
- v. The size of earth conductors for body earthing of equipments shall be as under:

Motors upto and including 10HP	2nos. 4mmdia. GI wire
12.5HPto40HP	2nos. 6mm dia.GIwire
50HPto75HP	2nos.25x3mmGIstrip
Above75HP	2nos. 25x6mm GIstrip
Switchboardswithincomingratingupto100A	2nos. 4mmdiaGIwire
125Ato 300Arating	2nos.25x3mmGIstrip
Above 300Arating	2nos. 25x6mm GI Strip

- vi. Armoring 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.

10.6 Deleted

10.7 Deleted

10.8 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, $\pm 10\%$, 50 Hz., 3 phase AC supply. Enclosures shall have protection of IP 52 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:
 - Thermal overload on all the three phases with adjustable settings
 - Under voltage protection, and
 - Independent single phasing preventer (current sensing type) wherever required.
- vi. Adequate number of extra NO/ NC contacts for interlocks, indicating lamps etc. shall be provided on the starter/ contactor.

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

11.0 PART XI - Mechanical Ventilation System:

11.1 Scope: This chapter includes specifications for supply air fan, exhaust air fan Specification for all associated works such as ducting, plumbing, electrical works etc. are same as for air conditioning works covered under chapter 9, 10 and 13. For system design Para 2.3 may be referred.

11.2 Centrifugal Fans:

- i. Centrifugal fans shall be of double-width, double-inlet construction, with bearing on both sides, complete with access door, squirrel-cage induction motor, V-belt drive, belt guard etc.
- ii. Housing shall be of heavy gauge sheet steel in welded construction. It shall be rigidly reinforced and supported by structural angles. Split casing shall be provided on larger sizes of fans. However, neoprene/ asbestos packing shall be provided throughout split joints to make it airtight. 1.2 mm galvanized wire mesh inlet guard, of 5cms sleeves shall be provided on both inlets. Housing shall be provided with access door with quick locking tension handles and neoprene gasket. Rotation arrow shall be clearly marked on the housing.
- iii. Fan wheel shall be backward/forward curved non-overloading type unless otherwise specified. Fan wheel and housing shall be statically and dynamically balanced. Fan outlet velocity shall not exceed 610 meters per minute.
- iv. Shaft shall be constructed of steel, turned, ground and polished.
- v. Bearings shall be of the sleeve/ball bearing type mounted directly on the fan housing. Bearing shall be self-aligned, oil grease packed, pillow block type.
- vi. Drive to fan shall be provided from 3 phase electric motor through belt with adjustable motor sheave and belt guard. Belt shall be of the oil resistant type. The number of belts shall be not less than two.
- vii. Drive motor shall be in accordance with Para 6.2.3.4(v).
- viii. Motor starter shall be in accordance with Para 13.9.

11.3 Axial Flow Fans:

- i. Casing shall be constructed of heavy gauge sheet steel. A small view port/inspection door with handle and neoprene gasket shall also be provided. Casing shall have flanged connection on both ends for ducted applications. Support brackets for ceiling suspension shall be welded/riveted to the casing for connection to hanger bolts.
- ii. Straightening vanes shall be aerodynamically designed for maximum efficiency by converting velocity pressure to static pressure potential and minimizing turbulence. Casing shall be de-rusted, cleaned, primed and finish coated with enamel paint. GSS with zinc coating of minimum weight 220 gram/sqmtr. on both sides of the sheet is also acceptable.
- iii. Rotor hub and blades shall be of cast aluminium, or cast steel construction. Blades shall be die-formed aero foil shaped for maximum efficiency and shall vary in twist and width from hub to tip to effect equal air distribution along the blade length. Fan blade mounting on the hub shall be statically and dynamically balanced. The fan pitch control may be manually read just able at site, upon installation, for obtaining actual airflow values, as specified.
- iv. Motor shall be of 3 phase squirrel-cage totally enclosed, fan cooled type. Motor and starter shall be in accordance with Para 6.2.3.4(v) and 13.9 respectively. The speed of fan shall not exceed 1450 RPM for fans up to 30000 CFM whereas it shall not exceed 950 RPM for CFMs above 30000.

v. DRIVE:

For Duct/Wall Mounted Fan:

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

For Floor/Ceiling Mounted Fan:

The fan shall be direct driven.

vi. Vibration Isolation:

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

11.4 Deleted

11.5 Scrubber:

11.25.6 General: The kitchen Scrubber will be self-contained and will consist of the following component parts listed in the following paragraph. The entire unit shall be WEATHER PROOFED and CORROSION PROTECTED as hereinafter specified. The unit shall be factory fabricated and will include.

11.25.7 Blower Section:

The blower section shall be constructed out of 16G GI sheet in folded construction and shall include a centrifugal backward/forward curved DIDW (Double Inlet Double Width) fan wheel of totally GI construction with inlet cones. It shall be complete with an individual motor and drive and shall be mounted on a C-channel frame with Cushy Foot or Spring Mounts.

The fan shall have a capacity not less than that specified in the catalogues and shall be constructed and rated based on delivery against the rated static pressure with the media and filters in place.

The fan shall be of riveted construction and manufactured from GI sheet of the required thickness. The fan wheel shall be of the multi-blade type and mounted on two self-aligning pillow block bearings of the requisite size.

The fan shall be driven through grooved belt drives as recommended by the drive supplier. The blower housing shall be of Pittsburgh joint construction, and the drive shall be provided by a motor of adequate capacity.

The motor plate shall be constructed out of 12G MS sheet or heavier metal and shall be provided with slotted holes to permit belt adjustment in both directions.

The outlet velocity of the blower shall be kept low.

11.25.8 Evaporative/Scrubber Section: The wet section will have 16G GI tank and body with folded construction with the bolted open able sides also in 18G SS sheet/FRP. The wet section will contain 50 mm thick rigid media to act as the first stage of scrubber to be sprayed by water through WIDE ANGLE NOZZLES to wet, scrub and clean the media installed at the inlet. These nozzles will be provided on a pipe grid such that the total face of the first bank of rigid media is kept fully wet and also gets pressure cleaning.

The wet section will have a also have another subsequent layer of 150 mm thick RIGID MEDIA which will act as the cleaning media for the smoke and smell, these media banks will be designed @ 2.5 m/s to give 90% adiabatic efficiency. For the second bank 2 mm thick FRP specially fabricated header will be provided for the water distribution using perforated PVC piping 15 mm brass bleed off cock along with 20 mm heavy duty brass float. PVC drain/overflow and bleed off outlet are to be provided on all wet sections.

11.25.9 Filter Section: All wet sections will include 5 layer 30 micron aluminium wire mesh filters of 50 mm thickness including the mounting channels in SS 304 16G GI for ease of removal and renewal of filter cells. The filters to be designed at 2.5 m/s to give 90% efficiency down to 30 microns.

11.25.10 Pumps: The unit will have a horizontal single phase 220 Volts + 6% 50 c/s single phase power supply mono block self-priming pump assembly to provide recirculated tank water and a pressurized flow via a piping system for And media water distribution. The pump capacity will be such that it can take care of the bank of nozzles provided for cleaning the first bank and also feed water to wet these Cond bank.

11.6 Cabinet Fans: The construction of the cabinet fans shall be identical with that of the air washer unit except that the cabinet fans will not have filters and humidifiers.

11.7 Painting: All Equipment Shall Be Supplied With The Manufacturer's Standard Finished Painting.

12.0 Part XII-Inspection, Testing and Commissioning

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

12.2 Initial Inspection at Manufacturer's Works

12.22.6 Centrifugal Compressor:

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

- ii. Manufacturer's internal test certificates shall be scrutinized to check compliance with the requirements as specified in the contract.
- iii. Free running test shall be carried out at the speed for which the motor is available with manufacturer but the speed shall not be than that specified in contract. This test shall be carried out for minutes in open space. iv. During this running test following operations are to be noted:
 - Manual operation of capacity control
 - Lubrication oil pressure
- v. Pneumatic test pressure test at 21 Kgf/sq.cm for casing of compressor
- vi. Vacuum test for the compressor for 0.5mm

12.22.7 Condensers:

- i. Salient features like number of tubes, inside diameter of tubes (from which the gauge of the tube can be verified), no. of passes, material of fins, length of condenser, provision of fittings like safety valve, water, gas connection shall be verified during stage inspection. The tube thickness shall be checked.
- ii. Manufacturer's internal test certificates shall be furnished and it shall be verified against contract requirements. iii. Pneumatic pressure test at twice the normal condensing pressure for gas side of condenser shall be carried out.
- iv. Hydraulic test at 10Kgf/ sqcm for water side of the condenser shall be carried out.

12.22.8 Chiller:

- i. Salient features like type of chiller, number and inside diameter of tubes (from which gauge of the tubes can be verified), material of tubes, type, material and the number of fins, wherever applicable, diameter and length of chiller and provision of fittings be verified against requirements specified in the contract during stage inspection. Tube thickness shall be checked.
- ii. Manufacturer's internal test certificate shall be furnished and same shall be checked as per contract requirements. iii. Pneumatic pressure test at twice the normal condensing pressure for gas side of condenser shall be carried out.
- iv. Hydraulic test at 10Kgf/sqcm for the water side of chiller shall be carried out.

12.22.9 Chilling Unit (Water Cooled Only): Full load test shall be carried out to verify the capacity and IKW / Ton. (For air cooled chilling units this test shall be carried out at site)

Note: In case of imported centrifugal chilling machine, initial inspection shall be carried out at site before installation in respect of items needing physical inspection and verification. No tests shall be done at manufacturer's works. The test certificates for all the specified tests shall be produced which shall be accepted if found in order.

12.22.10 Air Handling Units

- i. Salient features such as model, size, physical dimensions, and other details of various sections, fan motor details, fan dia, static pressure etc. shall be verified against the contract requirements.
- ii. Manufacturer's internal test certificates for the motor and air handling unit shall be furnished and scrutinized as per contract requirements.
- iii. Test certificate for static and dynamic balancing of the fan/ blower should be furnished. Fan balancing may be witnessed by Engineer-in-Charge or his authorized representative.
- iv. Salient features like type, material, no. and gauge of fins and tubes and no. of rows of cooling coil shall be furnished and verified with reference to contract requirements during stage inspection.

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

12.3 Initial Inspection at Site:

12.23.6 Ducting:

- i. The sheet used for ducting shall be checked for physical test at site. The physical test should include the sheet thickness and bend test as per relevant IS specifications.
- ii. Zinc coating of GSS sheet as mentioned in the tender documents may be got tested from a laboratory to verify that same meets the contract requirements.

12.23.7 Pumps:

- i. Salient features such as model and make shall be checked as per contract requirements.
- ii. The manufacturer's test certificates with Sr. No., head, discharge will be furnished and verified against contract requirements.

12.23.8 Cooling Tower:

- i. Salient features such as make, model, dimensions, materials used, constructional details, number and size of nozzles, headers, size of tank, etc. should be verified against the requirements. Inspection of cooling tower in knocked down condition would be carried out at the site.
- ii. Manufacturer's test certificate certifying the capacity of cooling tower and static balancing of fan should be furnished.

12.23.9 Switch Gear, Control Gear, and Measuring Instruments: These should be of specified make. For air circuit breaker manufacturers test certificate shall be furnished by contractor and the same shall be verified as per contract requirements.

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

12.23.11 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 contract.

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

12.4 Final Inspection:

- i. After completion of the entire installation as per specification in all respects, the AC contractor shall demonstrate trouble free running of the AC equipments and installation for a period of minimum 120 hours of running as detailed under Para 1.15.
- ii. After the trial run as in Para 1.15 above, the AC contractor shall offer the plant for the seasonal test, namely test for summer or monsoon season whichever occurs earlier. The test results as per Appendix G shall be furnished.
- iii. The equipment capacity computations as per Para '8' under notes of the Annexure 'G' shall be carried out.

- iv. The Input KW of the unit/TR at full load shall also be checked against contract requirements, if any.
- v. Pressure drops across chiller and condenser at specified flow rates shall be checked against the contract requirements.
- vi. All instruments for testing shall be provided by the AC contractor, these shall be as per Note 'A' of Appendix G, the accuracy of the instruments shall be as follows:
 - Temperature: Liquid in glass thermometer having accuracy ± 1 deg. C as per IS: 4825.
 - Wet bulb Temperature: Sling psychomotor conforming to IS:6017,
 - Scale Error: For less than 0 deg. $-C.0.3^{\circ}C \pm 0.2$ deg. C. For over $0^{\circ}C$ $0.2^{\circ}C \pm 0.1$ deg.
 - Pressure Gauge: With the accuracy of $\pm 1\%$ for maximum scale value from 10 to 90%, and $\pm 1.9\%$ for maximum scale value for rest of the scale conforming to IS: 3695.
 - Water flow meter Water flow shall be measured using the arrangement installed as per schedule of work,
- vii. 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.

12.5 Testing Requirements and Procedures:

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

- Microprocessor based calculation meter to measure DB and WB temperature, RH and Dew point
- Velo meter to measure air volume and air velocity
- Pitot tube -Electronic rotary vane Anemometer
- Accubalance flow measuring hood

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

12.25.7 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 leakages. 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.

12.25.8 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 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 rpm. Record rpm, motor amperage, discharge and suction pressure. Pumps shall operate without objectionable noise or cavitation. Plot actual pump and system performance points on manufacturers 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 rpm. 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.

12.25.9 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, at least the discharge head and BHP (on the input side) shall be field tested.

12.25.10 Balancing Tolerance: Systems shall be balanced within the following tolerances

1. Duct leakage Rates (at operating pressures)	
Low pressure ducts(0to0.5kPa)	5% of full flow
Medium Pressure Ducts(0.5to3kPa)	1% of full flow
High Pressure Ducts (Greaterthan3kPa)	1% of full flow
2. Airflow rates	
Under70L/S	10% of flow
Over/at70 L/S	5% of flow
3. Waterflow rates	
Chilled Water	2% of flow
Other	5% of flow
4. Heatflow rates	
Heat exchangers	5% of design capacity

Procedure:

- i. Review all pertinent plans, specifications, shop drawings and other documentation to become fully familiar with the systems and their specified and intended performance.
- ii. 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 Departments representative.
- iii. Test relative barometric pressures in various building area, as deemed necessary by the Department's representative and at least in an areas served by different systems.
- iv. 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.

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

12.25.11 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.

12.25.12 Final Documentation:

i. 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.

ii. The above tests and procedures are mentioned herein, for general guidance and information only, but not by way of lamination to the provisions of conditions of contract and design/ performance criteria.

iii. 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 per Para 1.18.3.

- Comprehensive operation and maintenance manual
- Test certificates, consolidated control diagram and technical literature on all controls.
- Equipment warranties from manufacturers.
- Commissioning and testing reports
- Rating charts for all equipment
- Log books as per equipment manufacturers standard format
- List of recommended spares and consumables
- Any special tools required for the operation or the maintenance of the plant shall be supplied free with the plant.

iv. 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.

- Any defective material or equipment supplied by the contractor
- 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.

13.0 Drawings:

13.1 Following drawings are enclosed

- ☐ All floors HVAC layout
- ☐ Chilled & Condenser water SLD
- ☐ Electrical SLD for HVAC Panels.

13.2 No other drawings shall be made available. The contractor may visit the site or discuss with Engineer-in-charge for any other site particular that he may need before submitting the tender.

13.3 Drawings have been prepared showing the areas to be Air conditioned & space allocated for the equipment. Adequacy of the plant room, AHU rooms etc for the equipment offered should be checked & confirmed by tenderer.

13.4 The above drawings represent a feasible scheme. Equipment layout, chilled water piping scheme, duct layout, sizes of grilles etc. shown in the drawings can be rearranged/ changed as per site/ Architectural requirements in consultation and with prior approval of Engineer-in-charge.

13.5 These are not working drawings. The contractor shall prepare detailed working drawings & execute the work as per working drawings approved by the Engineer-in-charge.

14.0 VRV/VRF System Technical specifications.

It is proposed to install **Centralized plant room with district cooling concept** (Secondary pumping) for main building & air cooled VRV/ VRF based Air Conditioning system with 100% inverter driven scroll compressor for capacity control for Guest House at IISER Berhampur, Orissa

The system selected is a modular system, with number of indoors connected to centrally located outdoor units, as per detail designing given in the tender.

- a)** The outdoor units for all the system shall be air cooled type and mounted on terrace of the building, or on ground Indoor units in various areas shall be as per enclosed drawings/ Bill of Quantities.
- b)** All the VRV/VRF air conditioners with Dual mode (Heating and Cooling mode) shall be fully factory assembled, wired, internally piped & tested. The outdoor unit shall be precharged with first charge of R410a /R407c refrigerant . All the units shall be suitable for operation with 415 V + 10%, 50 Hz + 3%, 3 Phase supply for outdoor units & 220 V + 10%, 50 Hz + 3%, 1 Phase supply for indoor units.
- c)** For laying down pipes inside building core cutting of beams should be carried out with detailed planning so necessary coordination with all agencies involved must be done.
- d)** Each indoor units shall have independent microprocessor based cordless remote controllers and electronics expansion valve.
- e)** Refrigerant pipes and control cables, running between outdoor and indoor units shall be connected with care and to be finished in good looking condition.
- f)** System shall be complete with cabling & earthing.
- g)** After award of work, the firm shall submit the design of complete VRV/ VRF AC system based on heat load calculation of all the rooms which are covered under the scope of work & got it approved from the department prior to the commencement of work.
- h)** Indoor and outdoor unit of VRV/ VRF based AC system should be compatible with PC and Central Controller so that one should be able to control all parameters like ON/ OFF, Temperature control, fan speed and locking/ unlocking of above said parameters.
- i)** The VRV/VRF system shall provide stable, trouble free & safe operation, with flexibility of operating desired indoor units. The outdoor units must be capable of delivering exact capacity proportional to the number of indoor units switched on & the heat load in the air conditioned area.
- j)** The operation of the VRV/VRF system shall be through independent wired/ wireless remote controllers as specified. The entire system shall be integrated with intelligent building management system of leading vendors like Honeywell/ Johnson Controls/ Staefa etc, through BAC Net Gateway. The detailing of operation required through BMS system are detailed under specifications of BMS system.
- k)** All the VRF air conditioners shall be fully factory assembled, wired, internally piped & tested. The outdoor unit shall be pre-charged with first charge of R-410A/R 407 refrigerant. Additional charge shall be added as per refrigerant piping at site. All the units shall be suitable for operation with 415 V $\pm$ 6%, 50 Hz $\pm$ 3%, 3 Phase supply for outdoor units & 220 V $\pm$ 6%, 50 Hz $\pm$ 3%, 1 Phase supply for in door units.

14.1. Specification of Outdoor units.

- (i)** Outdoors units of the VRV system (Cooling and Heating mode) shall be compact air cooled type.

(ii) All the compressors of the outdoor units must be hermetically sealed Inverter/ digital scroll/ Rotary type. Each module of outdoor unit must have separate 1# inverter compressor and/ or digital scroll compressor, suitable to operate at heat load proportional to indoor requirement.

(iii) “Anti Corrosive” treatment for Al fins of Condenser Coils is mandatory. The treatment should be suitable for areas of high pollution and salt laden air

(iv) The outdoor units must be suitable for up to 165 m refrigerant piping between outdoor unit & the farthest indoor units, total piping of 1000 m for all the indoor units. Allowable level difference between outdoor unit & indoor units shall be 50 m in case of outdoor unit on top & 40 m in case of outdoor unit at bottom. Allowable level difference between various indoor units connected to one out door unit shall be up to 15 m.

(v) Back up operation, in case of failure of one of the compressors of out door unit, for single module outdoor units or failure of one of the modules in case of multiple module outdoor units shall be possible. The VRV/VRF outdoor unit shall always be supplying at least 33% of back up operation, of the full load capacity.

(vi) The outdoor unit shall employ system of equal run time for all the compressors, inverter or on/ off type, within each outdoor unit – Single Module or Multi Module.

(vii) The outdoor units shall be suitable to operate within an ambient temperature range of – 5 Deg C to 50 Deg C, in cooling mode & -20 Deg C to 15 Deg C in heating mode.

(viii) Air cooled condenser shall have Axial Flow, upward throw fan, directly coupled to fan motors with minimum IP 65 protection. The outdoor unit condenser fan shall be able to develop external static pressure up to 6 mm of water column.

(ix) The entire operation of outdoor units shall be through remotes of indoor units. Separate Start/ Stop function shall be required.

(x) Starter for the Outdoor Unit compressor shall “Direct on Line” type. Digital/ inverter compressor of the unit shall start first & at the minimum frequency, to reduce the inrush current during starting.

(xi) Refrigerant control in the outdoor unit shall be through Electronic Expansion Valve. Complete refrigerant circuit, oil balancing/ equalizing circuit shall be factory assembled & tested.

(xii) Noise level of outdoor units shall not exceed 70 dB (A) at a distance of 1.5 m from the unit.

(xiii) The outdoor units shall confirm to Technological Guideline for Harmonic Suppression – JAE 9702-1995. High Harmonic Environmental Target Level for Power Distribution system shall be 5%. The efficiency of inverter shall not be less than 98.

(xiv) Proper duty cycling shall be ensured to prolong the life of the compressor.

(xv) Outdoor units shall be complete with following safety devices:

- 1 High pressure switch
- 2 Fan driver overload protector
- 3 Over current relay
- 4 Inverter Overload Protector
- 5 Fusible Plug Unit shall be supplied with

- 6 Installation manual 7 Operation Manual
- 8 Connection Pipes
- 9 Clamps

NOTE: Each VRF Outdoor units (single / multi models) Power supply providing Only one .

(xvi) **Civil Foundation** -The outdoor units will be placed on terrace with foundation made on columns/ beams. The scope shall include providing and fixing ISLB 100 structure for mounting of VRF ODUS on RCC blocks on terrace. The scope shall include RCC blocks, these blocks will be cast on top of existing columns/ beams (4Nos blocks placed over existing building columns & 4Nos placed on beam) on terrace (Each platform will have 8 blocks). RCC block shall be of size 300 x300mm & the height of these blocks shall be 200 mm, 24G GI sheet sandwiched between two layers of 8mm neoprene rubber will be placed between block & terrace. ISLB 100 will be anchored to RCC blocks.

Water proofing if it gets damaged due to men material movement of HVAC contractor, the same shall be repaired to the complete satisfaction of the engineer in charge. The VRF unit will be anchored to ISLB, 8mm neoprene rubber should be placed between ODU & ISLB.

(xvii) The outdoor units shall have multiple 100% inverter / digital driven scroll compressor, Minimum C.O.P of O D U should be minimum 3.3 at 100 % load at ARI condition and

5.1 at 50% load of ARI condition

(xviii) The machine must have a sub cool feature to use coil surface more effectively thru

proper circuit/ bridge so that it prevents the flushing of refrigerant from long piping due to this effect thereby achieving energy savings

14.2 Cassette type indoor units.

(i) These units shall be installed between the bottom of finished slab & top of false ceiling. The maximum allowable height for the cassette type units shall be 350 mm.

(ii) The unit must have in built drain pump, suitable for vertical lift of 1000 mm.

(iii) The unit casing shall be Galvanized Steel Plate.

(iv) Unit must be insulated with sound absorbing thermal insulation material, Polyurethane foam. The noise level of unit at the highest operating level shall not exceed 50 dB(A), at a vertical distance of 1.5 m from the grille of the unit.

(v) Unit shall have provision of connecting fresh air without any special chamber & without increasing the total height of the unit (350 mm maximum).

(vi) The unit shall be supplied with suitable decorative panel.

(vii)The unit shall be supplied with Resin Net filter with Mold Resistance. The filter shall be easy to remove, clean & re install.

(viii) The unit will be connected in series to a suitable outdoor unit & it must be possible to operate the unit independently, through cordless remote specified in the “Bill of quantities”. The unit will be further may be connected to Intelligent Building Management System (To be supplied by other vendors) & it shall be possible to operate the unit through this IBMS system.

(ix) The unit shall be supplied with following from the factory

- a) Operation Manual

- b) Installation Manual
- c) Paper pattern for installation
- (x) Drain hose/ Clamp metal/ Washer fixing plate/ Sealing pads/ Clamps/ Screws/ Washer for hanging bracket/ Insulation for fitting.

14.3 Hi wall type units.

- (i) These units shall be Hi wall split ac with suitable supports to take care of operating weight of the unit, without causing any excessive vibration & noise. The cold air supplied by these units will be supplied to the area to be air conditioned, through duct system specified in the tender.
- (ii) Each indoor unit must have electronic expansion valve operated by microprocessor thermostat based temperature control to deliver cooling/ heating as per the heat load of the room.
- (iii) The unit casing shall be Galvanized Steel Plate.
- (iv) Unit must be insulated with sound absorbing thermal insulation material, Glass Fiber. The noise level of unit at the highest operating level shall not exceed 49 dB(A), at a vertical distance of 1.5 m below the units with duct connected to the unit.
- (v) The unit must be able to develop external static pressure of 25 mm, at the specified air quantities.
- (vi) Unit must have Thermal Fuse for fan motor protection, in case of motor heating.
- (vii) The unit will be connected in series to a suitable outdoor unit & it must be possible to operate the unit independently, through corded/ cordless remote specified in the bill of quantities. The unit will be further connected to Intelligent Building Management System (To be supplied by other vendors) & it shall be possible to operate the unit through this IBMS system.
- (viii) The unit shall be supplied with following from the factory
 - a) Operation Manual
 - b) Installation Manual
 - c) Paper pattern for installation
- (ix) Drain hose/ Clamp metal/ Insulation for fitting/ Sealing pads/ Clamps/ Screws

14.4 HIGH STATIC DUCT TYPE UNITS.

- (i) These units shall be ceiling suspended with suitable supports to take care of operating weight of the unit, without causing any excessive vibration & noise. The cold air supplied by these units will be supplied to the area to be air conditioned, through duct system specified in the tender.
- (ii) Each indoor unit must have electronic expansion valve operated by microprocessor thermostat based temperature control to deliver cooling/ heating as per the heat load of the room.
- (iii) The unit casing shall be Galvanized Steel Plate.
- (iv) Unit must be insulated with sound absorbing thermal insulation material, Glass Fiber. The noise level of unit at the highest operating level shall not exceed 49 dB(A), at a vertical distance of 1.5 m below the units with duct connected to the unit.

(v) The unit must be able to develop external static pressure of 25 mm, at the specified air quantities.

(vi) Unit must have Thermal Fuse for fan motor protection, in case of motor heating.

(vii) The unit will be connected in series to a suitable outdoor unit & it must be possible to operate the unit independently, through corded/ cordless remote specified in the bill of quantities. The unit will be further connected to Intelligent Building Management System (To be supplied by other vendors) & it shall be possible to operate the unit through this IBMS system.

(viii) The unit shall be supplied with following from the factory Operation Manual Installation Manual

(ix) Paper pattern for installation

Drain hose/ Clamp metal/ Insulation for fitting/ Sealing pads/ Clamps/ Screws

14.5. COPPER REFRIGERANT PIPING:

Seamless soft copper tumbling type L shape be used to make connections to equipment, wherever required or specified.

Flare fittings e.g. flare nuts, tees elbows, reducers etc. shall all be of brass.

All refrigerant piping for the air conditioning system shall be constructed from soft seamless upto 19.1 mm and hard drawn copper refrigerant pipes for above 19.1 mm with copper fittings and silver soldered joints. The refrigerant piping arrangements shall be in accordance with good practice within the air conditioning industry, and are to include charging connection, suction line insulation and all other items normally forming part of proper refrigerant circuits.

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

After the refrigerant piping installation has been completed, the refrigerant piping system shall be pressure tested using nitrogen at pressure of 20 Kg. per Sq. cm and 10 Kg. per sq. cm. (low side). Pressure shall be maintained in the system for 24 hours. The system shall then be evacuated to minimum vacuum if 700 mm hg. and held for 24 hours.

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

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

	<u>Pipe size in mm (OD)</u>	<u>Wall Thickness in mm</u>
a)	6.40	0.80
b)	9.53	0.80
c)	12.70	0.80
d)	15.86	1.00
e)	19.00	1.00
f)	22.70	1.00
g)	28.60	1.20
i)	34.92	1.20

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

Copper piping shall be supported or clamped at every 1.5 mt distance. Fittings from the equipment supplier should be used. Pressure testing of copper piping should be carried out floor wise as per site condition. Final pressure testing should be carried out after completing the entire piping and after connecting to the indoor units and outdoor units. Copper piping shall be tested at 550 PSI for 24 hours. Proper supports on the terrace shall be provided for copper refrigerant piping at 1.5 mt. interval. Refrigerant piping shall be covered with perforated GI cable tray to prevent physical damage.

14.6 INSULATION TO REFRIGERANT PIPING:

Nitrile rubber tube insulation of 19mm Thick Above 1" dia pipes and 13mm thick for below 1" shall be used for copper piping both for suction line and liquid line. All joints shall be sealed with self-adhesive type aluminium tape of 75 mm width.

14.7 COMMUNICATION CABLE AND CONTROL CABLING:

Communication cable and control cabling: Communication cable and control cabling shall be laid in 25 mm dia PVC conduits of required size. PVC conduit should be clamped neatly. Cable terminations and dressing shall be done properly and neatly.

14.8 DRAIN PIPING:

CPVC drain pipe shall be used for the drain piping. Proper care shall be taken to lay the drain piping with sufficient slope and should be clamped or supported at 1.5 m interval. All drain pipe joints shall be done with adhesive. Drain piping should be tested for leaks before commissioning. After testing for leaks, drain pipe shall be insulated with 13 mm thick, nitrile rubber tube insulation. Insulation shall be finished with self adhesive black cotton tape For Proper drainage of condensate. U Trap shall be provided in the drain piping (wherever required). All pipe supports shall be of pre-fabricated & pre painted slotted angle supports, properly installed with clamps etc.

14.9 PERFORMANCE TESTS

The installation as whole shall be balanced and tested upon completion and all relevant information, including the following shall be submitted to the department a. Air Volume passing through each unit, duct, grilles, apertures.

- b. Inside DB temperature and relative humidity over specified period.
- c. Electrical current reading, in amperes of full and average load running, and starting together with name plate current of each electrical motor.
- d. Continuous recording over a specified period, or ambient wet and dry bulb temperatures under varying degrees of internal heat load and use and occupation in each zone of each part of the building.

LIST OF APPROVED MAKE OF MATERIALS

(FOR CIVIL WORKS)

Specification/brands names of materials (Refer materials, whichever are applicable for the scope of work) and finishes approved by the Architect/Engineer-in-Charge are listed below. However approved equivalent material and finishes of any other specialized firms may be used, in case it is established that the brands specified below are not available in the market but only after approval of the alternate brand by the Architect/Engineer-in-Charge. (See also condition of contract).

Sl.No.	Material	Approved Makes / Brands		
1.	Ordinary Portland Cement / Portland Pozzolona Cement	ACC	Ultratech	J. K Cement
		Dalmia	Ambuja Cement	Konark
2.	White Cement	Birla White	J.K. White	Lafarge
3.	Ready Mix Concrete	ACC	Ultratech	RMC
		Lafarge	L&T	AB Dinesh
4.	Reinforcement Steel (CRS TMT- Fe 500D/CRS 550D)	SAIL	Tata Steel	RINL
		JSW Steel Ltd		Jindal Steel & Power Ltd
5.	Structural Steel / M.S. Tubes	TATA	JSW Steel Ltd	SAIL
		Jindal Steel & Power Ltd	Rashtriya Ispat Nigam Ltd	
6.	Plasticizer, Super Plasticizer, Admixtures, Other construction chemicals		Fosroc	Pidilite
		CICO	Sika	BASF
7.	Waterproofing Compound (Crystalline)	BASF	Sika	
		Fosroc		Tapecrete
		Pidilite		CICO
8.	Waterproofing Self		Fosroc	Pidilite
	Adhesive (HDPE) membrane		CICO	
9.	EPDM Water proofing Membrane		Pidilite	STP
		Fire Stone		
10.	PU Elastomeric Membrane (spray applied for Deck Waterproofing)	BASF	Fosroc	Sika
		Pidilite		

11.	Glasswool Insulation	UP Twiga	Poly Glass	Ownscomring
12.	Rock Wool Insulation	Lloyds	Roxul Rockwool	
13.	Swellable Bar	Pidilite	Fosroc	
			Sika	CICO
14.	Polycarbonate Sheet	GE Plastic (SABIC)	Tuflite	Dpi Day lighting
15.	Decking Steel Sheet	TATA Steel	Lloyds	JSW
16.	Shuttering Ply	Archid	Century	Merino
		Kitply	Greenlam	
17.	Rebarring Chemical	Hilti	3M India	Birla
18.	Fire Sealant	Hilti	3M India	Fischer
19.	Parallel Threaded Couplers (Compliant to IS 16172:2014)	Dextra	Halfen Moment	G-Tech
20.	Extruded Polysterene Board	STP	UP Twiga	Ownes Corning, Shalimar, Technonicol
21.	AAC Block	Aerocon	Builttech	
	Concrete fast build corex siporex fast build			JK
22.	AAC Mortar	Ferrouscrete	Ultratech	JK
23.	Moisture Resistant Board	Saint Gobain	Gyprox	USG Boral
		Greenlam		Merino
24.	Veneered Particle Board	Merino		Greenlam
		Kitply	Archid	
25.	Laminated Particle Board / Laminates	Merino	Greenlam	Century
		Novapan	Duro	Archid
26.	Flush door / Laminated Flush Doors	Century	Greenlam	Merino
		Duro	Jayna	Kitply/ Swastic
27.	Toilet Cubicles	Merino	Greenlam	Dorma
28.	Hardware for Fire Check Door	Dorma	Hettich	Hafale
29.	Plywood/ Veneer/Laminate	Merino	Greenlam	Century

		Everest	Greenply	
30	Expansion Joint - Modular	C.S.	Herculus	Z-Tech
		Vexcolt	Devin	Sainfield
31.	Polyster Powder Coating Paints Repellent /Weather Sealant	Nerolac	Berger	Akzonobel
			Wacker	STP
32.	Poly-Sulphide Sealant	Fosroc	Pidilite	Sika
		Myk Laticrete	Wacker	Dow Corning
33.	Wall Putty	Birla Wall Care	JK White	Saint Gobain
34.	Curing Compound	Fosroc	Sika	Cico
		STP	Pidilite	BASF
35.	Oil Bound Washable Distemper	Asian Paints	AkzonobelDulux	Berger
		ICI	Nerolac	
36.	Acrylic Distemper	Berger	Asian	Dulux
37.	Premium Acrylic Emulsion paints	Dulux	Nerolac	Asian Paints
		Berger		
38.	Cement Primer	BP White (Berger)	Decoprime WT (Asian)	Akzonobel (Dulux)
		Nerolac		
39.	Cement Paint	Snowcem Plus	Berger(Durocem Extra)	Nerolac (Nerocem with Titanium)
		Asian		
40.	Steel / Wood Primer	Akzonobel (Dulux)	Nerolac	Asian Paints
		Berger	Jenson & Nicholson	

41.	Textured Exterior Paint	Akzonobel (Dulux)	Asian (Apex Ultima)	Nerolac Kansai (Excel)
			Unistone	Berger
42	Synthetic Enamel Paint	Akzonobel (Dulux)	Asian (Apcolite)	Kansai Nerolac (Synthetic Enamel)
		Berger		
43.	Epoxy Paint	Kansai Nerolac	Asian Akzonobel(Dulux)	FOSROC
		ICI		
44.	Epoxy Flooring	Pidlite	BASF	FOSROC
45.	Fire Paint	asian		Akzonobel
46.	Heat Resistant Tiles	Swastik	Thermax	NTC
47	Gypsum Plaster	Ferrous Crete	Elite (90)	Ultratech
48.	Pre-Cast GRC & GFRC Jali	Unistone	Birla White GRC	Ecovision
49.	Stainless Steel	Salem Steel	Jindal Alloys	SAIL
50.	Welding Electrodes	Advani	Oerlikon	Modi
		L & T		
51	Stainless Steel Hardware	Dorma	Hafale	Hettich
			KICH	OZONE
52	Formwork systems	Peri Myvan	Doka MFS Formwork System	Symons-L&T Formwork
53	Aluminium Shuttering	Maini	S-Form	
		MFE Form Work	Mivan	
54	Metal Standing Seam roofing system.	MULTI-INFRATECH -Multi-Zip	LYSAGHT Flex-lok of Tata Blue Scope	Lloyd
55	Automatic Sliding Door	Dorma	Ozone	Geze
56	HDPE Grass Pavers	Ovilite	Elemich	Baijanath Landscape

57	Wall Hanging Online Water Fountain	Bluestar	Voltas	Usha
58	Post Tensioning Tendon Anchorage System	Freyssinet	BBR, Ultracon	Stresstech and VSL
FALSE CEILING				
S. No.	Material	Approved Makes / Brands		

1	False Ceiling – Gypsum	Saint Gobain	India Gypsum	Boral Lafarge
		Armstrong	Aerolite	
2.	False Ceiling – Metal	Saint Gobain	Hunter Douglas	Armstrong
3.	Gyp Board	Saint Gobain	Boral	Lafarge
4.	Open Cell Ceiling	Armstrong		
		Hunter Douglas		
5.	False Ceiling Grid System	Gyproc	Grid System	Aerolite
		Gridline	Armstrong	Boral Lafarge
6.	Baffle Ceiling	Armstrong		Hunter Douglas
7.	Accoustical Tile False Ceiling	Armstrong	Aerolite, Denosonic	Himalaya Acoustic
8.	Acrylic Solid Surfaces	Hanex	L.G-Hymac	Dupont

FLOORINGS				
S. No.	Material	Approved Makes / Brands		
1	Mosaic / Chequered Tiles	Bisazza	NITCO	Unitile
				ZICO
2.	Ceramic Tiles / Glazed Tiles	RAK	Somany	OASIS
		Asian (AGL)	Orient, Bell	Kajaria
3.	Vitrified Tiles (Antiskid / Matt / Glazed)	OASIS	RAK	Kajaria
		Asian (AGL)	Orent Bell	Somany

4.	PVC Flooring	Armstrong	Tarquet	Pergo
5.	Cement Concrete Tiles / GRC Pavers (Designer Tiles)	Unistone	Ultra	Eurocon
		Laxmi	Zico	Nitco
6.	Paver Block &Kerb Stone	NITCO	Unitile	Ultra
			Zico	
7.	Tile / Stone Adhesive /Tile / Epoxy Grout	Pidilite	Ferrous Crete	MYK Laticrete
		Fosroc	BASF	
S. No.	Material	Approved Makes / Brands		
8.	Dash / Anchoring Fasteners	Hilti	Fisher	Bosch
9.	Floor Hardener	Ironite	Fosroc	Hardonite
		Sikka		
10.	Laminated Floor	Armstrong	Tesa	Pergo
11.	Composite Marble / Granite / Engineered Stone	Asian	Johnson	Kalinga
12.	Water Based Melamine Polish	Asian Paint	Pidilite	ICI Dulux
		Berger		
13.	Fire Retardant Paint	Asian Paint	Berger Paint	Shalimar
14.	Clamp System For Dry Stone Cladding	Hilti	Fischer	Bosch
15.	Calcium Silicate FalseCeiling	Everest	NCL	Aerolite
16.	Calcium Silicate Ceiling Tile / Board			
GLAZINGS				
S. No.	Material	Approved Makes / Brands		

1.	Anodised Aluminum Hardware (Heavy Duty)	Hardima	Indalco	Hindalco
		Everite	Godrej	
2.	Aluminum Structural Members – Windows, Glazing and Partitions	Jindal	Indalco	Hindalco
		Nalco		Alom
3.	Glazing Structural / Suspended / Skylight	Saint Gobain	Pilkington	Glaverbal
4.	Clear / Float / Frosted Glass	Saint Gobain	AIS	Pilkington
		MODI Guard		
5.	Glass Spider Fittings	Dorma	Hafale	Ozone
6.	Stainless Steel Railing, Accessories etc. in Grade SS 304 & 316	Dorma	D-line	Geze
		Ozone		
7.	Hermitically Sealed performance glass Toughened Glass	Saint Gobain		Pilkington
		Modiguard	ASAHI	
8.	Fire Rated Vision Panels	Pilkington	Schott	
		Saint Gobain	Glaverbel	
9.	Ceramic panel Cladding	Hunter Douglas		
10.	Aluminum Louvers	Hunter Douglas	Kawneer	Colt
11.	Aluminium Composite Panels		Alucobond	
		Aludecor	Alstrong	
12.	G.I. Steel Door Frame	Synergy Thrislington	Navair	Shakti
13.	Friction Stay Hinges	Dorma	LG Sysmac	Dorset
14.	EPDM Gasket	Hanu	Anand	Osaka / Alps
15	Glass Processor for making DGU / Toughing	Art N Glass		
		ASAHI	Gold Plus	Kaenat Glass

S. No.	Material	Approved Makes / Brands		
16.	Mirror Glass	Atul	Modi Guard	Saint Gobain
		Glalverbel	AIS	
17.	UPVC Doors & Windows	Fenesta	Wintech	
		Windowmagic		
18.	Poly Sulphide Sealant	Fosroc Wacker	Dow Corning	GE
19.	Silicone / Weather Sealant	Fosroc Wacker	Dow Corning	GE

HARDWARE				
S. No.	Material	Approved Makes / Brands		
1	Nuts / Bolts / Fastners / Screws	GKW	Atul	Hilti
2.	Door/Window Fittings	Godrej	Everite	Doorset
		Hardwyn		
3.	Door Closer	Dorma	Godrej	Hettich
		Everite	Hardwyn	
4.	Die Cast Patch Fittings	Dorma	Geze	AssaAbloy
		Hettich	Ozone	
5.	Fire Rated Doors	Iclean	Shakti	Promat
		Navair		Godrej
6.	Floor Springs	Dorma	Geze	Hettich
		Dorset	Everite	
7.	SS Mortise lock with one dead bolt and pair of SS handles steel grade SS 316	Dorma	Godrej	Hafele
		Dorset		
8.		Dorma	Godrej	Hafele

	SS Mortise latch &lock with six levers and pair of SS handles steelgrade SS316	Dorset		
9.	SS Tower bolt	Dorma	Godrej	Hafele
10.	SS Butt hinges with ball bearing grade SS 316	Dorma	Godrej	Ingersoll Rand
11.	SS Hardware fitting	Kitch	Hafele	Godrej
12.	Pull handle back to backof length 150mm of Steel Grade SS 316	Godrej	Geze	Ozone
13	Pull handle, single side of length 150mm of Steel Grade SS 316	Godrej	Geze	Ozone
14.	Aluminium lever Handles	Hardima	Godrej	Everite
15.	Lever handle in SS 316 finish	Dorma	Hafele	Godrej
16	Magic Eye	Dorma, Godrej, Ingersoll Rand		
HVAC / VENTILATION SYSTEM				
S. No.	Material	Approved Makes / Brands		
1	Chillers	York	Carrier	Daikin
		Dunham Bush	Trane	
2	Chilled/ Condenser Pumps:	Kirloskar	Bell & Gossett	Wilo (Mather+Platt)
		Grundfos	Armstrong	
3	Cooling Towers	Mihir	Advance	Paharpur
4	Hot Water Generator	Rapid Cool	Emerald	Sandhu
5	Air Handling Units & TFA:			
5a.	Air Handling Units (Eurovent certified	VTs	System Air	Stulz
		Flaktwood	Edgetech	Zeco

5b.	Cooling Coil	As per manufacture standard of AHU		
5c.	Fan	Kruger / Comferi	Airflow	Nikotra
6	Fan Coil Unit & Cassette Unit	Sinko	Carryaire	Trane
7	Split AC	Daikin	Hitachi	Toshiba
		Carrier		
8	M.S. Pipes: - Any dia	Tata	Jindal Hissar	Sail
9	Butterfly Valves	Advance	L&T	Danfoss
		VTM	Axim	
10	Motorized Butterfly Valve	Belimo	Danfoss	Siemens
		Oventrop		
11	Pressure independent control valve (PICV)	Belimo	Danfoss	Siemens
		Oventrop	Flowcon	
12	Check Valves	Advance	L&T	Danfoss
		VTM	Axim	
13	Ball valve	Zoloto	Audco	RC
		VTM	Axin	
14	Balancing Valves	Danfoss	Advance	Danfoss
		VTM	Axin	
15	2-way Modulating Valves with Thermostat	Belimo	Honeywell	Siemens
16	2-way on off valve with thermostat for FCU	Belimo	Honeywell	Siemens
17	Expansion Bellows	Resistoflex	Easyflex	Areaflex
		Dunlop	Axin	

18	Pot/Y-Strainers	Sandhu	Rapid Cool	Emerld
		Axin		
19	Suction Guide with Strainer	Anergy	Armstrong	Emerald
		Axin		
20	BTU meter	Belimo	Siemens	Honeywell
		Shenitech		
21	RH Sensor	Belimo	Honeywell	Siemens
		Omnicon		
22	Thermostat	Danfoss	Belimo	Honeywell
		Siemens	Omnicon	
23	Pressure Gauge (Industrial Type)	Feibig	H. Guru	Emerald
		Axin		
24	Differential Pressure	Siemens	Rapid Contro	Anergy
	Switch	Sant		
25	Thermometers	Feibig	H.Guru	H.Guru
		Emerald	Axin	
26	Closed Expansion Tank	Anergy	Bell & Gossett	Sandhu
		Emerald		
27	Air Separator	Anergy	Emerald	Sandhu
28	Auto Air Vent	Anergy	Rapid Cool	Oventrop
29	Plug Valve	Anergy	Rapid Cool	
30	G.I. Sheets	Sail	Tata	Jindal
31	MS. Sheets	Hindalco	Balco	NALCO
32	Fire Dampers	Systemair	Caryaire	Ruskin
		Greenheck		
33	Damper Actuator	Belimo	Sinider	Sinider

34	Grills/Diffusers	Systemair	Caryaire	Titus
		Trox		
35	Fresh Air Louvers	Systemair	Caryaire	Titus
		Trox		
36	Resinbonded Glass Wool Insulation	UP TWIGA	Owens Corning	Kimmco
		K-flex		
37	Protective Coating over insulation (Lag coating)	Pidilite	Foster	Idendan
		CISBOND		
38	Resinbonded Glass Wool Acoustic Insulation	UP TWIGA	Owens Corning	Kimmco
		K-flex		
39	Insulation Adhesive	Pidilite	Foster	CISBOND
		Henkel		
40	Factory Made ducting	Rolastar	Ductofab	Zeco
		Technofab	Ecoduct	
41	Filters (in Airconditioning system) Ventilation Fans:	Thermodyne	Purolator	Anfilco
		Mackmark		
42	Tube/Vane Axial	Kruger	System Air	Greenheck
43	Inline (Centrifugal)	Kruger	System Air	Caryaire
		Ostberg		
44	Propeller Fans	Kruger	GE	Crompton
45	Air Washer/Scrubber	Edgetech	Zeco	System Air
		VTS	Crystal Air	
46	Fan	Kruger	Nikotra	Comferi
47	Pump	Kirloskar	Beacon	Wilo
48	Filters	As per manufacturer's standard		

49	Heat Recovery Wheel units	DRI	Enventus (Ostberg)	Flakt
50	Heat Pipe	HPT	SPC	VTs
51	Vibration Isolator	Easyflex	Resistoflex	Dunlop
52	Anchor/Fastener	Hilti	Fisher	Gripple
		Rawlplug		
53	Duct Support	GPL	Gripple	Easyflex Zip-Clip
54	PUF Saddles	Lloyds	Beardsell	Malanpur
55	FCU link	ATS (CSI)	Oventrop	CIM

56	Sound Attenuator	Ruskin	Systemair	Trox
57	CO Sensor	Siemens	Omicron	Johnson
58	VFD	Danfoss	ABB	Siemens
		Fuji		
59	CO2 Sensor	Siemens	Omicron	Johnson
	Demand Ventilation System			
60	Equipment	Conaire	Glenstorm	Tristar
61	Motorized Assembly	Conaire	Glenstorm	Tristar
62	Integrator	Conaire	Glenstorm	Tristar
63	High Density PVC Pipe	Finolex	Kissan	Prince
		Supreme		
64	UVCI	Universal UV Solutions	UVTronix	Supco
65	Online Scale preventer	Scale Guard	Ristello	Supremo
66	Electronic Air Filtration System	Honeywell	Trion	Trane
67	VRF/VRV System	Daikin	Tosiba	Samsung
		Mitsubishi Electric	Midea	

68	Copper Refrigerant Pipe	Camipro	Rajco	Mandev
PLUMBING & SANITARY				
S. No.	Material	Approved Makes / Brands		
1.	Sanitary Fittings & Accessories	Hindware (Italian collection)	Kohler	Cera
		Jaquar	Somany, Roca	Krovit
	Concealed cistern	Grohe	Johnson	
		Hindware	Kohler	Roca
		Geberit		
	WC connector	Geberit	Kohler	Viega
	Auto Urinal Flush System	Duravit	Kohler	Roca
		Grohe		
2	CP Brass Fittings	Jaquar	Kohler	Parryware
		Hindware	Grohe	Johnson
3	G.I. / M.S. Pipe	Tata, SAIL	Jindal (Hissar) Keshoram	Eletrostal
4	G.I. Fittings	Unik		Zoloto
			Surya	
5	SS Pipes 316	Jindal	Tata	SAIL
6	HDPE Pipes	Reliance		Oriplast
				Supreme
7	DI Pipes	Electrosteel	Jindal	Tata Ductura
8	DI Fittings	Kartar	Electrosteel	Kalinga
9	CI Fittings	Neel	Kartar	Electrosteel
10	Float Valve	IVC	Leader	Zoloto
		KSB		
11	UPVC Pipe and Fittings	Astral	Supreme	Finolex
			AKG	HSIL (TRUFLO)

12	PVC Pipe & Fittings	AKG	Supreme	Finolex
		Surya	HSIL (TRUFLO)	
13	CPVC Pipes & Fittings	AKG	Astral	Supreme
		Finolex	Surya	
		SFMC	HSIL (TRUFLO)	
14	Centrifugally Cast (Spun) Iron Pipes & Fittings	NECO	SKF	Electrosteel
15	Centrifugally Cast (Spun) Iron (Class LA) Pipes	NECO	Electro Steel	TATA Keshoram
16	Centrifugally Cast (Spun) Ductile Iron Pipes & Fittings	Electro Steel	Jindal (Hissar)	Kalinga, Keshoram
17	C.I. Manhole covers, Frames & GI Gratings	NECO	RIF	
		SKF		
18	SFRC Manhole covers & gratings	KK	OCR	Pargati
		T-CON		
19	RCC manhole Covers & Frames	KK manhole	Grating Co. Pvt Ltd	
20	D.I. Manhole Covers & Frames	Neco,	Raj Iron Foundry Agra	Kartar
21	Gun Metal Valves, Globes	Kartar	Castle	Zoloto
22	NRV - Ball type - Sewage application	Danfoss	ZOLOTO (AUDCO)	
23	Bellow Type, Pressure Reducing Valve	CIM	Danfoss	Honey well
24	Floor Taps	Jayana	Chilly	Nirali
25	Water Meter	Prima	Zoloto	Leader

		Capstan		
26	Brass Stop & Bib Cock	Zoloto		
		Leader	Astral	
27	Non Return Valve (Check valve) 1/2" to 1 1/4"	Zoloto		Leader
		Kartar		
28	Brass Ferrules	Dhawan Sanitary Udyog	Kalsi	Annapurna
29	Polythylene water storage tank	Sintex	Polycon	SPL
		Vectus		
30	Insulation for hot water pipes	Kaiflex	Armaflex	Careflex
		Lloyd		
31	Insulation for external/ exposed hot water pipe	Kaiflex	Armaflex	Careflex
		Lloyd		
32	Pipe protection for external water supply pipes	Pypkote	Armaflex	Makpolykote
33	GI/MS Pipe Protection Wrapping & Coating	IWL - Pypkote	Rustech - Coatek	
34	Stainless Steel Sink	Neelkanth	Nirali	Jayna
		Cera		
35	Stoneware Pipes	Perfect	Hind	Burn
		Anant	PARRY	SFMC
36	Gully Traps	Perfect	Hind	Burn
		PARRY	SFMC	Anant
37	RCC Pipes (NP-2)	Lakshmi	Sood&Sood	Jain & Co.
			Balaji	Raj Cement Product
38	Atactic Polypropylene	STP	HTL	Hydro Tech

		Pidilite	Texsa	Bengal Bitumen
39	C.P. Waste, Spreaders, Urinal Flush Pipes	Jaquar	Parko	
40	Check Valve - Dual Plate	Advance	Danfoss	Kirloskar
41	Ball Valves / wafer type valves	Zoloto	Leader	IBP
42	Check Valve Forged Screwed	CIM/ Leader	Sant	ZOLOTO
43	Ball Cocks	GPA	Sant	L&K
44	Air Release Valves	Sant	Leader	Zoloto
45	Pipecoat	IWL Ltd	Pypkote	STP
46	CI Double Flanged Sluice Valve	Kirloskar		
		Kejriwal		
47	Adhesives	Nuwood	Duratuff	Pidilite
48	PE-AL-PE	Kitec	Jindal	Supreme
49	Solar Water Heating System	Tata BP	Honey Well	Solar
50	Water Heater (Geyser)	Venus	Bajaj Spherhot	
		Racold	Havells	
51	Hand Drier	Euronics	Duravit	Grohe Kohler
52	Backflow preventer (Water Hammer)	Normex	Kessel	Lahri
53	Drinking Water Cooler	Blue Star, Usha	Voltas	Oasis

54	Anti-Vibration Mounting & Flexible connections	Resistoflex	Dunlop	Flexionics
55	Electronic Flow Meter	Blue Star	Usha	Voltas
56	Temperature Sensor/ Gauge	Forbes Marshall	Danfoss	Wika

FIRE FIGHTING				
S. No.	Material	Approved Makes / Brands		
1	M. S Pipe	Tata	Jindal Hissar	Prakash Surya
		SAIL		
2	G. I Pipes	Jindal Hissar	Prakash Surya	SAIL
		TATA		
3	Forged Fittings	SS	VS	True Forge
4	ERW / butt Welded Fittings	MEC (Jainsons)	Unik	
5	Groove Fittings (UL listed)	Victaulic	Jainson	New
6	Ball Valve / Gate Valve (Gunmetal)	Sant	Leader	Zoloto
		CIM		
7	Butterfly Valve	Zoloto	Kirloskar	Leader
		Audco		
8	Motorized Butterfly Valve	Advance	AUDCO	L&T
		Zoloto		
9	Balancing Valve	Advance	Utam& VTM	L&T
10	Non Return Valve	Advance	Utam& VTM	L&T

11	Y-Strainer	Emerald	AUDCO	Kirloskar
		Zoloto		
12	Pot Strainer	Rapidcool	Emerald	Sant
		AUDCO	Zoloto	
13	Thermometer	Emerald	Anergy	Honeywell
14	PICB Valve	Danfoss	Frees	Ovenrop
		Spirotech	Reflex	
15	Control Valve	HD	Viking (VL Listed)	
16	Airvent	Anergy	Siemens	Emerald/CIM /Advance/ Honeywell
17	Expansion Tank	Anergy	Emerald	
18	Hot Water Generator	Sant	Emerald	Rapidcool
19	Air Pressure Valve	Anergy	Flemco	Castle
		SKS	Leader	
20	C.I. Double flanged sluice valves	Kirloskar	Zoloto	Sant
		IVC		
21	C.I. Double flanged Non-return valves	Kirloskar	Zoloto	Leader
		IVC		
22	Dual Plate / Wafer Type Non-return valves	Kirloskar	Zoloto	Leader
		IVC		
23	Foot valve with Strainer	Kirloskar	Leader	Zoloto
24	Y-Type / Pot / Suction Strainer	Kirloskar	Leader	Zoloto
		Tyco	Advance	
25	Fire Extinguishers	Zenith	Minimax	Safex

		Ceasefire	Newage	Safe Fire
26	First Aid Hose Reel Drum	Superex	Newage	Safex
		Safe Fire		
27	Thermo Plastic Hose Reels for Drums	Superex	Newage	Safex
28	R.R.L. Hose & C.P.	Superex	Newage	Eversafe
	Hose	Safe Fire		
29	Branch Pipe, Nozzle, Coupling etc.	Superex	Newage	Eversafe
		Minimax	Lifeguard	Safeguard
		Safe Fire		
30	Landing Valves	Superex	Newage	Eversafe
		Safe Fire		
31	Fire Brigade Connections	Superex	Newage	Eversafe
		Minimax	Safe Fire	
32	Fire Fighting Equipment not covered elsewhere	Superex	Newage	Eversafe
33	Hose Box	Superex	Newage	Eversafe
34	Sprinkler & Rosette Plates	Tyco	Viking	HD
		Spray Safe		
35	Flexible Connector (Drop) for Sprinkler	Easyflex	Viking	Newage
36	Flow Switches	System Sensor	Honeywell	Potter
		Tyco		
37	Inspector Test valve	Viking	Tyco	Hd
38	Pre-Fabricated Structural supports and clamps	Chilly	Hitech	Camry
		Easyflex		

39	Pressure Gauge	Emerald	Fiebig	H.Guru
		Danfoss		
40	Alarm Valve	Viking	Tyco	HD
41	Ant suction & delivery flexible pipe connectors	Easyflex	Resistoflex	Dunlop
		SAIL	Tata Steel Ltd	RINL
42	Flexible Duct Connector	Mapro	Kanwall Industrial corporation	Resistoflex
43	Stainless Steel Brach Pipe	Safex	Padmini	GETech
44	Fireman Axe / Installation Control Valve	Safex	Padmini	GETech
45	2-way / 4-way FBC	Safex	Newage	GETech
46	Sprinkler Heads	Tyco	HD	Omax UL
47	Pipe Protection Pypcoat wrapping	IWL	Taxa	Mac-poly coat
48	Rubber Bellow	Kanwal Industrial Corporation	Resistoflex	AIP Valves
49	Deluge Valve	Safex	Tyco	HD
50	Flexible Drop (UL Approved)	Safex	HD	Kofulso
51	Anti Vibration Pad	Cori Dunlop	Diamond Pipe Support	Easyflex
		Flexionics	Resistoflex	Emerald
52	Motors for Fire Pumps	Siemens	Kirloskar	Crompton
		ABB		
53	Fire Pumps	Kirloskar	Mather & Platt	Grundfoss
		Siemens	Schneider	ABB

54	Electrical Switch Gears	Siemens	Schneider	ABB
		L&T	Legrand	
55	Power and Control Cables	Universal	Polycab	Havells
		Finolex	Grandlay	
56	Control Panel of Terrace Pumps	Advance panel & Switchgear	Adlec	Tricolite Elect Industry
		Precision System Control	Ambit	RST
		Neptune		
57	Voltmeter & Ammeter	Schneider	Neptune	Rishabh
		Conserve		
58	Indicating Lamp and Selector Switches	BCH	Rishabh	Conserve
59	CT	AE	Kappa	Nutech Electrical
60	MCCB / MPCB / MCB/RCCB	Siemens	Schneider	Legrand
		ABB	Havells	
61	Contractors / Times, Overload Relays / Starter	L&T	Siemens	Schneider
62	Annunciation panels	PCD	Agni	Tricolite
		Adlec		
63	Single phase preventor	Minilac	L&T	Siemens
64	Anti Vibration Mounting	Kanwal Industrial Corporation	Resistoflex	Ewren

65	Starter	L&T	Siemens	Crompton
		GE	ABB	BCH

66	Current Transformer (Cast Resin)	AE	L& T	Kappa
67	Nuts / bolts	Lakshmi	Unbrako	
INSULATION				
S. No.	Material	Approved Makes / Brands		
1	Glass Wool	U.P. Twiga	Owen Corning	
2	Nitrile Rubber	Armacell	K-flex	Aerocell
3	Expanded polystyrene	SHI	Beardshell	Styrene packaging
4	Vibration isolator pads	Resistoflex	Kanwal	
5	Paracoat BPC	Paramount	Pidilite	
PUMPS AND WATER TREATMENT SYSTEM				
S. No.	Material	Approved Makes / Brands		
1	Pumps	Grundfoss	Xylem	WILLO
		KSB		
2	Submersible Drainage Pumps	KSB	Grundfoss	Crompton
3	Ball Valves	ARCO	SANT	Zoloto
4	Butterfly Valve	KSB	SKS	AUDCO
5	C.I. double flanged	Zoloto	Sant	Castle
	sluice valve	Kartar		
6	Non Return Valve	Zoloto	Sant	Castle
		Kartar	Leader	
7	Y – Strainers	Zoloto	Sant	Castle
		Kartar		

8	Float Switch	Nolta	Danfoss	Honey Well
9	Pressure Gauge	Fiebig	H. Guru	Danfoss
10	Dosing system	Milton Roy	Asialmi	Grundfoss
11	Liquid Level Controllers/ Liquid Level Indicator	Advance	Honey Well	Danfoss
12	Filter / Softener	Ion Exchange	Renaissance Aqua	Pentair
		Watcon		
13	Salt Saturator	Ion Exchange	Renaissance Aqua	Pentair
		Watcon		
14	Water Meter	Kent	Marshall	Sant
15	Water Treatment Plant	Ion Exchange	Brisanzi	Netsol
		Thermax	Hydro tech Paryavaran	
16	Vessels	Astral	KGM	Structural
17	Mechanical Seal	Burgmann	Sealol	
18	Grease Trap / Separator	ACO	Wade	Kassel

SEWAGE TREATMENT PLANT (STP)				
S. No.	Material	Approved Makes / Brands		
1	C.I. double flanged sluice valve	Kirloskar	Leader	Sant
2	C.I. Disk Type non return valves (65mm dia and above – Dual plate type)	Kirloskar	Leader	Sant
3	C.I. Strainer more than 65mm dia	Leader	Sant	Castle
4	PVC Valves	Cepex	Astral	Audco

5	C.I./D.I. Manholes cover	NECO	Kartar	SKF
6	Plastic Encapsulated Foot Rest	KGM	KK	
7	Filter feed pump	Grundfoss	ITT	WILO / KSB
8	Hydro-Pneumatic Pumping Systems (Flushing, Soft and garden hydrant)	Grundfoss	ITT	WILO / KSB
9	Submersible Sump Pumps for collection chamber, qualization tank, Plant room drainage, Filter backwash sump	KSB	Grundfoss	Crompton
10	Domestic Hydro pneumatic transfer pump	Grundfos	DP-Holland	Willo - Mather
11	Pressure Transmitters / Hydrostatic Level	WIKA	Siemens	Johnson
	Indicators			Control
12	Pressure Gauges	Fiebig	H. Guru	WIKA
13	Dosing System	ASIA LMI	Milton Roy	Grundfoss
14	Pump Vibration Pads & Suction & Delivery Flexible Connectors	Easyflex	Resistoflex	Dunlop
15	Pressure Sand & Activated carbon filter	M.S. Prefabricated	BRISANZA	FONTUS
16	Air Blowers	Everest	Beta	ABL
S. No.	Material	Approved Makes / Brands		
17	Ultra Violet Disinfection for Treated Effluent	Alpha UV	Sukrut	Neotec
18	Air Diffusors	BOBKAY	MM Aqua	REHAU

19	MBBR media for Aeration tank	MM Aqua	PP Aqua	Tecpro, INDION (ION Exchange)
20	Dosing Pumps	Milton Roy	Asia LMI	Grundfoss
21	Sludge Pumps (Centrifugal)	Kirloskar	Grundfoss	ITT Industries
22	Sludge Pumps (Screw)	Roto	UT Pumps	Stork
23	Tube Settler media	MM Aqua	PP Aqua	Tecpro
24	Centrifuge	Hiller	Alpha	Humboldt Wedag
25	Pressure Gauge	H. Guru	Fiebeig	WIKA
26	Level Gauge	H. Guru	Fiebeig	WIKA
27	pH Meter	Hach	Toshniwal	Ionix
28	Conductivity Meter	Hach	Toshniwal	Ionix
29	DO Meter	Hach	Toshniwal	Oakton
30	TDS Meter	Hach	Toshniwal	Oakton
31	Ultra Violet Water Purifier (WTP / STP)	Alfa UV Mumbai	Pentair	Eureka Forbes
32	Syphonic Roof Drainage System	Geberit	Saint Gobain	
33	Ozonisation System	Oraipl	Ozonics	Voltas
34	Geared Motor	Bonfiglioli	Grease Cotton	Motovario
35	Exhausters	Nicotra	Krugger	Green Heck
36	Compost Plant	Excel, Smart Enviro Bombay	Ecoman	Clean India
37	Solid Waste Handling and Conveying	Env Tech (P) Ltd.	Rosa Roca	

ELECTRICAL WORKS

S. No.	Material	Approved Makes / Brands		
1	Air Circuit Breaker	Schneider - Masterpact Nw	Siemens - 3WL	Legrand - DMX3
		L&T - U Power Omega	ABB Emax	
2	LT Panel	Advance Panel & Switchgear	Adlec	Tricolite
		Precision System Control	Neptune	EAP
3	TTA (Type Tested Assembly) Electrical Panels	Schneider (Blockset)	ABB (MNS)	Siemens (Silvacon-S-8)
4	MCCB	Siemens - 3VA	Legrand - DPX3	Schneider - Easypact
		L&T -D sine, MTX 1.0 MTX-2.0, MTX3.0	ABB Tmax	
5	MCB / MPCB/DB	Siemens - Betagard	Legrand - Ekinox ³	Schneider - Acti 9
		ABB-S200M	Hager - Novello+	
6	Modular Type light & power Accessories (Switches, socket etc.) G.I. Switch Boxes	Legrand (Arteor)	Schneider Electric (Zencelo)	ABB (IVIE)
		MK Honeywell (Elements)		
7	Multifunction Meters	Schneider	Siemens	Neptune
		Secure		
8	Power Contactor-AC 3 Rating / Capacitor Duty Contactor / Starter /Thyrister Module	Siemens	L&T	ABB
		Schneider		
9	APFC Panel including all accessories (OEM Mfg only)	Siemens	Schneider	ABB
		L&T		

10	Electrical Motor / Motor Starter / Contactor / Switches	Siemens	ABB	Crompton
		L&T		
11	Bus Ducts / Rising Mains	Schneider	Legrand	ABB
12	FRLS PVC Insulated Copper Wire	Lapp	RR Cables	Havells
		Polycab		
13	Power Cables / Control Cables up to 11 KV	Havells	Polycab	Gloster
		Universal	CCI	
14	Lugs / Gland	Dowel	Comet	
15	PVC Conduit	AKG	BEC	Precision
16	MS Conduit ISI Marked	BEC	AKG	RMCON
17	DLP Trunking	MK Honeywell	OBO Betterman	Legrand
18	Floor Trunking / Raceway	MK Honeywell	OBO Betterman	Legrand
19	Cable Tray	Slotco	RMCON	BEC
		Steel craft		
20	Solar Street Light Fitting with pole	Philips	Bajaj	Wipro
		Trilux		
23	Ceiling Fan / Exhaust Fan	Crompton Greaves	Havells	Bajaj
		Orient		
24	Octagonal Steel / High mast Pole	Bajaj	Valmont	Transrail
25	Internal Lighting LED	Philips	Trilux	Lighting Technologies
26	Outdoor Lighting	Keselec Schreder	Philips	Wipro
		Trilux	Lighting Technologies	
27	Special Lighting	Canara	Stage Technolgies	ADB

	(stadium/Stage lighting/Audi)	Leksa Lighting	ADB	
28	Solar water Heating System	Tata BP	Racold	Honeywell
29	Electromagnetic Lock	Bosch	Faraday	ESS, Swastik

SUBSTATION WORKS				
S. No.	Material	Approved Makes / Brands		
1	Oil Type Transformers	Crompton Greaves	Schneider Electric	Raychem
		Siemens		
2	Dry Type Transformers	Esennar	Amesimpex	ABB
		Raychem		
3	33 KV VCB HT Panels	Crompton Greaves	Schneider Electric	ABB
4	H.T. Termination & Joining Kit	Ray Chem	M-Seal	Birla – 3M
5	Cables Glands	Comet	Dowell	Electromac
		Siemens	Jainsons	Braco
6	Maintenance Free Earthing	Protec	Tercel	JMV
		Ecosafe	ABB	
7	Protection Relays	ABB	Schneider Electric	Siemens
8	SCADA SYSTEM	ABB	Schneider Electric	Siemens
DG SETS & RELATED ITEMS				
S. No.	Material	Approved Makes / Brands		
1	Diesel Engine	Cummins	Caterpillar	Mitshubishi
2	Alternator	Siemens	Caterpillar	Stamford

		GE	Crompton	
3	Batteries	Panasonic	Exide	Amaron
4	Batteries Charger	Uptron	Volstat Electronics	Statcon
		AE		
FIRE DETECTION & ALARM SYSTEM				
S. No.	Material	Approved Makes / Brands		
1	Detectors & Devices – Intelligent multi criteria detector, smoke, heat &duct detectors, control &monitor module, fault isolator, hooters etc. Addressable Main Fire Alarm Panel with Digital Voice Evacuation System	Honeywell-Notifier	Bosch	Siemens
2	UPS System	APC	RIELLO	TMEIC
		Vertiv		
3	Public Address & Back ground music system	Honeywell	Bosch	Bose
		Heinrich		
4	Access Control including Emergency Break Glass Unit	Bosch	HID	Siemens
		Honeywell		

IP BASED CCTV/ EPABX. LAN SYSTEM				
S. No.	Material	Approved Makes / Brands		
1	CCTV Cameras, NVR / Video Management Softwares & Accessories Encoder Decoder/ Weather proofing housing	Axis	Bosch	Avigilon
		Sony		
2	Network Switch (L2 / L3)(Access Switch/ Distribution Switch / Core Switches/ Wifi Routers) All Active Components for LAN	Cisco	Juniper	HP

3	Firewall	Cisco	Fortinet	Palo Alto
4	Boom Barrier	Gunnebo	Neptune Automatic	Somfy
5	Co-Axial TV Cable	Lapp	RR Cables	Havells
		Polycab		
6	Optical Fiber cable (Single & Multimode) and all accessories including LIU etc.	Commscope (Systimax)	Panduit (Pannet)	Siemon
7	CAT6/Cat 6A 24Port Jack Panel /Passive networking - Cat6A cable and all accessories.	Commscope (Systimax)	Panduit (Pannet)	Siemon
8	Networking – IT racks	CISCO	Rittal	APW
		President		
9	Network Attached Storage	HP	Dell	Lenovo

10	Desktop PC	HP	Dell	Lenovo
11	Professional Display Panel	HP	Dell	Lenovo
12	EPABX / IPABX & Accessories	CISCO	Avaya	Alacatel

ELEVATORS & ESCALATORS

S. No.	Material	Approved Makes / Brands		
1	Elevators/Escalators	Mitsubishi	Kone	Schindler
		OTIS	Johnson	
2	Special elevator (Director Residence)	Thyssenkrupp (Elite Elevators)	Apex elevators	

BMS WORK				
S. No.	Material	Approved Makes / Brands		
1	IP Based BMS System (All Hardware & Software) including accessories	Honeywell-	Siemens	Johnson Controls
		Schneider Electric		

2	LAN cables for BMS Network	Commscope (Systimax)	Panduit (Pannet)	Siemon
3	PVC Conduits	BEC	AKG	
4	Network Switches	HP	Cisco	Juniper

BMS WORK				
S. No.	Material	Approved Makes / Brands		
1	Standalone DDCs	Honeywell-Comfort point	Siemens (PX SERIES)	Johnson Controls Metasys
		Schneider Electric Struxureware		
2	Web Based BMS Software with unlimited user license	Honeywell-EBI	Siemens Desigo	Johnson Controls Metasys
		Schneider Electric Struxureware		
3	Web Based Router / Network Area Controller	Honeywell-Comfortpoint	Siemens Desigo	Johnson Controls Metasys
		Schneider Struxureware		
4	Power & Energy Management Software.	Honeywell	Siemens	Johnson Controls
		Schneider Electric		
5	Duct Temperature Sensor	Honeywell	Siemens	Johnson Controls
		Schneider Electric	Greystone Energy	Omicron
6	Immersion Temperature Sensor	Honeywell	Siemens	Johnson Controls
		Schneider Electric	Greystone Energy	Omicron
7	Room Temperature Sensor	Honeywell	Siemens	Johnson Controls
		Schneider Electric	Greystone Energy	Omicron
8	Duct Humidity Sensor	Honeywell	Siemens	Johnson Controls
		Schneider Electric	Greystone Energy	Omicron
9	Room Humidity Sensor	Honeywell	Siemens	Johnson Controls

		Schneider Electric	Greystone Energy	Omicron
10	Flow Meter	Schenitech	Honeywell	Kampstrup

		Omicron		
11	Duct Static Pressure Sensor	Honeywell	Siemens	Johnson Controls
		Schneider Electric	Greystone Energy	Omicron
12	Water Level Switch	Veksler	Filpro	Sontay
		Omicron		
13	DP Switch – Water	Honeywell	Siemens	Johnson Controls
		Schneider Electric	Greystone Energy	Omicron
14	DP Switch – Air	Honeywell	Siemens	Johnson Controls
		Schneider Electric	Greystone Energy	Omicron
15	CO2 Sensor / IAQ	Honeywell	Siemens	Johnson Controls
		Schneider Electric	Greystone Energy	Omicron
16	Water Flow Switch	Honeywell	Siemens	Johnson Controls
		Schneider Electric	Greystone Energy	Omicron
17	Pressure Transmitter – Water	Honeywell	Siemens	Johnson Controls
		Schneider Electric	Greystone Energy	Omicron
18	Current Relay	Veris	Seto	Mamac
		Omron	ABB	Omicron
19	Voltage / Current / Power Factor Transducer	SETO	ABB	L&T
		Enercon	SETCO	Situ
		Omicron		
20	Flame Proof Level Switch / Level Transmitter	Veksler	Filpro	Sontay
		Techtrol	Omicron	
21	PH Sensor / TDS Sensor	Honeywell	Hach	Greisinger
		Shenitech	Omicron	

22	Personal Computer and Servers	HP	DELL	LENOVO
		TOSHIBA		
23	Colour Monitor	DELL (ULTRA SHARP)	HP(PAVILION)	SAMSUNG (SYNC MASTER)
		ASUS	LG (FLATRON)	Lenovo
24	Printer	HP	EPSON	CANON
25	Copper Conductor Control Cable	Finolex	Skytone	Delton
		Fusion Polymers	Polycab	Excel
26	Communication Cables / Signal Cable	Finolex	Skytone	Delton
		Fusion Polymers	Polycab	Excel
27	LAN cables for BMS Network	Commscope	Panduit	Siemon
28	PVC Conduits	BEC	AKG	
29	Network Switches	HP	Cisco	Juniper

LIST OF ACCEPTABLE MATERIALS

Note:

1. The Contractor shall obtain prior approval from the Engineer-in-charge before placing order for any specific material or engaging any of the specialized agencies. The Contractor shall make a detailed submittal with catalogues and highlighted proposed specifications, as well as full details of the works proposed to be executed by the specialized agency, as specified.
2. Wherever applicable, the Engineer-in-charge may approve any material equivalent to that specified in the tender subject to proof being offered by the Contractor for equivalence to his satisfaction.
3. Unless otherwise specified, the brand/make of the material as specified in the item nomenclature, in the particular specifications and in the list of approved materials attached in the tender, shall be used in the work.
4. All makes shall further confirm to standard specifications of each items as mentioned in technical specifications of tender documents.

Abstract of Cost - ELECTRICAL & MECHANICAL		
Name of work : Construction of Academic cum Administrative Building (G+6), Residential Buildings Type-II&III, 2 Blocks, 72 Nos,(S+9), Type-IV&IV(s), 1 block, 28 nos, (S+7), Type-V, 4 Blocks, 80 Nos,(S+10) with Monolithic Concrete Construction technology , Type-VI,1Block,14 Nos,(S+7), Director's Residence (G+1), 3nos 656 bedded Hostel Buildings (S+8) with Monolithic Concrete Construction technology , Kitchen cum Dining (G+2), Guest House (G+2), 500 seated Auditorium (GF), Health Centre (G+1), Community Centre (G) , Commercial facility Centre (S+1), Sports Complex (GF) including all internal & external services of Civil, Electrical, Mechanical including STP, WTP, Roads, Footpaths, Landscaping & Horticulture etc Fire, GRIHA & IGBC compliant building for a Functional Permanent Campus of IISER, at Berhampur, Odisha. (SH: Carrying out balance E&M Works in auditorium Building under clause 14 of the main work at risk & cost of the contractor.)		
S.No.	DESCRIPTION	TOTAL
1	Total Sub-Head I (Internal Electrical Installation)	27,42,158.00
3	Total Sub-Head II (Fire Fighting System)	9,99,451.00
4	Total Sub-Head III CCTV	5,10,175.00
5	Total Sub-Head IV (Earthing & Lighting Arrestor)	21,75,679.00
6	Total Sub-Head V (HVAC)	7,37,572.16
	TOTAL	
	TOTAL ESTIMATED COST (DSR+N.S. ITEMS)	71,65,035.00

SCHEDULE OF QUANTITY					
S.N.	DESCRIPTION	Qty	Unit	Rate	Amount
	Sub-Head I				
	INTERNAL ELECTRICAL INSTALLATION				
1	Balance work for light point/ fan point/ exhaust fan point/ call bell point with 1.5 sq. mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit, with modular switch, modular plate, suitable GI box and earthing the point with 1.5 sq.mm. FRLS PVC insulated copper conductor single core cable etc as required.				
1.1	Group C	168	point	491.00	82,488.00
1.2	Balance work group controlled (looped) light point/fan point/exhaust fan point/ call bell point (without independent switch etc.) with 1.5 sq. mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit, and earthing the point with 1.5 sq. mm FRLS PVC insulated copper conductor single core cable etc. as required.				
1.2.1	Group C	278	point	246.00	68,388.00
1.3	Balance work for light/power plug with 2x4 sq. mm FRLS PVC insulated copper conductor single core cable in surface/recessed steel conduit alongwith 1 No 4 sq. mm FRLS PVC insulated copper conductor single core cable for loop earthing as required.	652	metre	60.00	39,120.00
1.4	Balance work of supply and drawing of wires for Wiring for circuit/ submain wiring alongwith earth wire with the following sizes of FRLS PVC insulated copper conductor, single core cable in surface/ recessed steel conduit as required.				
1.4.1	2 X 1.5 sq. mm + 1 X 1.5 sq. mm earth wire	100	metre	59.00	5,900.00
1.4.2	4 X 10 sq. mm + 2 X 6 sq. mm earth wire	150	metre	505.00	75,750.00
1.4.3	4 X 16 sq. mm + 2 X 6 sq. mm earth wire	200	metre	702.00	1,40,400.00
1.5	Balance work for Supplying & fixing Two Module stepped type electronic fan regulator on the existing modular plate switch box including connections but excluding modular plate etc. as required.	10	each	73.00	730.00
1.6	Balance work for Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 3 pin 5/6 amps modular socket outlet and 5/6 amps modular switch, connection etc. as required.	35	each	310.00	10,850.00

1.7	Balance work for Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 6 pin 5/6 & 15/16 amps modular socket outlet and 15/16 amps modular switch, connection etc. as required.	30	each	434.00	13,020.00
1.8	Balance work for Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 6 pin 5/6 & 15/16 amps modular socket outlet and 15/16 amps modular switch, connection etc. as required.	28	each	530.00	14,840.00
1.9	Balance work for SITC of following size/ modules, GI box alongwith modular base & cover plate for modular switches in recess etc as required.				
1.9.1	1 or 2 Module (75mm X 75mm)	12	each	173.00	2,076.00
1.10	Balance work for Supplying and fixing following modular switch/ socket on the existing modular plate & switch box including connections but excluding modular plate etc. as required.				
1.10.1	TV antenna socket outlet	2	each	129.00	258.00
1.11	Balance work for Supplying and laying co-Axial Cable RG-6 grade, 0.7 mm solid copper conductor PE Insulated, shielded with fine tinned copper braid and protected with PVC sheath in the existing surface/recessed steel/PVC conduit as required.	200	meter	36.00	7,200.00
	DB & SWITCHGEARS				
2.1	Balance work Supplying and fixing of following way Horizontal Type three pole & Neutral sheet steel, MCB distribution board 415 V on surface/recess, complete with tinned copper bus bar, neutral bus bar, earth bar, interconnections powder painted including earthing etc. as required. (but without MCB / RCCB / isolator) IP for outdoor panels should not be less than IP54 and for indoor panels IP should not be less than IP42.				
2.1.1	8 way (4 + 24), Double door	5	each	2435.00	12,175.00
2.1.2	12 way (4 + 36), Double door	3	each	2781.00	8,343.00

2.2	Balance work Supplying and fixing of following ways surface / recess mounting, vertical type, 415 V, TPN MCB distribution board of sheet steel,dust protected, duly powder painted, inclusive of 200 A, tinned copper bus bar, common neutral link, earth bar, base for mounting MCCBs (but without MCBs and incomer MCCB) as required. (Note : Vertical type MCB TPDB is normally used where 3 phase outlets are required). IP for outdoor panels should not be less than IP54 and for indoor panels IP should not be less than IP42.				
2.2.1	12 way (4 + 36), Double door	1	each	4182.00	4,182.00
2.3	Balance work Supplying and fixing Cable End Box (Loose Wire Box) suitable for following triple pole and neutral, sheet steel, MCB distribution board, 415 Volts, on surface/ recess, complete with testing and commissioning etc.as required.				
2.3.1	For 8 way, Double door TPN MCBDB	4	each	100.00	400.00
2.4	Supplying and fixing 5 amps to 32 amps rating, 240/415 volts, "C" curve, MCB suitable for inductive load of following poles in the existing MCB DB complete with connections, testing and commissioning etc. as required i/c 1 year DLP.				
2.4.1	Single pole	120	each	214.00	25,680.00
2.4.2	Triple pole	15	each	869.00	13,035.00
2.5	Supplying and fixing following rating, double pole, (single phase and neutral), 240 volts, residual current circuit breaker (RCCB), having a sensitivity current upto 300 milliamperes in the existing MCB DB complete with connections, testing and commissioning etc. as req i/c 1 year DLP.				
2.5.1	40 amps	20	each	2197.00	43,940.00
2.6	Supplying and fixing following rating, Three pole, 415 volts, MCB in the existing MCB DB complete with connections, testing and commissioning etc. as required i/c 1 year DLP.				
2.6.1	63 amps	8	each	1717.00	13,736.00
2.7	Providing and fixing following rating and breaking capacity and pole MCCB in existing cubicle panel board including drilling holes in cubical panel, making connections, etc. as required i/c 1 year DLP.				
2.7.1	125 A,36KA,FPMCCB	5	each	7865.00	39,325.00

	Panel Board - (Auditorium)				
2.8.1	Balance work of Fabrication, supply, installation, testing and commissioning of wall/floor mounted cubicle panels made out of 2 mm thick CRCA MS sheet steel, all incomngs/outgoings shall be arranged in suitable size compartments, locking arrangement for each compartments, including interconnection with 1100 V grade PVC insulated copper conductor bus bar labelling, earthing, brass compression glands for incoming and outgoing cables, powder coated painting etc. as required. Material of bus bar shall be aluminium as per item.				
	Incoming:				
	630 A, FP MCCB 36 KA - 1 No.				
	700 A TPN AL. bus bar with coloured heat shrinkable PVC sleeve -1 Set				
	Outgoings:				
	63 A TPN MCCB, 36 KA - 5 Nos.				
	100 A TPN MCCB, 36 KA - 1 Nos.				
	200 A TPN MCCB, 36 KA - 1 Nos.				
	Instruments:				
	Multi Function Meter (MFM) -1 No.				
	Indication lamp RYB with selector switch, Ammeter, voltmeter etc as req.	1	each	40952.00	40,952.00
2.8.2	Panel Board-FDB - (Auditorium)				
	Incoming:				
	100 A TPN MCCB, 36 KA - 1 Nos.				
	200 A TPN AL. bus bar with coloured heat shrinkable PVC sleeve -1 Set				
	Outgoings:				
	63 A TPN MCCB, 36 KA - 4 Nos.				
	Instruments:				
	Multi Function Meter (MFM) -1 No.				
	Indication lamp RYB with selector switch, Ammeter, voltmeter etc as req.	1	each	15872.00	15,872.00
2.8.3	Panel Board-FDB - (Auditorium - Control Room)				
	Incoming:				
	200 A, FP MCCB 36 KA - 1 No.				
	300 A TPN AL. bus bar with coloured heat shrinkable PVC sleeve -1 Set				
	Outgoings:				
	63 A TPN MCCB, 36 KA - 3 Nos.				
	100 A TPN MCCB, 36 KA - 1 Nos.				
	Instruments:				
	Multi Function Meter (MFM) -1 No.				

	Indication lamp RYB with selector switch, Ammeter, voltmeter etc as req.	1	each	23401.00	23,401.00
2.9	Balance work of Supplying, Laying and fixing of one number of PVC insulated XLPE aluminium conductor armoured cable of 1.1 KV grade of following sizes confirming to IS: 7098 (Part I) on wall/ surface/ cable tray as required.				
2.9.1	4 x 35 sq mm	130	metre	64.00	8,320.00
2.10	Balance work of Supplying and making end termination with brass compression gland and aluminium lugs for following size of PVC insulated and PVC sheathed / XLPE aluminium conductor cable of 1.1 KV grade as required.				
2.10.1	4 x 35 sq mm (32 mm)	2	each	220.00	440.00
	FAN & FITTINGS				
3.0	Supplying, installing, testing and commissioning of Light Fitting, Fans and Fixtures and Geysers				
3.1	Balance work SITC of LED Recessed/surface Downlighter with a nominal system Wattage <= 15 W, System Lumen >= 1500, system efficacy at System level (Not Chip Level) >110lumens/watt, Life of fixture 50000hrs@L70% Lumen maintenance, CCT Range 5700-6500 K, CRI >80, PF >0.95, THD <9%. The luminaire shall have a rated system lifetime of 50,000 burning hours at L70. The luminaire shall meet IP20 rating. The luminaire housing should made of pressure die cast aluminium and the luminaire optics shall have a high efficiency diffuser with more than 85% transmittance. The fixture should comply with the parameters as per IS10322.	45	each	160.00	7,200.00
3.2	Balance work Supplying, installation, testing and commissioning of Ceiling fans suitable for 230 Volt, 50 Hz, Single phase, A.C. supply and complete without speed regulator all standard accessories such as blades & capacitor etc. of 5 Star Rating complete as required of approved model from approved make. Fans shall be 5 star rated ISI Marked				
	3 Blade-1200 mm Ceiling fan	10	each	339.00	3,390.00
3.3	Balance work Supplying, installation, testing and commissioning of Exhaust fans suitable for 230 Volt, 50 Hz, Single phase, A.C. supply and complete with all standard accessories required of approved model from approved make.				
	300 mm dia.	6	each	816.00	4,896.00
	LIGHTING CONTROL				

4.1	Supplying, installation, testing and commissioning of 3 Universes DALI HF Ballast Controller (+ 3 x 20Amp Relays) For Auditorium. it features three DALI outputs, allowing control of up to 192 DALI devices. It also features 3 x 20 A feed-through switched circuits for DALI driver mains supply i/c 1 year DLP.	5	each	92,307.00	4,61,535.00
4.2	Supplying, installation, testing and commissioning of Antumbra Display Keypad White with Chrome Rim For Auditorium. Antumbra Display user interface provides a central LCD display to present multiple pages of functions and system information. It incorporates the latest in field effect technology. The contemporary design features a number of button configurations, with each button capable of local or site-wide control functions i/c 1 year DLP.	8	each	27,782.00	2,22,256.00
4.3	Balance work Supplying, installation, testing and commissioning of Communication Module For Auditorium. The DACM-DyNet is a DyNet communication module that connects any Antumbra user interface to the system i/c 1 year DLP.	8	each	12,070.00	96,560.00
4.4	Supplying, installation, testing and commissioning of 12 x 20A Relays Controller (feed through) General Loading . 12 x 20A Relays Controller (feed through) General Loading provides control of multiple types of switched loads. This general-purpose 12-channel controller supports switched loads of up to 20 A per channel, up to a maximum device load of 180 A i/c 1 year DLP.	25	each	43,398.00	10,84,950.00
4.5	Supplying, installation, testing and commissioning of Stand Alone Occuswitch Movement Detector. The Occuswitch can switch any load up to 6 A and control an office area of around 20sqmeter.The Occuswitch's detection pattern is 4 by 5 meters for small movements (desk work) and 6 by 8 meters for larger movements like walking i/c 1 year DLP.	4	each	1,317.00	5,268.00
4.6	Supplying, installation, testing and commissioning of Networked Universal Sensor Ceiling Mount, Wide angle detection, DALI Multimaster port For Auditorium. Networked Universal Sensor is a recess mountable 360 degree multifunction sensor that combines motion detection (PIR) and ambient light level detection (PE) in one device. The DALI sensor is powered and communicates to the networked control system via a DALI bus i/c 1 year DLP.	6	each	14,696.00	88,176.00

4.7	Supplying, installation, testing and commissioning of DIN Network Pwr Supply 15V1.5A For Auditorium. DIN Network Pwr Supply is a 15 V DC 1.5 A regulated designed to supplement the DyNet network DC supply i/c 1 year DLP.	1	each	34,488.00	34,488.00
4.8	Supplying, installation, testing and commissioning of Universal Time Clock For Auditorium. Universal Time Clock provides a tamper resistant solution for time-based event control on a DyNet network i/c 1 year DLP.	1	each	22,618.00	22,618.00
	Total Sub-Head I (Internal Electrical Installation)				27,42,158.00
	Sub-Head II				
	FIRE FIGHTING				
5.1	Balance work for Supplying, Installation, Testing and Commissioning of electric driven Terrace pump suitable for automatic operation and consisting of following: complete in all respect including DLP of one year as required.				
	Horizontal type, multistage, centrifugal pump of cast iron body and bronze impeller with stainless steel shaft, mechanical seal and flow of 450 lpm at 25.0 m. head conforming to IS : 1520.				
	Suitable HP SQ cage induction motor TEFC type suitable for operation on 415 volts, 3 phase 50 Hz. AC with IP 55 class of protection for enclosure horizontal foot mounted type with Class- 'F' insulation, conforming to IS : 325. (15 HP)				
	M.S. fabricated Common base plate, coupling, coupling guard, foundation bolts and pressure gauge with valve etc.				
	Suitable cement concrete foundation duly plastered with anti vibration pads.	2	Set	9273.00	18,546.00
5.2	Balance work for Fabrication, Supplying, Installation, Testing & Commissioning of electrical control panel of cubical construction, floor mounted type, fabricated out of 2mm. Thick CRCA sheet, dust and vermin proof, powder coated of approved shade after 7 tank treatment process cable alley, inter-connection, having switchgears and accessories mounting and internal wiring, earth terminals, numbering etc. complete in all respect, suitable for operation on 415V, 3 phase, 50 HZ. AC Supply with enclosure protection class IP 42 as required including DLP of one year.				
	Terrace Pump Control Panel (for 450 LPM Pump)				
	Incomer				
	63 Amps. TP MCCB.25 KA				

	Voltmeter (0-500 Volt) with selector switch				
	Ammeter (0- 100 Amps.) with Selector switch				
	Set of 3 Phase indication lamp				
	Suitable HP fully Automatic star delta starter with overload protection current sensing type single phase preventor complete with all accessories and internal wiring required for automatic operation.				
	selector switch for local / remote , auto/manual/ off operation, On/Off indication lamp	2	Set	4666.00	9,332.00
5.3	Balance work for Supplying and installing following size of perforated painted with powder coating M.S. cable trays with perforation not more than 17.5%, in convenient sections, joined with connectors, suspended from the ceiling with M.S. suspenders including bolts & nuts, painting suspenders etc. as required.				
	300 mm (W) x 50 mm (D) x 1.6 mm (T)	50	metre	580.00	29,000.00
5.4	Balance work for Providing, laying, testing & commissioning of 'C' class heavy duty MS pipe conforming to IS 3589 and 1239 including fittings like elbows, tees, flanges, tapers, nuts bolts, gaskets etc., fixing the pipe on the wall/ceiling with suitable clamps and painting with two or more coats of synthetic enamel paint of required shade complete as required.				
	i)100 mm dia	200	metre	196.00	39,200.00
	ii)80 mm dia	50	metre	179.00	8,950.00
	iii)25 mm dia	30	metre	108.00	3,240.00
5.5	Balance work for Supplying and fixing single headed internal hydrant valve with instantaneous Gun metal couplings of 63mm dia with cast iron wheel ISI marked conforming to IS 5290 (Type-A) with blank Gunmetal cap and chain as required	12	each	8107.00	97,284.00
5.6	Balance work Supplying, fixing, testing and commissioning of following size butterfly valve (manual) with CI body SS disc nitrile sheet & O-ring & PN 1.6 pressure rating as specified.				
	i)150 mm dia	12	each	9133.00	1,09,596.00
	ii)80 mm dia	4	each	5250.00	21,000.00
5.7	Balance work for Supplying, fixing, testing and commissioning of following size butterfly valve (manual) with CI body SS disc nitrile sheet & O-ring & PN 1.6 pressure rating as specified.				
	i)150 mm dia	12	each	1596.00	19,152.00
	ii)80 mm dia	4	each	843.00	3,372.00

5.8	Supplying, fixing, testing and commissioning of following size non return valve with dual plate of CI body SS plates vulcanized NBR seal flanged end & PN 16 pressure rating as specified i/c 1 year DLP.				
	i)150 mm dia	12	each	18800.00	2,25,600.00
	ii)80 mm dia	4	each	7949.00	31,796.00
5.9	Balance work for Supplying and fixing 63mm dia, 15mtr. Long RRL hose pipe with 63mm dia Male and Female Gun metal couplings duly binded with GI wire, rivets etc. conforming to IS 636 (type-A) as required.	20	each	5580.00	1,11,600.00
5.10	Balance work for Supplying and fixing First-Aid-Hose Reel with MS construction spray painted in Post office Red, conforming to IS 884 with upto date amendments, complete with the following as required.				
	30 m long 20mm (nominal internal) dia water hose Thermoplastic (Textile reinforced) Type-2 as per IS: 12585				
	20 mm (nominal internal) dia gun metal globe valve & nozzle.				
	Drum and brackets for fixing the equipments on wall.				
	Connections from riser with 40 mm dia stop valve (gun metal) & M.S. Pipe	10	each	8904.00	89,040.00
5.11	Balance work for Supply and fixing 63mm dia S/S branch pipe with 20mm (nominal internal diameter) size Gun Metal nozzle conforming to IS 903, suitable for instantaneous connection to interconnect hose pipe coupling as required.	12	each	2582.00	30,984.00
5.12	Balance work for Supplying and fixing air vessel made of 250 mm dia, 8 mm thick MS sheet, 1200 mm in height with air release valve on top and flanged connection to riser, drain arrangement with 25 mm dia Gun metal wheel valve, with required accessories, pressure gauge and painting with synthetic enamel pain of approved shade as required.	6	each	1971.00	11,826.00
5.13	Balance work for Providing fixing testing & commissioning of 15 mm size quartzoid bulb type sprinklers, of rating 68 degree C. pendent/upright with required accessories.				
	i)side throw	20	each	240.00	4,800.00
	ii)pendant	10	each	237.00	2,370.00
5.14	Balance work Providing and fixing in position the industrial type pressure gauges with gun metal / brass valves complete as required	2	each	308.00	616.00
	FIRE ALARM SYSTEM				
6.1	Balance work Supplying, installation, testing & commissioning of intelligent addressable thermal detector with rate of rise cum fixed	20	each	160.00	3,200.00

	temperature thermister complete with base as required.				
6.2	Balance work Supplying, installation, testing & commissioning of addressable horn cum strobe complete as required.	10	each	339.00	3,390.00
6.3	Balance work Supplying, installation, testing & commissioning of addressable manual call point complete as required.	10	each	351.00	3,510.00
6.4	Balance work Supplying, installation, testing & commissioning of response indicator on surface/recessed MS Box having two LED, metallic cover complete with all connections etc as required.	10	each	79.00	790.00
6.5	Balance work Supplying, installation, testing and commissioning of micro processor based intelligent addressable main fire alarm panel, central processing unit with the following loop modules and capable of supporting not less than 240 devices (including detectors) and minimum 120 detectors per loop and loop length up to 2 km, network communication card, minimum 320 character graphics/ LCD display with touch screen or other keypad and minimum 4000 events history log in the non volatile memory (EPROM), power supply unit (230 ± 5% V, 50 hz), 48 hrs back-up with 24 volt sealed maintenance free batteries with automatic charger. The panel shall have facility to connect printer to printout log and facility to have seamless integration with analog/digital voice evacuation system (which is part of the schedule of work under SH: PA System) and shall be complete with all accessories . The panel shall be compatible for IBMS system with open protocol BACnet/ Modbus over IP complete as per specifications.				
	i)2 loop Panel	1	each	11193.00	11,193.00
	PUBLIC ADDRESS SYSTEM				
7.1	Balance work Supplying, installation, testing & commissioning of 6 zone, voice alarm controller with USB, MP3 player (including 6 zone button paging station) with seamless integration facility with main fire alarm panel for voice evacuation complete as required.	1	each	4154.00	4,154.00
7.2	Balance work Supplying, installation, testing & commissioning of 1.5/3/6W metal box ceiling/wall speakers complete as required.	5	each	1001.00	5,005.00
7.3	Balance work Supplying, installation, testing & commissioning of digital audio amplifier 75 Watt, 25V rms operating at 240 Volt AC Supply complete as required.	1	each	4596.00	4,596.00

7.4	Balance work Supplying, installation, testing & commissioning of Voice command keypad 6 zone, with microphone assembly complete as required.	1	each	2609.00	2,609.00
7.5	Balance work Supplying and fixing of following sizes of steel conduit along with accessories in surface/recess including painting in case of surface conduit, or cutting the wall and making good the same in case of recessed conduit as required.				
	i)25 mm	150	metre	260.00	39,000.00
7.6	Balance work Supplying and drawing of cable Fire Retardant PVC insulated copper conductor cable in the existing surface / recessed steel conduit of following pairs, cores and size including connections and interconnections etc. as required.				
	i)speaker cable Two pair, 2-core, 1.5 sqmm	250	each	91.00	22,750.00
7.7	Balance work Supplying and drawing following sizes of FR PVC insulated copper conductor, single core cable in the existing surface/ recessed steel/PVC as required.				
	i)2 x 1.5 sq. mm	450	metre	71.00	31,950.00
	Total Sub-Head II (Fire Fighting System)				9,99,451.00
	Sub-Head III				
	CCTV				

8.1	Balance work SITC of IP Network TDN Low-Light 2MP IR Rugged Outdoor Bullet Camera, 1/2.9" CMOS, 2MP @ 25/30fps, Video compression H.265, H.264 High Profile and MJPEG, Min. Pixels 1920x1080p, Automatic Varifocal lens 3-12 mm DC Iris with motorized focus & zoom, Min. Illumination required 0.07 lux (color), 0.008 (mono), 0 Lux IR ON , Min WDR as per IEC-62676-PART 5 - 85dB, Defog, 850nm intensity adjustable IR LEDs Smart IR with upto 50m IR distance, MInimum 512GB SD card support, 60 sec pre- alarm recording, Camera should have fully configurable quad streaming , Alarm I/O: 1 In/ 1out, Audio I/O: 1 In/ 1outPoE, Analog Video Output, IP 67, IK 10 , Camera security Password protection, IP address filtering, HTTPSa encryption, IEEE 802.1Xa network access control, digest authentication, user access log, centralized certificate management, trusted computing function, public key infrastructure, IP addresses which have never been successfully logged in and had more than 3 failed log-in attempts during the last 20 seconds are blocked, Camera Encryption TLS1.0/1.2, AES128, AES256. Certifications: ONVIF Profile S & Profile G compliant, UL, EN, CE,IEC, FCC , RoHS compliant along with Pole Mounts. Inbuild VA Video Motion Detecion, Camera Tamper, Any object Object in field ,Crossing line, Entering field, Leaving field Loitering, Following route ,Idle object ,Removed object ,Counter Occupancy ,Crowd detection ,Condition change ,Similarity search, Detection of audio to generate an alarm.	5	each	685.00	3,425.00
8.2	Balance work Supply, Installation, Testing and commissioning of Monitor, 55" LED high resolution monitor with high performance 240VAC, 50 Hz. 24x7 for spot display including all accessories as per specifications and as required to complete the system.	1	each	685.00	685.00
8.3	Balance work Supply, Installation, Testing and commissioning of Client Workstation supports Windows 8.1 /10 (64-bit,Professional or Enterprise),Internet Explorer 11, Intel Core i7 4770 3.4 GHz (up to 3.9 GHz), Minimum 8 GB RAM,1000Base-T,Video resolution 1280x1024 pixels or higher,32 bit 102-key keyboard and mouse.	1	each	2988.00	2,988.00
	LAN				
9.1	Balance work Supply , Installtion , Testing and comissioning of 15U wall mount rack with fans, 2 cable managers, satationary shelf, 2 Nos of hardware pkts.	1	each	1451.00	1,451.00

9.2	Balance work Supply, Laying, Installation, Testing and Commissioning of 12 core Single Mode, Outside Plant, Bend Insensitive, Stranded Multi Loose Tube, Gel-Free, Metallic Armored, OS2, Telcordia GR-20.	120	Mtrs.	414.00	49,680.00
9.3	Balance work for Supplying and fixing of following sizes of PVC conduit along with accessories in surface/recess including painting in case of surface conduit, or cutting the wall and making good the same in case of recessed conduit as required.				
	i)25 mm	50	metre	94.00	4,700.00
9.4	Balance work for Supply, Laying, Installation, Testing and Commissioning of 10G, ETL Verified Category 6A U/UTP Cable, Blue/grey/white/other jacket, LSZH Sheath as per flame rating standard IEC 60332-3-22, IEC 61034-2, IEC 60754-2, 4 pair count, 1000 ft (305 m) length in the existing surface/recessed steel/ PVC conduit as required.	120	metre	26.00	3,120.00
9.5	Balance work for Supply, Installation, Testing and Commissioning of Cat 6A, 10G Information Outlet, UL Listed, Color Blue/grey/white/other (I/O) for Data, Voice, cctv & Wi-Fi User end.	15	each	151.00	2,265.00
9..6	Balance work for Supply , Installtion , Testing and comissioning of 15U wall mount rack with fans, 2 cable managers, satationary shelf, 2 Nos of hardware pkts.	1	each	1451.00	1,451.00
9.7	Balance work for Supplying & Installation of Cat 6A-10G, U/UTP Solid Low Smoke Zero Halogen Cordage Modular Patch Cordas per IEC 60332-3-22, IEC 60754-2, IEC 61034-2, Blue/grey/white/other Jacket, 3 Feet (user end)	15	each	155.00	2,325.00
9.8	Balance work for Supplying & Installation of Cat 6A-10G, U/UTP Solid Low Smoke Zero Halogen Cordage Modular Patch Cord as per IEC 60332-3-22, IEC 60754-2, IEC 61034-2, Blue/grey/white/other Jacket, 7 Feet (Rack end)	15	each	151.00	2,265.00
9.9	Balance work for Supply, Installation, Testing and Commissioning of Category 6A U/UTP Loaded Patch Panel, 24 port,1U, with rear cable manager Intelligent Upgradable for DATA, Voice, CCTV, Wifi etc.	1	each	23870.00	23,870.00
9.10	Balance work for Supply, Installation, Testing and Commissioning of 1 and 2 port, 3X3 , Square faceplate white for I/O fixing at user side.	20	each	131.00	2,620.00
9.11	Balance work for Supply, Installation, Testing and Commissioning of LC to LC, Multi Mode Fiber Patch Cord, 1.6 mm Duplex, 10 Feet., OM4	10	each	1428.00	14,280.00

9.12	Balance work for Supply, Installation, Testing and Commissioning of LC to LC, single Mode Fiber Patch Cord, 1.6 mm Duplex, 10 Feet. Bend Insensitive, OS2	10	each	703.00	7,030.00
9.13	Supply, Installation, Testing and Commissioning of Outdoor Fiber Joint closure, mechanical sealing, IP 68 rated, with Oval and round ports for cable entry i/c 1 year DLP.	2	each	125526.00	2,51,052.00
	ACTIVE LAN SYSTEM				
10.1	Balance work for SITC of Distribution switch with 24-port 1/10/25G Gigabit Ethernet, 4 x 40/100G uplink ports and integrated redundant power supply. The switches, should be implemented in Active - Active, redundant topology for High Availability with Redundant Power Supply.	1	each	58847.00	58,847.00
10.2	Balance work for SITC of Access Switch with 24 1Gig BaseT RJ45 PoE ports with PoE budget of 370Watts plus 4x10G SFP+ ports and having option to have dedicated stacking port which is in addition to above mentioned ports.	1	each	9963.00	9,963.00
10.3	Balance work for Supply & Installation of dual-band (5 GHz and 2.4 GHz concurrent) & Dual Radio 802.11ac (867Mbps) Wireless Access Point with PoE (802.3af) support/ capability. These indoor AP's should be capable of being used with inline & external power source (Thin & thick AP), with Mounting brackets.	1	each	68158.00	68,158.00
	Total Sub-Head III (CCTV)				5,10,175.00
	Sub-Head IV				
	EARTHING & LIGHTENING ARRESTER				
11.1	Balance work for Earthing with G.I. earth plate 600 mm X 600 mm X 6 mm thick including accessories, and providing masonry enclosure with cover plate having locking arrangement and watering pipe of 2.7 metre long etc. with charcoal/ coke and salt as required.	8	set	2710.00	21,680.00
11.2	Balance work Providing and fixing 25 mm X 5 mm G.I. strip in 40 mm dia G.I. pipe from earth electrode including connection with G.I. nut, bolt, spring, washer excavation and re-filling etc. as required.	20	metre	728.00	14,560.00
11.3	Balance work Providing and fixing of lightning conductor finial, made of 25 mm dia 300 mm long, GI tube, having single prong at top, with 85 mm dia 6 mm thick copper base plate including holes etc. complete as required. The base plate shall be of GI	16	each	433.00	6,928.00
11.4	Balance work Providing & fixing of G.I. tape 20 mm X 3 mm thick on parapet or surface of wall for lightning conductor complete as required. (For horizontal run)	200	metre	124.00	24,800.00

11.5	Balance work Providing & fixing of G.I. tape 20 mm X 3 mm thick on parapet or surface of wall for lightning conductor complete as required.(For vertical run)	50	metre	332.00	16,600.00
11.6	Balance work Providing and fixing testing joint, made of 20 mm X 3 mm thick GI strip, 125 mm long, with 4 nos. of tinned GI bolts, nuts, chuck nuts and spring washers etc. complete as required.	6	each	121.00	726.00
11.7	Providing and fixing double scaffolding system (cup lock type) on the exterior side/high rise inside, up to seven story height made with 40 mm dia M.S. tube 1.5 m centre to centre, horizontal & vertical tubes joining with cup & lock system with M.S. tubes, M.S. tube challies, M.S. clamps and M.S. staircase system in the scaffolding for working platform etc. and maintaining it in a serviceable condition for the required duration as approved and removing it there after. The scaffolding system shall be stiffened with bracings, runners, connection with the building etc wherever required for inspection of work at required locations with essential safety features for the workmen etc. complete as per directions and approval of Engineer-in-charge. The elevational area of the scaffolding shall be measured for payment purpose. The payment will be made once irrespective of duration of scaffolding.	6180	sqm	338.25	20,90,385.00
	Note: - This item to be used for ITC work judiciously for fittings and fixtures at height for Auditorium Building any E&M works.				
	Total Sub-Head IV (Earthing & Lighting Arrestor)				21,75,679.00
	Sub-Head V				
	HVAC				

12.1	Balance work for Testing and commissioning of factory built floor mounted chilled water double skin type horizontal/vertical air handling units made of 25mm thick panels consisting of pre plasticized G.I. casing of thickness 0.8mm outside layer and 0.8 mm inside layer with polyurethane foam (PUF) insulation factory injected between them by injection moulding machine, complete with blower section with blower suitable for static pressure as required, minimum 2 bend GSS/PVC eliminators, cooling coil section with aluminium finned copper tubes (tubes thickness not less than 0.5mm) cooling coil of 6 row deep, filter section with 50mm thick metal viscous/ washable synthetic type air prefilters & Fine filter (Bag filters) , belt drive package with TEFC drive motor of efficiency class IE3 suitable for $415 \pm 10\%$ volts, 50Hz, 3 Phase AC supply suitably designed for variable frequency drive applications, drain connections, stainless steel (18G) drain pan with PUF insulation, 150 mm dia. dial type pressure gauges (2 nos.) and industrial type thermometers (2 nos.) at the inlet and outlet of coil, auto purge valve wherever required, necessary vibration isolation arrangement etc. complete as per specification and of following capacities. Note: 1. The scope shall include master controller with sensor to monitor CO2 level, capable to modulate fresh air damper to increase or decrease volume as per set value. 2. The scope shall also include AHU mounted VFD drive complete with incoming electrical isolator in enclosure.				
i)	10200 65 MERV13 (6000 CFM)	3	Set	28,310.00	84,930.00
ii)	13600 65 MERV13 (8000 CFM)	3	Set	34,557.00	1,03,671.00
12.2	Balance work Testing and Commissioning of Factory built Energy Recovery Ventilator (ERV) unit made of 22 gauge pre coated cabinet and casing shall insulated with 13mm closed cell high density insulation to prevent condensation of moisture on exteriors or interiors of the unit. ERV shall consist of inlet fresh air fan motor set and room air exhaust fan motor set. A 3Å molecular sieve coated aluminium heat recovery wheel along				
	with drive motor for exchange of heat between fresh air and room exhaust air. The rotor/wheel matrix has equal sensible and latent recovery. Large panel opening for easy access to filter, filter section with washable synthetic type air prefilters, Feather touch brush seals minimize cross contamination. Belt drive package with TEFC drive motor suitable for $230 \pm 10\%$ volts , 50Hz, 1 Phase AC supply having a remote control to start /stop.				

	Item shall include MCB and Electrical cabling for proper connection.				
i)	Air Flow - 3000 CMH	3	Nos.	31,150.00	93,450.00
ii)	Air Flow - 2000 CMH	2	Nos.	33,048.00	66,096.00
12.3	Balance work for Testing and commissioning of AMCA certified long casing Tube / Vane Axial fans, Complete fan with casing, impeller with adjustable blade angles, wire guard, fire retardant flexible connection, necessary nut bolts and directly coupled with TEFC Sq.cage induction motor suitable for 415V±10%, 50 Hz. 3 phase electric supply (Class H insulation). Fan & motor assembly shall be suitable for operation upto 250°C temp. for 2hrs fire/smoke conditions. Fan to have safety wire mesh screen on any exposed face. Fan Speed Not exceeding 1450 rpm. The Scope shall include electrical isolator capable of receiving signal from fire panel.				
i)	Air Qty. 14000 CFM, Static Pressure 12 mm Wg	2	Nos.	9,437.00	18,874.00
12.4	Balance work for Emergency panel - Aud Installation, Testing & Commissioning of - Suitable for out door application - Terrace	1	Nos.	13,141.00	13,141.00
	63 Amp 3P MCCB 36K with Extended Rotary Operating Handle, Phase Spreader links and Phase barriers. The Scope shall include electrical isolator capable of receiving signal from fire panel.				
	Bus Bar:-				
	TPN aluminium extensible type main bus bars of minimum of 100 A capacity (As per capacity of corresponding incoming / Bus couplers) , and auxilliary bus bars of suitable capacity with heat shrunk coloured sleeves and i/c SMC bus bars supports at required intervals complete for cross section, size supports & their spacing etc. for withstanding fault level of 35kA for 1 Sec.				
	Outgoings				
	Supplying and fixing following outgoing MCCB / MCB complete connection, inter-connection etc. with suitable size of solid links / wires (2A backup SP MCB) complete as required.				
	4 Nos. - 40A TPN MCB with DOL stater for 14000cfm fan				
12.5	Supplying, fixing testing commissioning of supply air diffusers of powder coated aluminium with aluminium volume control dampers with anti smudge ring & removable core i/c 1 year DLP.	24.12	Sqm	13,054.00	3,14,862.48

12.6	Supplying, fixing testing commissioning of Return air diffusers of powder coated aluminium without volume control dampers with anti smudge ring & removable core i/c 1 year DLP.	5.04	Sqm	8,442.00	42,547.68
	Total Sub-Head V (HVAC)				7,37,572.16
	Total Sub-Head I (Internal Electrical Installation)				27,42,158.00
	Total Sub-Head II (Fire Fighting System)				9,99,451.00
	Total Sub-Head III CCTV				5,10,175.00
	Total Sub-Head IV (Earthing & Lighting Arrestor)				21,75,679.00
	Total Sub-Head V (HVAC)				7,37,572.16
	Grand Total : -				71,65,035.16
	SAY : -				71,65,035.00
	Assistant Engineer(E)-II			EE & SM(E)	
	IPED,CPWD,Berhampur			IPED,CPWD,Berhampur	