

भारत सरकार
GOVERNMENT OF INDIA
केंद्रीय लोक निर्माण विभाग
CENTRAL PUBLIC WORKS DEPARTMENT



NOTICE INVITING e-TENDERS

NIT No.	:	10/CE/(GZB)/NIT/2026-27
Name of Work	:	Construction of Babugarh campus of ICAR-CIRC at Babugarh Hapur, UP. (SH:C/o Administration cum Laboratory building and Farmers Training Hostel i/c Land development at Site A, in EPC Mode -I).
Estimated cost put to tender	:	Rs.102,13,30,153/- (Civil work -Rs.73,56,78,489/- + Electrical work- Rs.28,56,51,664/-)
Earnest Money	:	Rs.1,12,13,302/- (to be refunded after receiving the performance guarantee)
Performance Guarantee	:	(a) 5% of tendered value or Estimated Cost Put to Tender (ECPT) (whichever is higher). (b) Where the tendered amount is less than eighty percent (80%) of the Estimated 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.
Value of Security Deposit	:	2.5% of tendered amount
Period of Completion	:	20 months (4 months for Planning, design and obtaining local body Approvals +16 months for execution and completion of work).

The Executive Engineer,
Meerut Division, CPWD,
Meerut

Volume-I

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Certified that this bid-document contains 688 (Six Hundred and Eighty-Eight) pages including drawings attached in Volume-III except cover page, GCC-2024 for EPC Projects.

Executive Engineer,
Meerut Division,
CPWD, Meerut

NOTICE INVITING TENDER

N.I.T. No.	10/CE/(GZB)/NIT/2026-27
Name of work	Construction of Babugarh campus of ICAR-CIRC at Babugarh Hapur, UP. (SH:C/o Administration cum Laboratory building and Farmers Training Hostel i/c Land development at Site A, in EPC Mode -I).
Estimated cost	Rs.102,13,30,153/- (Civil work -Rs. 73,56,78,489/- + Electrical work-Rs.28,56,51,664/-)
Earnest Money	Rs. 1,12,13,302/- (to be refunded after receiving the performance guarantee)
Performance Guarantee	(a) 5% of tendered value or Estimated Cost Put to Tender (ECPT) (whichever is higher). (b) Where the tendered amount is less than eighty percent (80%) of the Estimated 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.
Value of Security Deposit	2.5% of tendered amount
Time Allowed	20 months (4 months for Planning, design and obtaining local body Approvals +16 months for execution and completion of work).

NIT amounting to Rs. 102,13,30,153/- (Rs. One Hundred Two Crore Thirteen Lakh Thirty Thousand One Hundred and Fifty-Three Only) is here put for approval please.

Assistant Engineer (P)
Ghaziabad Zone, CPWD
Ghaziabad.

Assistant Engineer (E)P
Ghaziabad Zone, CPWD
Ghaziabad

Executive Engineer (P)
Ghaziabad Zone, CPWD
Ghaziabad

Approved

**Chief Engineer
Ghaziabad, CPWD
Ghaziabad**

PRESS NOTICE



CENTRAL PUBLIC WORKS DEPARTMENT

NOTICE INVITING e-Bid

The Executive Engineer, Meerut Division, CPWD, Income tax office Bhainsali Ground, Meerut (UP) 250001 (Telephone No: 0121-2970744, e-mail: mrtee-itocbg@cpwd.gov.in) on behalf of the President of India invites online bids on EPC basis mode-I from CPWD enlisted contractors of appropriate class in building & roads category and eligible firms/ agencies satisfying the set eligibility criteria, in two bid system (Technical and Financial) for the following work:

NIT No : 10/CE/(GZB)/NIT/2026-27

Name of Work: Construction of Babugarh campus of ICAR-CIRC at Babugarh Hapur, UP. (SH: C/o Administration cum Laboratory building and Farmers Training Hostel i/c Land development at Site A, in EPC Mode -I)

Estimated cost: Rs.102,13,30,153/- (Civil work -Rs.73,56,78,489/- + Electrical work- Rs.28,56,51,664/-)

Earnest Money: ₹1,12,13,302/- (to be refunded after receiving the performance guarantee)

Period of Completion: 20 months (4 months for Planning, design and obtaining local body Approvals +16 months for execution and completion of work).

Last date & time of online submission of

Technical and Financial Bids: 15:00 Hrs. on 31.07.2026

Pre-bid Meeting: Pre-bid conference shall be held with the eligible and intending bidders in the office of Chief Engineer, Ghaziabad, CPWD, CGO-I, Hapur Road, Ghaziabad **at 11.00 Hrs. on 15.07.2026.**

Time and date of opening of financial bid: The time and date of opening of financial bid of bidders qualifying the eligibility (Technical) bid shall be communicated to them at a later date

The bid forms and other details can be obtained from the website www.etender.cpwd.gov.in or www.eprocure.gov.in . All corrigendum/addendum shall only be available on this website and shall not be published anywhere else.

EE/CPWD

Executive Engineer
Meerut Division, CPWD,
Meerut. (U.P.)

PART-A

PART-I

GENERAL INFORMATION

Check list for contractors for submission of bids

1. The tenderers should read all the instructions, terms & Conditions, contract clauses, nomenclature of items, specifications etc. contained in the tender documents very carefully, before quoting the rates. The tenderers should also read the General Conditions of Contract 2024 for EPC Projects with correction slips up to date of submission of bids which will be part of the agreement.
2. The agency shall quote the rate for complete scope of work in both words and figures in the financial bid.
3. The contractor shall quote his rates keeping in mind the scope of work, specifications, terms & conditions, additional conditions and special conditions etc. and nothing shall be payable extra whatsoever unless otherwise specified.
4. The contractor shall also furnish Performance Guarantee as mentioned elsewhere in the contract for proper performance of the agreement. The Performance Guarantee shall be in the shape as per Performa given in FORM– ‘G-1’ enclosed.
5. The bidder shall quote their rates considering all prevalent taxes/ cess like GST, Workers Cess or any other tax on material / work as applicable and nothing extra shall be paid to the contractor on this account. The department shall deduct Workers Cess, Royalty or any other tax as applicable, from the R/A bills & final bill. However, the contractor shall pay GST to the concerned authorities directly. TDS as applicable shall be deducted from all bills of contractor.
6. The tender which is not duly signed by authorized signatory or is conditional shall be treated as non-responsive and shall be summarily rejected.
7. Online bid documents submitted by intending bidders shall be opened, only of those bidders, whose EMD deposited with any division office of CPWD, anywhere in India and other documents as prescribed in the bid document are scanned and uploaded are found in order.

Information and Instructions for Bidders for e-Tendering
Forming Part of Bid Document

The Executive Engineer, Meerut Division, CPWD, Income tax office Bhainsali Ground , (UP) 250001 (Telephone No: 0121-2970744, e-mail:mrtee-itocbg@cpwd.gov.in) on behalf of the President of India invites online E-tenders on Engineering, Procurement and Construction (EPC) basis mode -I from CPWD enlisted contractors of appropriate class in building & roads category and eligible firms/contractors of repute in two bid system (Technical and Financial) for the following work:

NIT No	10/CE/(GZB)/NIT/2026-27
Name of Work	Construction of Babugarh campus of ICAR-CIRC at Babugarh Hapur, UP. (SH:C/o Administration cum Laboratory building and Farmers Training Hostel i/c Land development at Site A, in EPC Mode -I)
Location	Babugarh, Hapur (U.P.)
Estimated cost put to bid	Rs.102,13,30,153/- (Civil work -Rs. 73,56,78,489/- + Electrical work- Rs.28,56,51,664/-)
Earnest Money	Rs.1,12,13,302/- (to be refunded after receiving the performance guarantee)
Period of Completion	20 months (4 months for Planning, design and obtaining local body Approvals +16 months for execution and completion of work).
Pre-Bid Conference	Pre-bid conference shall be held with the eligible and intending bidders in the office of Chief Engineer, Ghaziabad, CPWD, CGO-I, Hapur Road, Ghaziabad at 11.00 Hrs. On 15.07.2026
Last date & time of online submission of "Technical and Financial Bids"	On 31.07.2026 up to 15:00 Hr.
Time and date of opening of eligibility documents/Technical Bid	On 31.07.2026 at 15:30 Hr.
Period during which hard copies of documents shall be physically submitted	Within 7 days after the opening of the technical bid (Eligibility) document.
Time and date of opening of financial bid	The time and date of opening of financial bid of bidders qualifying the eligibility (Technical) bid shall be communicated to them at a later date

- 1. Contractors who fulfil the following requirements shall be eligible to apply. Joint ventures are not accepted. [1(b), (c) & 1(d) are not applicable for CPWD enlisted contractors of appropriate class. 1(a) (i), (ii) and 1(e) are applicable for CPWD enlisted contractors also).**

- 1.1 The bidder should have satisfactorily completed the works as mentioned below during the last 07 (seven) years ending last date of the month previous to the one in which tenders are invited.

(i)	Three similar works each costing not less than	40.86 Crore
OR		
(ii)	Two similar works each costing not less than	61.28 Crore
OR		
(iii)	One similar works each costing not less than	81.71 Crore

- 1.2 Similar works shall mean works of Construction of RCC framed structure having minimum one building of five or more storeys including water supply, sanitary installation, internal electrical installations and any 3 (Three) of the following E&M services in one agreement

- a. HVAC/VRF/VRV
- b. Lift
- c. Fire Alarm System,
- d. Fire Fighting System,
- e. Sub Station
- f. EPBAX system
- g. DG Set

or

Similar works shall mean works of: - Completing balance Construction of RCC framed structure having minimum one building of five or more storeys including water supply, sanitary installation, internal electrical installations and any 3 (Three) of the following E & M services in one agreement.

- a. HVAC/VRF/VRV
- b. Lift
- c. Fire Alarm System,
- d. Fire Fighting System,
- e. Sub Station
- f. EPBAX system
- g. DG Set

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 previous day to last date of submission of tenders.
- In case, the eligible work has been executed by a Joint venture through one or more individual firm(s), then cost of completed work shall be distributed among the individual firm(s) in proportion to their share in Joint venture and that will be considered as work experience for individual firm(s) for pre-qualification in present bidding.

- Stilt constructed in the building shall be considered as a storey. However, Staircase head room (Mumty), Lift Machine Room, Terrace water tank or any other supporting structure above Terrace Level shall not be counted as storey for the above purpose.
- For the purpose of similar works, works executed in India only shall be considered. Qualified similar works may be physically inspected by the CPWD Engineers to ascertain the completion, performance on quality of works for finalizing the technical bid.
- Work of specialized E&M service etc is executed under a separate contract may also be considered for the purpose of assessing the technical competence only without adding its monetary value for determining the eligibility criteria.
- **The eligible similar works executed and submitted by the bidders and ongoing works may be got inspected by CPWD official as decided by NIT approving authority. The marks for the quality shall be given based on this inspection, if inspection is carried out.**

- 1.3 For EPC tenders under Mode- I/II only (Applicable for CPWD enlisted contractors of appropriate class also).

One completed work costing not less than **Rs. 20.43** Crore executed with the structural system technology, as proposed by bidder and mentioned in the letter of transmittal. This work can be part of eligible work at 1(a)(i) above or as a separate work. The value of executed work shall be brought to the current level by enhancing the actual value of work at simple rate of 7% per annum; calculated from the date of completion to previous day of last day of submission of tenders.

- 1.4 If the bidder does not have adequate experience of opted technology, then the bidder can associate with contractor having requisite experience of executing work in structural system with the opted technology. Bidder has to submit MoU in the prescribed format (Form-I) with such associate contractor, along with his tender, for structural system in opted technology only. The associated contractor must satisfy the eligibility criteria of having successfully completed one work of opted technology having the cost of structural system not less than 20% of the estimated cost put to tender during the last seven years ending last day of month previous to the one in which tender is invited.

In case separate cost of structural system of a particular technology is not available in the experience certificate of associated contractor, it will be taken as 30% of completed cost of project/work.

Associated contractor should not have been debarred from any Ministry or any govt. organization in the last five years.

- 1.5 In case, the eligible work has been executed by a Joint Venture through one or more individual firm(s), then cost of completed work shall be distributed among the individual firm(s) in proportion to their share in Joint Venture and that will be considered as work experience for individual firm(s) for prequalification in bidding.

2. The bidder should have Average Annual Financial Turn Over of Rs. **30.64** Crore on construction works during the last three years ending **31st March, 2025**. (Scanned copy of Certificate from CA with Unique Document Identification Number (UDIN) to be uploaded).

The value of annual turnover figures shall be brought to the current value by enhancing the actual turnover figures at simple rate of 7% per annum.

3. Should not have incurred any loss (profit after tax should be positive) in more than two years during the last five consecutive years ending **31st March 2025**, duly audited and certified by the Chartered Accountant.
4. Should have a Banker's Certificate from a commercial Bank for Rs. **40.85** crore or Net Worth for Rs. **10.21** crore certificate from CA with Unique Document Identification Number (UDIN) of minimum 10 % amount of ECPT (Scanned copy of original to be uploaded).

Should have bidding capacity equal to or more than the estimated cost of the work put to tender. The bidding capacity shall be worked out by the following formula: -

$$\text{Bidding Capacity} = \{(A \times N \times M) - B\}$$

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

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

M = Multiplying factor i.e. 1.5

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

NOTE:

- a) The bidder should submit bidding capacity as per Form 'C-3'.
- b) Bidding capacity is applicable for all the contractors including CPWD enlisted contractors.
- c) Bidding capacity formula, for CPWD contractors who are enlisted based on rule 6.1.7 of Enlistment Rules-2024 i.e. government retired engineer/ architect for three years from the date of issue of enlistment order, is as follows: -

$$\text{Bidding Capacity} = \{(A \times N \times 1.5) - B\}$$

Where,

A = Banker certificate figure as submitted by applicant (i.e. government retired engineer/ architect) at the time of enlistment for first year of enlistment and subsequent fresh bankers' certificate for second and third year respectively. Value of A for first year will be mentioned in the enlistment order by the member secretary of advisory committee for enlisting authority.

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

B = Value of existing commitments of ongoing works during the period of execution of work for which bids have been invited. This value is for newly enlisted entity.

Within three years from the date of issue of enlistment order, the newly enlisted entity has to develop its own bidding capacity and thereafter the general bidding capacity formula being used for other entities shall be applicable to it for calculation of bidding capacity. Newly enlisted entity may like to follow general bidding capacity formula even before period of three years if it so chooses.

- d) Bidding capacity, for CPWD contractors who are enlisted based on rules 9.6.3 & 9.6.4 of Enlistment Rules-2024 i.e. new entity based on previously enlisted entity for three years from date of issue of enlistment order, is as follows: -

Annual turnover of newly enlisted entity shall be in proportion to the shareholding of partners/directors in the original enlisted entity at the time of enlistment of the newly enlisted entity. Within three years from the date of issue of enlistment order, the newly enlisted entity has to develop its own bidding capacity and thereafter the general bidding capacity formula being used for other entities shall be applicable to it for calculation of bidding capacity. Newly enlisted entity may like to follow general bidding capacity formula even before period of three years, if it so chooses.

Bidding Capacity for newly enlisted entity based on rules 9.6.3 & 9.6.4 enlistment rules -2024 shall be as follows: -

$$\text{Bidding Capacity} = \{(A' \times N \times 1.5) - B\}$$

Where,

A' = Proportionate share of newly enlisted director/partner in originally enlisted company/firm multiplied by the factor A, as given below. Value of A' will be mentioned in the enlistment order by member secretary of Advisory committee for Enlistment Authority, it will remain same for three years.

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

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

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

- e) Enlisted entities based on rules 6.1.7, 9.6.3 or 9.6.4 of enlistment rules-2024 can submit MoU from agency having requisite experience for structural system technology if the enlisted entity does not have required experience.
5. The intending bidder must read the terms and conditions of CPWD-6 carefully. He should only submit his bid if he considers himself eligible and he is in possession of all the documents required.

6. Information and instructions for bidders posted on website shall form part of bid document.
7. The bid document consisting of Plans, Specifications, Schedule of quantities of various types of items to be executed and the set of terms and conditions of the contract to be complied with and other necessary documents can be seen and downloaded from website <https://etender.cpwd.gov.in> or www.cpwd.gov.in free of cost.
8. But the bid can only be submitted after deposition of original EMD either in the office of Executive Engineer inviting bids or division office of any Executive Engineer, CPWD within the period of bid submission and uploading the mandatory scanned documents such as Insurance Surety Bonds, Account Payee Demand draft or Banker's Cheque or Fixed Deposit Receipts or/ and Bank Guarantee including e- Bank Guarantee (for balance amount as prescribed) from any of the Commercial Bank towards EMD in favour of Executive Engineer as mentioned in NIT, receipt for deposition of original EMD to division office of any Executive Engineer (including NIT issuing EE), CPWD and other documents as specified.
9. 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](https://etender.cpwd.gov.in)
10. 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 instruction available on download section of <https://etender.cpwd.gov.in>
11. On opening date, the Bidder can login and see the bid opening process. After opening of bids, he will receive the competitor bid sheets.
12. Bidder can upload documents in the form of JPG format and PDF format.
13. Certificate of Financial Turn Over: At the time of submission of bid contractor may upload Affidavit/ Certificate from CA mentioning Financial Turnover of last 7 years or for the period as specified in the bid document and further details if required may be asked from the contractor after opening of technical bids. There is no need to upload entire voluminous balance sheet.
14. Contractor must ensure to quote rate of each item. The column meant for quoting rate in figures appears in yellow colour and the moment rate is entered, it turns sky blue.

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

However, if a tenderer quotes nil rates against each item in item rate tender or does not quote any percentage above/below on the total amount of the tender or any section / sub head in percentage rate tender, the tender shall be treated as invalid and will not be considered as lowest tenderer.
15. The eligibility (Technical) bid shall be opened first on due date and time as mentioned above. The time and date of opening of financial bid of bidders qualifying the eligibility (Technical) bid shall be communicated to them at a later date.
16. **Pre-bid conference** shall be held with the eligible and intending bidders in the office of Chief Engineer (GZB) CPWD, CGO -1, Hapur Road, Ghaziabad, Uttar Pradesh (201002) at **11 hrs on 15.07.2026** to clear the doubt of intending bidders, if any. Bidders should send by email all queries, before pre-bid conference, latest by **17:00 Hrs. of 14.07.2026** to the office of the

Executive Engineer, Meerut Division, CPWD, Income Tax Office, Bhainsali Ground, (UP) 250001 (Telephone No: 0121-2970744, e-mail: mrtee-itocbg@cpwd.gov.in). Because of pre-bid conference, certain modifications may be issued to all eligible bidders by the Engineer-in-Charge by e-mail, if felt necessary by him. If further pre-bid conferences are required for complete and effective interactions, the date and time of same will be communicated at the end of 1st pre-bid meeting or later. All modifications/addendums/corrigendum issued regarding this bidding process, shall be uploaded on website only and shall not be published in any Newspaper.

17. 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.
18. I propose to adopt structural system technology as mentioned in the letter of transmittal.
19. The Agency shall submit within 120 days after award of work an undertaking from the OEMs for specialised E&M works taken in part-C of this NIT like Lifts & DG Sets, HVAC that "OEM shall unconditionally support the lowest tenderer technically throughout the execution of contract as well as for Maintenance/Comprehensive Maintenance Contract for the useful life of the system, and they shall also provide all the spares required for healthy functioning of the equipment for at least seven years from the date of supply of equipment". This undertaking is to be given in Form- H.
20. If any information furnished by the applicant is found incorrect at a later stage, he shall be liable to be debarred from tendering/taking up of works in CPWD. The department reserves the right to verify the particulars furnished by the applicant independently.
21. The agency will bring samples of all approved brands as mentioned in chapter B & chapter C and as mentioned elsewhere in the NIT for Civil and Electrical materials depending upon the availability.
The right of approval of samples will remain with the Engineer-in-Charge. Conformation of approval of samples will be conveyed in writing by the Engineer-in-Charge.
22. Contractor shall not divert any advance payments or part thereof for any other purpose other than needed for completion of the contracted work. All advance payments received as per terms of the contract (i.e. mobilization advance, secured advance against materials brought at site, T&P advance against plant & machinery and / or for work done during interim stages, etc.) are required to be re-invested in the contracted work to ensure advance availability resources in terms of materials, labour, plant & machinery needed for required pace of progress for timely completion of work.
23. In case of discrepancy in Area Statements shown in drawing and as mention in NIT, numerical details given in NIT will prevail for the purpose of calculation of payment vis a vis quoted rates.

List of Documents to be filled in by the bidders, scanned and uploaded within the period of bid submission.

1. For non-CPWD enlisted contractor sand CPWD enlisted contractors other than in appropriate class in building and road category.

- (a) Scanned Copy of receipt for deposition of original EMD to division office of any EE, CPWD.
- (b) Scanned copy of EMD in the Form of Insurance Surety Bonds, Account Payee Demand Draft, Fixed Deposit Receipt, Banker's Cheque or Bank Guarantee including e-Bank Guarantee (For balance amount as prescribed) from any of commercial bank.
- (c) GST Registration Certificate, if already obtained by the bidder.

If the bidder has not obtained GST registration as applicable, then he shall scan and upload following undertaking along with bid documents.

“If work is awarded to me, I/we shall obtain GST registration Certificate as applicable 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.”

- (d) Permanent Account Number (PAN) as issued by the Income tax department.
- (e) Letter of transmittal.
- (f) Certificate of Financial Turn over from CA in Form-A.
- (g) Bank Solvency Certificate in Form-B or Net worth certificate from Chartered Accountant in Form B-1
- (h) Detail of similar eligible nature of works completed in Form-C
- (i) Performance report of completed works (mentioned in Form-C) in Form-D. (Form D-1 need not to be filled by the bidder. Assessment of quality for completed as well as ongoing works. (As per OM No. DG/MAN/386 Dated: 21.05.2019) Marks will be assigned by the designated CPWD Engineer/committee nominated by CPWD for quality of works at site based on the inspection of chosen works after opening of technical bid.
- (j) Details of projects under execution in Form C-1
- (k) Affidavit as per Form C- (b)
- (l) Detail of one work in support of having successfully completed with the structural system technology proposed to be used in the work in Form C-2.
- (m) Bidding capacity in Form-C-3
- (n) Certificate of experience of bidder in support of having successfully completed with

the structural system technology proposed to be used in the work in Form D-2.

Or

MoU with associated contractor and Certificate of experience of associated contractor in support of having successfully completed with the structural system technology proposed to be used in the work (mentioned in Form D-2) in Form-I.

- (o) If the bidder chooses precast concrete construction system technology in structural system technology, then copy of type Test Report for precast concrete construction system technology

Or

If bidder do not choose precast concrete construction system technology in structural system technology, then “I have not chosen precast concrete construction system technology and hence do not require uploading of this document for tendering for this work” Uploading of this is mandatory otherwise system will not clear mandatory fields.

- (p) Structure and Organization of the bidder in Form-E.
- (q) Undertaking on structural stability and soundness as per prescribed format Form ‘F’.
- (r) Undertaking for association of specialised agency for E&M – Form- H.
- (s) ERP (Enterprise Resource Planning) training certificate (As per DG/Enlist Rules-2023/10 dated 22.04.2024) issued from LMS, CPWD. If already obtained by the bidder, If Bidder has not obtained ERP (Enterprise Resource Planning) training, then he shall scan and upload the undertaking along with bid documents as below: -

“If work is awarded to me, I/we shall obtain ERP (Enterprise Resource Planning) Training from CPWD, as applicable, within Two months from the date of receipt of award letter and failure to do so, a recovery of Rs. 10,000/- per week shall be made from the R/A Bill without giving any show cause notice in this regard.”

2. For CPWD enlisted contractors of appropriate class in building and road category.

- (a) Scanned Copy of receipt for deposition of original EMD to division office of any EE, CPWD.
- (b) Scanned copy of EMD in the Form of Insurance Surety Bonds, Account Payee Demand Draft, Fixed Deposit Receipt, Banker’s Cheque or Bank Guarantee including e-Bank Guarantee (For balance amount as prescribed) from any of commercial bank.
- (c) GST Registration Certificate, if already obtained by the bidder.

If the bidder has not obtained GST registration as applicable, then he shall scan and upload following undertaking along with other bid documents.

“If work is awarded to me, I/we shall obtain GST registration Certificate as applicable 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.

- (d) Permanent Account Number (PAN) of bidder as issued by the Income Tax Department.
 - (e) Letter of transmittal.
 - (f) Against Certificate of Financial Turnover “I/We are CPWD enlisted contractor in class...#..... and do not require uploading of this document for tendering for this work”. Uploading of this is mandatory otherwise system will not clear mandatory fields.
 - (g) Against Bank Solvency Certificate or Net worth certificate “I/We are CPWD enlisted contractor in class ...#..... and do not require uploading of this document for tendering for this work”. Uploading of this is mandatory otherwise system will not clear mandatory fields.
 - (h) Detail of similar eligible nature of works completed in Form-C
 - (i) Performance report of completed works (mentioned in Form-C) in Form-D. (Form D-1 need not to be filled by the bidder. Assessment of quality for completed as well as ongoing works. (As per OM No. DG/MAN/386 Dated: 21.05.2019) Marks will be assigned by the designated CPWD Engineer/committee nominated by CPWD for quality of works at site based on the inspection of chosen works after opening of technical bid.
 - (j) Details of projects under execution in Form C-1.
 - (k) Affidavit as per Form C- (b).
 - (l) Detail of one work in support of having successfully completed with the structural system technology proposed to be used in the work in Form C-2.
 - (m) Bidding capacity in Form-C-3.
 - (n) Certificate of experience in support of having successfully completed with the structural system technology proposed to be used in the work in Form D-2
- Or
- MoU with associated contractor and Certificate of experience of associated contract or in support of having successfully completed with the structural system technology proposed to be used in the work (mentioned in Form D-2) in Form-I.
- (o) If the bidder chooses precast concrete construction system technology in structural system technology, then copy of type Test Report for precast concrete construction system technology

Or

If bidder do not choose precast concrete construction system technology in structural system technology, then “I have not chosen precast concrete construction system technology and hence do not require uploading of this document for tendering for this work” Uploading of this is mandatory otherwise system will not clear mandatory fields.

- (p) Against Structure and Organization of bidder “I/We are CPWD enlisted contractor in class...#...and do not require uploading of this document for tendering for this work”. Uploading of this is mandatory otherwise system will not clear mandatory fields.
- (q) Undertaking on structural stability and soundness as per prescribed format Form ‘F’.
- (r) Undertaking for association of specialised agency for E&M – Form- H.
- (s) Certificate of ERP training issued through LMS, CPWD.
- (t) Enlistment order of the contractor in appropriate class of Building and road category in CPWD

#To be filled by Bidder.

Executive Engineer
Meerut Division, CPWD
Income Tax Office Campus
Meerut

CPWD-6 FOR E-TENDERING

1. The Executive Engineer, Meerut Division, CPWD, Income tax office Bhainsali Ground, (UP) 250001 (Telephone No: 0121-2970744, e-mail: mrtee-itocbg@cpwd.gov.in) on behalf of the President of India invites online E-tenders on Engineering, Procurement and Construction (EPC) basis mode-I from CPWD enlisted contractors of appropriate class in building & roads category and eligible firms/contractors of repute in two bid system (Technical and Financial) for the following work: -

Name of Work	:	Construction of Babugarh campus of ICAR-CIRC at Babugarh Hapur, UP. (SH:C/o Administration cum Laboratory building and Farmers Training Hostel i/c Land development at Site A, in EPC Mode -I)
Estimated cost put to tender	:	Rs.102,13,30,153/- (Civil work -Rs.73,56,78,489/- + Electrical work- Rs. 28,56,51,664/-)
Earnest Money	:	Rs.1,12,13,302/- (to be refunded after receiving the performance guarantee)
Period of Completion	:	20 months (4 months for Planning, design and obtaining local body Approvals +16 months for execution and completion of work)

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.

- 1.1 The work is estimated to cost Rs.102,13,30,153/- (Civil work -Rs.73,56,78,489/- + Electrical work- Rs. 28,56,51,664/-) However, this estimate cost is merely for rough guidance.
- 1.2 Intending bidders are eligible to submit the bid provided he has definite proof from the appropriate authority, which shall be to the satisfaction of the competent authority, of having satisfactorily completed similar works of magnitude specified below:

Criteria of eligibility for submission of bid documents

- 1.2.1 Conditions for CPWD registered as well as non-CPWD contractors.
- i. Should have satisfactorily completed the following works in last 7 (seven) year sending last date of the month previous to the one in which tenders are invited.

(i)	Three similar works each costing not less than	40.86 Crore
OR		
(ii)	Two similar works each costing not less than	61.28 Crore
OR		
(iii)	One similar works each costing not less than	81.71 Crore

To become eligible for issue of bid, the bidders shall have to furnish an affidavit as under: -

I/We undertake and confirm that eligible similar works(s) has/have not been got executed through another contractor on back-to-back basis. Further that, if such a violation comes to the notice of Department, then I/we shall be debarred for bidding 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. (Scanned copy to be uploaded at the time of submission of bid).

- 1.2.2 For EPC tender under Mode- 1 only (Applicable for CPWD enlisted contractors of appropriate class also).

One completed work costing not less than **Rs.20.43** crore executed with the structural system technology as proposed by bidder in letter of transmittal during the last 7 years ending last day of the month previous to the one in which tenders are invited.

This work can be part of eligible work at 1.2.1 (i) above or as a separate work.

Or

If the bidder does not have adequate experience of opted technology, then the bidder can associate with contractor having requisite experience of executing work in structural system with the opted technology. Bidder has to submit MoU in the prescribed format (Form-I) with such associate contractor, along with his tender, for structural system in opted technology only.

- 1.2.3 The associated contractor must satisfy the eligibility criteria of having successfully completed one work of opted technology having the cost of structural system not less than 20% of the estimated cost put to tender during the last seven years ending last day of month previous to the one in which tender is invited.

In case separate cost of structural system of a particular technology is not available in the experience certificate of associated contractor, it will be taken as 30% of completed cost of project/work.

- 1.2.4 Associated contractor should not have been debarred from any Ministry or any govt. organization in the last five years.

- 1.2.5 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 previous day of last day of submission of bid
2. Agreement shall be drawn with the successful bidders on prescribed Form No. CPWD-7 including Standard General Condition of Contract Form GCC 2024 for EPC Projects as amended up to the last date of submission of bid, which is available as a Govt. of India Publication, and available on website www.cpwd.gov.in. Bidders shall quote his rates as per various terms and conditions of the said form which will form part of the agreement.
 3. The time allowed for carrying out the work will be 20 Months (4 months for Planning, design and obtaining local body Approvals +16 months for execution and completion of work) and 36 months defect liability period from the date of completion as defined in schedule 'F' or from the first date of handing over of completed building, in accordance with the phasing, if any, indicated in the bid documents.
 4. (i) The full site for the work is available.
(ii) The architectural and structural drawings shall be made available by the EPC contractor and got approved from the Engineer-in-charge within 4 Months of date of start of the work.
 5. The bid document consisting of indicative architectural plans, specifications, schedule of quantities of various type of items to be executed and the set of terms & conditions of the contract to be complied with and other necessary documents except standard general conditions of contract form can be seen free of cost from **website <https://etender.cpwd.gov.in>**.
 6. After submission of the bid the contractor can re-submit revised bid any number of times or withdraw it before last date and time of submission of bid as notified. No post-tender modification is allowed by the tenderers except through negotiations, if required. In case, any tenderer does so, the tender will be rejected and the tenderer will be debarred for future tendering in CPWD for two years by the concerned enlisting authority (in case of CPWD enlisted contractor) and by the concerned CE/SE (in case of non-enlisted contractor).
 7. While submitting the revised bid, bidder can revise the quoted rates of one or more items any number of times but before last time and date of submission of bid as notified.
 8. Earnest Money in the form of Insurance Surety Bonds, Account Payee Demand Draft, Fixed Deposit Receipt, Banker's Cheque or Bank Guarantee including e- Bank Guarantee (for balance amount as prescribed) from any of the Commercial Banks (drawn in favour of Executive Engineer, Meerut Division, CPWD, Income Tax Office Campus, Bhainsali Ground, Meerut-250001) shall be scanned and uploaded on the e-Tendering website within the period of bid submission. 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 tender inviting EE in the NIT.

A part of earnest money is acceptable in the form of bank guarantee also. In such case, minimum 50% of earnest money or Rs. 20 lacs, whichever is less, shall have to be deposited in shape prescribed above, and balance may be deposited in shape of Bank Guarantee including e- Bank Guarantee of any Commercial bank having validity for a period of 180 days or more from the last date of receipt of bids which is to be scanned and uploaded by the intending bidders.

The earnest money given by all the tenderers except the lowest tenderer shall be refunded immediately after the expiry of stipulated bid validity period or immediately after acceptance of the successful bidder, whichever is earlier. However, in case of two/ three bid system, earnest money deposit of bidders unsuccessful during technical bid evaluation etc. should be returned within 30 days of declaration of result of technical bid evaluation.

Copy of Enlistment Order and certificate of work experience and other documents as specified in the notice inviting e- tender shall be scanned and uploaded on the e-Tendering website within the period of bid submission. However, certified copy of all the scanned and uploaded documents as specified in e-tender notice shall have to be submitted by the lowest bidder within a week physically in the office of tender opening authority. Online bid documents submitted by intending bidders shall be opened only of those bidders, who has deposited EMD with any division of CPWD and other documents scanned and uploaded are found in order.

The technical/eligibility bid submitted shall be opened at 3:30 PM on 31.07.2026

The date of opening of Financial Bid shall be informed through web site and office order by The Executive Engineer, Meerut Division, CPWD, Income Tax office Bhainsali Ground, Meerut (UP) 250001 (Telephone No: 0121-2970744, e-mail: mrtee-itocbg@cpwd.gov.in)

9. The bid submitted shall become invalid and e-bid processing fees shall not be refunded if:
 - (i) The bidder is found ineligible.
 - (ii) The bidder does not upload all the documents (including PAN/GST registration) as stipulated in the bid documents including copy of receipt for deposition of original EMD with Division office of any of Executive Engineer, CPWD.
 - (iii) 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 bidder in the office of bid opening authority.
 - (iv) If a tenderer quotes nil rates against each item in percentage rate tender or does not quote any percentage above / below on the total amount of the tender or any section head in percentage rate tender, the tender shall be treated as invalid and will not consider as lowest tender.
10. The contractor whose bid is accepted will be required to furnish performance guarantee at specified percentage of the tendered amount as mentioned in schedule E and within the period specified in Schedule F. This guarantee shall be in the form of Insurance Surety Bonds,

Account Payee Demand Draft, Fixed Deposit Receipt or Bank Guarantee from any of the Commercial Banks in accordance with the prescribed form. 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 bid shall be returned after receiving the aforesaid performance guarantee. The contractor whose bid is accepted will also 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 including Provident Fund Code No. If applicable and also ensure the compliance of aforesaid provisions by the subcontractors, if any engaged by the contractor for the said work within the period specified in Schedule F.

11. **The description of the work is as follows:** Construction of Babugarh campus of ICAR-CIRC at Babugarh Hapur, UP. (SH: C/o Administration cum Laboratory building and Farmers Training Hostel i/c Land development at Site A, in EPC Mode -I) i/c Planning, Designing and Construction of RCC Buildings, Internal Water supply, Sanitary Installations, Drainage, Development works like Terrace water Tanks, Laboratory furniture and all related services, Rain water harvesting system, Internal Roads, Pathways, Water Supply Lines, Storm Water Drains, External Sewerage System, Service Trenches and all E&M Services such as Internal Electrical Installations, Lift, Fire Alarm System, Fire fighting system, Sub-Station, DG sets, UPS, VRV/VRF AC System, Solar water heating system, solar photo voltaic power generation system, CCTV system, LAN system, IP based EPBAX system, Street lightening with LED, Water supply pumps, STP plant, Emergency light and illuminated signages, RO water plant, Split AC & other Misc. works all complete on Engineering, Procurement and Construction basis including development of BIM models.

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 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 charge 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 rates at which stores, tools and plant, etc. will be issued to him by the Government and local conditions and other factors having a bearing on the execution of the work.

12. 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 assigning any reason. Bids in which any of the prescribed conditions is not fulfilled

or any condition including that of conditional rebate is put forth by the bidders shall be summarily rejected.

13. Canvassing whether directly or indirectly, in connection with bids is strictly prohibited and the bids submitted by the bidders who resort to canvassing will be liable to rejection.
14. 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.
15. The contractor shall not be permitted to bid for works in the CPWD Circle (Division in case of Bidders of Horticulture / Nursery category) responsible for award and execution of contracts, in which his near relative is posted as Divisional Accountant or as an officer in any capacity between the grades of Superintending Engineer and Junior Engineer (both inclusive). He shall also intimate the names of persons who are working with him in any capacity or are subsequently employed by him and who are near relatives to any Gazetted officer in the Central Public Works Department or in the Ministry of Urban Development. Any breach of this condition by the bidder would render him liable to be removed from the approved list of Bidders of this Department in case of CPWD registered Bidders and this breach by other Bidders i.e. non-CPWD registered shall be treated as concealing of information and penal.
16. 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 Bidder or any of his employees is found any time to be such a person who has not obtained the permission of the Government of India as aforesaid before submission of the bid or engagement in the Contractor's service.
17. The bids for the work shall remain open for 75 days in case bids are invited in 2 or 3 bid system. Further:
 - (i) If any tenderer withdraws his tender within 7 days after last date and time (24 hours basis) of submission of bids, then the Government shall without prejudice to any other right or remedy, be at liberty to forfeit 50% of the earnest money absolutely irrespective of letter of acceptance for the work is issued or not.
 - (ii) If any tenderer withdraws his tender after expiry of 7 days after last date and time (24 hours basis) of submission of bids, then the Government shall without prejudice to any other right or remedy, be at liberty to forfeit 100% of the earnest money absolutely irrespective of letter of acceptance for the work is issued or not.
 - (iii) Withdrawal of the tender, by the tenderer, shall only be made through e-tender portal. Any other method i.e. through letter / e-mail etc. shall not be considered.
 - (iv) In case of forfeiture of earnest money as prescribed in para (i) and (ii) above, the bidders

shall not be allowed to participate in the rebidding process of the same work.

18. This notice inviting bid shall form a part of the contract document. The successful bidder / bidder, on acceptance of his bid by the Accepting Authority shall within 15 days from the letter of acceptance, sign the agreement consisting of:
 - a. The Notice Inviting Bid, all the documents including special conditions, additional conditions, particular specifications and drawings, if any, forming part of the bid as uploaded at the time of invitation of bid and the rates quoted online at the time of submission of bid and acceptance thereof together with any correspondence leading thereto.
 - b. Standard C.P.W.D. Form 7 (GCC 2024 for EPC Projects) modified up to previous day to last date of submission of Bid.

19. For Composite Bids

- 19.1 The Executive Engineer in charge of the major component will call tenders for the composite work. The cost of bid document will be fixed with respect to the combined estimated cost put to tender for the composite tender.
- 19.2 The bid documents will include following components:
 - Part A:- CPWD-6, CPWD-7 including schedule A to F for all components of the work, standard General Condition of Contract for CPWD 2024 on EPC mode for construction works as amended/modified upto last date of submission of tender, Information & instructions for Bidders for e-Bidding and Technical Bid.
 - Part B:- Scope of Work, Planning, Designing & Safety, conditions & Specifications of Civil Works and Scope.
 - Part C:- Scope & Specifications of Electrical & Mechanical works.
 - Part D:- Architectural Controlling Norms, Schedule of Finishes/Specifications
 - Part E:- Area statement and Project Management.
 - Part F:- Schedule of Stage Payments for original work & Maintenance work, Schedule of Quantity.
 - Part G:- Soil investigation report and concept drawings.
- 19.3 The bidders must associate himself, with agencies of the appropriate class eligible to bid for each of the minor component individually as per details given in respective minor component.
- 19.4 The eligible bidders shall quote rates for all items of major component as well as for all items of minor components of work.
- 19.5 After acceptance of the bid by competent authority, the Executive Engineer in charge of major component of the work shall issue letter of award on behalf of the President

of India. After the work is awarded, the main contractor will have to enter into one agreement with Executive Engineer in charge of major component and has also to sign two or more copies of agreement depending upon number of EE's/DDH in charge of minor components. One such signed set of agreement shall be handed over to EE(E)/DDH in - charge of minor component. EE of major component will operate part-A, part B, Part D, Part-E, Part-F and Part-G, of the agreement. EE(E)/DDH in- charge of minor component(s) shall operate Part-C Part-D, Part-E, Part -F and Part-G along with Part A of the agreement.

19.6 Entire work under the scope of composite tender including major and all minor components shall be executed under one agreement.

19.7 Security Deposit will be worked out separately for each component corresponding to the estimated cost of the respective component of works.

19.8 The main contractor has to associate agency(s) for specialized component(s) conforming to eligibility criteria as defined in the tender document and has to submit detail of such agency(s) to Engineer-in-charge of relevant component(s) within prescribed time. Name of the agency(s) to be associated shall be approved by Engineer-in-charge of relevant component(s).

19.9 In case the main contractor intends to change any of the above agency/agencies during the operation of the contract, he shall obtain prior approval of Engineer-in-charge of relevant specialized component(s).

The new agency/agencies shall also have to satisfy the laid down eligibility criteria. In case Engineer-in-charge is not satisfied with the performance of any agency, he can direct the contractor to change the agency executing such items of work and this shall be binding on the contractor.

19.10 The main contractor has to enter into MOU with the contractors associated by him. Copy of such MOU shall be submitted to EE(E)/DDH in charge of each relevant component as well as to EE in charge of major component. In case of change of associate contractor, the main contractor has to enter into MOU/agreement with the new contractor associated by him.

19.11 Running payment for the major component shall be made by EE of major discipline to main contractor. Running payment for minor components shall be made by the Engineer-in-charge of the discipline of minor component directly to the main contractor. The CMB shall be maintained independently by Engineer-in-Charge of major and minor components.

19.12 The composite work shall be treated as complete when all the components of the works are complete. The completion certificate of the composite work shall be recorded by Engineer-in-charge of major component after record of completion certificate of all other components.

- 19.13 Final bill of whole work shall be finalized and paid by the EE of major component. Engineer(s) in charge of minor component(s) will prepare and pass the final bill for their component of work and pass on the same to the EE of major component for including in the final bill for composite contract.
- 19.14 In case main contractor fails to make the payment to the contractor associated by him within 15 days of receipt of each running account payment then on the written complaint of contractor associated for such specialized/minor component, EE(E)/DDH in charge of specialized/minor component shall serve the show cause to main contractor and after considering the reply of the same he may make the payment directly to the contractor associated for specialized/minor component as per the terms & conditions of the agreement drawn between main contractor and associate contractor fixed by him, if reply of main contractor either not received or found unsatisfactory. Such payment made to the associate contractor shall be recovered by EE of major or specialized/minor component from the next RA/final bill due to main contractor as the case maybe.
- 19.15 The main firm should either himself meet the eligibility conditions for the respective E&M packages/ minor components or otherwise he will have to associate agencies meeting the eligibility requirements after award of the work & within the time prescribed in the NIT document. They will have to submit willingness certificate for each of the component of the Electrical & Mechanical work for Associate agencies by clearly indicating the applicable component of the work.
- 19.16 Separate MOU has to be signed with each of the specialized works with either OEM's or with specialized agencies who have the credentials of executing either one work of 80% value or two work of 60% value or three works of 40% value of the corresponding component of the specialized work in last seven years. MOU should be submitted within one month of the award of work. Value of the specialized work will be approved by Engineer-in-charge.
- 19.17 It will be obligatory on the part of the tenderer to sign the tender documents for all components before the first payment is released.
- 19.18 The responsibility of investigations, designing, planning, procurement, construction, safety, quality and risk of engineering lies with the EPC contractor.
- 19.19 The intending bidders are required to update their profile in CPWD e- tender portal and to upload their bids well in advance of last date of submission of tender. Any issue related to updating profile/uploading tender can be resolved through ERP helpline no.18001803286 or e-mail Id cpwd.support@techmahindra.com. The e-tendering bidders are also advised not to wait to raise any issues till the last date of submission of bid in their own interest.

Executive Engineer
Meerut Division, CPWD,

PART-II

TECHNICAL BID

GLOSSARY

AAI	Airport Authority of India
AE / AEE	Assistant Engineer / Assistant Executive Engineer
BIM	Building Information Management
BIS	Bureau of Indian Standards
HPCL	HP Power Corporation Ltd. Local DISCOM
C & D Waste	Construction & Demolition Waste
COA	Council of Architecture
CPI	Consumer Price Index
CPM	Chief Project Manager
CPWD	Central Public Works Department
DBR	Design Basis Report
DLP	Defects Liability Period
DSR	Delhi Schedule of Rates
EE (C)	Executive Engineer (Civil)
EE (E)	Executive Engineer (Electrical)
EMD	Earnest Money Deposit
EPC	Engineering Procurement & Construction
GCC	General Conditions of Contract
GPRA	General Pool Residential Accommodation
GRIHA	Green Rating for Integrated Habitat Assessment
HSE	Health Safety & Environment
IGBC	Indian Green Building Council
IPC	Interim Payment Certificate
IS	Indian Standard
MAS	Material at Site
MEP	Mechanical Electrical Plumbing
MT	Metric Tonne
MTC	Material Testing Certificate
NBC	National Building Code
NGT	National Green Tribunal
NIT	Notice Inviting Tender
OEM	Original Equipment Manufacturer
PPE	Personal Protection Equipment
SAP	Safety Action Plan
SOP	Schedule of Payment
SOQ	Schedule of Quantities
STP	Sewage Treatment Plant
ETP	Effluent Treatment Plant
TDS	Tax Deduction at Source
TPQAA	Third Party Quality Assurance Agency
WPI	Wholesale Price Index
WTP	Water Treatment Plant

SECTION-1

1. Salient Details of the works for which bids are invited are as under:

S.No.	Item	Description
1.	Name of work	Construction of Babugarh campus of ICAR-CIRC at Babugarh Hapur, UP. (SH:C/o Administration cum Laboratory building and Farmers Training Hostel i/c Land development at Site A, in EPC Mode -I)
2.	Estimated cost	Rs.102,13,30,153/- (Civil work -Rs. 73,56,78,489/- + Electrical work- Rs.28,56,51,664/-)
3.	Period of Completion	20 months (4 months for Planning, design and obtaining local body Approvals +16 months for execution and completion of work).
4.	NIT No.:	10/CE/(GZB)/NIT/2026-27
5.	Earnest Money	Rs. 1,12,13,302/- (to be refunded after receiving the performance guarantee)
6.	Security Deposit	2.5% of tendered amount
7.	Performance Guarantee	(a) 5% of tendered value or Estimated Cost Put to Tender (ECPT) (whichever is higher). (b) Where the tendered amount is less than eighty percent (80%) of the Estimated 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.

2. The work is situated at ICAR /CIRC campus at Babugarh, Hapur, U.P. 245201. This area falls under the jurisdiction of Hapur Pilkhuwa Development Authority, Hapur (UP.)



3. The work consists of **Planning, Design, Procurement and Construction** of Babugarh campus of ICAR-CIRC at Babugarh Hapur, UP. 245201, for **Administration cum Laboratory building and Farmers Training Hostel, Development at Site A**, in EPC Mode -I with detailed Planning, Designing and Construction of RCC Buildings, Internal Water supply, Sanitary Installations, Drainage, Development works, Terrace water Tanks, Laboratory furniture and all related services, Rain water harvesting system, Internal Roads, Pathways, Water Supply Lines, Storm Water Drains, External Sewerage System, Service Trenches and all E&M Services such as Internal Electrical Installations, Lift, Fire Alarm System, Firefighting system, Sub-Station, DG sets, UPS, VRV/VRF AC System , Solar water heating system, solar photo voltaic power generation system, CCTV system, LAN system, IP based EPBAX system, Street lightening with LED, Water supply pumps, STP plant, Emergency light and illuminated signages, RO water plant, Split AC & other Misc. works all complete on Engineering, Procurement and Construction basis including development of BIM models.
4. The Agency is required to complete the project on EPC (Turn-Key) basis within controlled architectural norms as mentioned in the Scope of Work, Technical Specifications & Architectural Drawings including development of entire site area shown in drawings attached with this document
5. 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 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 charge 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 rates at which stores, tools and plant, etc. will be issued to him by the Government and local conditions and other factors having a bearing on the execution of the work.

6. The General features of the Project are detailed in given table.

Brief scope of work with features and services etc.		
S.No.	Item	Description
1.	Admin cum laboratory building (G+6)	Plinth Area 15421.66 sqm
2.	Farmer training hostel (G+1)	Plinth Area 3262.40 sqm
	Total	Plinth Area 18684.06 sqm
3	Development (Site A)	Plot Area 1,05,200sqm (approximate). Area in between Road No. 5,6,7,8,9,10, 11,12, 13,14,15,16,17,25,27 and 26. As per attached drawing.
4.	Miscellaneous	Furniture work in designated labs (Nine typical labs). Other labs E&M services to be designed and provided as per the requirement of lab and provided upto/from inlet/outlet points in the lab.
5.	1. Internal Water supply, 2. Sanitary Installations, 3. Drainage, Development works 4. Terrace water Tanks 5. Laboratory furniture and all related services, 6. Rainwater harvesting system, - Internal Roads, 7. Pathways, 8. Water Supply Lines, 9. Storm Water Drains, 10. External Sewerage System, 11. Service Trenches 12. All E&M Services such as Internal Electrical Installations, 13. Lift, Fire Alarm System, 14. Firefighting system, 15. Sub-Station,	All designs and construction shall be as per relevant National Building Code, BIS codes, IEC/other international codes, CPWD Specifications, Industry practices, manufacturers Specification etc as per direction of Engineer -in-charge.

	16. DG sets, 17. UPS, 18. VRV/VRF AC System, 19. Solar water heating system, 20. Solar PV power generation system, 21. CCTV system, 22. LAN system, 23. IP based EPBAX system, 24. Street lightening with LED, 25. Water supply pumps, 26. STP plant, 27. Emergency light and illuminated signages, 28. RO water plant, 29. Split AC & other Misc. works 30. development of BIM models. 31. Topographic survey, 32. Geo-technical soil investigation 33. All Preparatory / Ancillary works 34. Obtaining approvals from Local bodies, Hapur Pilkhuwa Development Authority, Fire Services, Tree Cutting etc. required as per site conditions 35. The buildings are to be constructed to meet FIVE STAR GRIHA/ Equivalent CPWD GHAR Green rating and conforming to UPECBC code 2017 amended up to date and obtaining the certification of the same	

SECTION-II

Information and Instructions for bidders

1.0 General

- 1.1 Letter of transmittal and forms for deciding eligibility are given in Section III.
- 1.2 All information called for in the enclosed forms should be furnished against the relevant columns in the forms. If for any reason, information is furnished on a separate sheet, this fact should be mentioned against the relevant column. Even if no information is to be provided in a column, a “nil” or “no such case” entry should be made in that column. If any particulars/query is not applicable in case of the bidder, it should be stated as “not applicable”. The bidders are cautioned that not giving complete information called for in the application forms or not giving it in clear terms or making any change in the prescribed forms or deliberately suppressing the information may result in the bid being summarily disqualified. Bids made by telegram or telex and those received late will not be entertained.
- 1.3 The bid should be type written. The bidder should sign each page of application, over writing should be avoided. Corrections if any should be made by neatly crossing out, initializing, dating and rewriting. Pages of the eligibility criteria document are numbered. Additional Sheets if any added by the Bidder should also be numbered by him. They should be submitted as a package with signed letter of transmittal.
- 1.4 The bidder may furnish any additional information which he thinks is necessary to establish his capabilities to successfully complete the envisaged work. He is, however, advised not to furnish superfluous information.
- 1.5 No information/documents shall be entertained after submission of bid unless it is required to clarify the query raised by Employer. No fresh/revised mandatory document is permitted at this stage.
- 1.6 If private works are shown in support of eligibility, certified copy of the tax deducted at source certificate (TDS) shall be submitted along with the experience certificate and the TDS amount shall tally with the actual amount of work done.
- 1.7 References, information and certificates from the respective clients certifying suitability, technical knowledge or capability of the bidder should be signed by an officer not below the rank of Executive Engineer or equivalent

2.0 Definitions

- 2.1 In this document the following words and expressions have the meaning hereby assigned to them:

EMPLOYER: Means the President of India, acting through The Executive Engineer, Meerut Division, CPWD, Income Tax Office Bhainsali Ground, (UP) 250001 (Telephone No: 0121-2970744, e-mail: mrtee-itocbg@cpwd.gov.in)

- 2.2 User/Client/Owner: ICAR-CIRC
- 2.3 BIDDER/Agency/Contractor/Firm: Means the individual, proprietary firm, firm in partnership, limited company (private or public) or corporation.
- 2.4 “Year” means “Financial Year” unless stated otherwise.
- 2.5 “Competent Authority” means “Committee constituted of Representatives of CPWD and Client.

3 Method of Application

- 3.1 If the bidder is an individual, the application shall be signed by him above his full type written name and current address.
- 3.2 If the bidder is a proprietary firm, the application shall be signed by the proprietor above his full type written name and the full name of his firm with its current address.
- 3.3 If the bidder is a firm in partnership, the application shall be signed by all the partners of the firm above their full type written names and current address, or, alternatively, by a partner holding power of attorney for the firm. In the latter case a certified copy of the power of attorney should accompany the application. In both cases a certified copy of the partnership deed and current address of all the partners of the firm should accompany the application.
- 3.4 If the bidder is a limited company or a corporation, the application shall be signed by a duly authorized person holding power of attorney for signing the application accompanied by a copy of the power of attorney. The bidder should also furnish a copy of the Memorandum of Articles of Association duly attested by a Public Notary.

4 Final Decision-Making Authority

The employer reserves the right to accept or reject any bid and to annul the process and reject all bids at any time without assigning any reason or incurring any liability to the bidders.

5 Particulars Provisional

- 5.1 The particulars of the work given in the scope of work are provisional. They are liable to change and must be considered only as advance information to assist the bidders.

6 Site Visit

- 6.1 The bidder is advised to visit the site of work, at his own cost, and examine it and its surroundings to himself collect all information that he considers necessary for proper assessment of the prospective assignment.

7 Initial Criteria for Eligibility (Technical Bid)

- (a) The bidder should have satisfactorily completed similar works during last 07 (seven) years ending last date of the month previous to the one in which tenders are invited as below. For this purpose, cost of work shall mean gross value of the completed work including cost of material supplied by the Government/client but excluding those supplied free of cost. This should be certified by an office not below the rank of Executive Engineer/Project Manager or equivalent.

(i)	Three similar works each costing not less than	40.86 Crore
OR		
(ii)	Two similar works each costing not less than	61.28 Crore
OR		
(iii)	One similar works each costing not less than	81.71 Crore

Similar works shall mean works of: - Construction of RCC framed structure having minimum one building of five or more storeys including water supply, sanitary installation, internal electrical installations and any 3 (three) of the following E & M services –

- a) HVAC/VRF/VRV
- b) Lift
- c) Fire Alarm System,
- d) Fire Fighting System,
- e) Sub Station
- f) EPBAX system
- g) DG Set

Or

Similar works shall mean works of Completing balance Construction of RCC framed structure having minimum one building of five or more storeys including water supply, sanitary installation, internal electrical installations and any 3 (three) of the following E & M services –

—

- a) HVAC/VRF/VRV
- b) Lift
- c) Fire Alarm System,
- d) Fire Fighting System,
- e) Sub Station
- f) EPBAX system
- g) DG Set

Stilt constructed in the building shall be considered as a storey. Mumty and Machine Room shall not be counted as storey/height for this purpose.

Work of specialized E&M services etc. if executed under a separate contract shall also be considered for the purpose of assessing the technical competence only without adding its monetary value for determining the eligibility criteria.

Components of work executed other than those included in definition of similar work shall be deducted while calculating the cost of similar work. RCC framed structure shall be of RCC slab, beams & columns. The bidder shall submit abstract of cost of work along with supporting documents and certificate issued by the experience issuing authority in support of this.

- (i) One completed work costing not less than **₹20.43** Crore executed with the structural system technology as proposed by bidder in the letter of transmittal. This work can be part of eligible work at 7.1(i) above or as a separate work.

Or

The bidder can associate with contractor having requisite work experience of the opted technology. Bidder has to submit MoU with such associate contractor along with his tender; However, the associated contractor must satisfy the eligibility criteria of having successfully completed one work of costing not less than 20% of the estimated cost put to tender with opted technology during the last seven years ending last day of month previous to the one in which tender is invited.

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

The bidder shall satisfy the following financial eligibility criteria. However, CPWD registered contractors enlisted in appropriate class of building category, need not to submit financial eligibility documents 7.2 to 7.4 but need to submit the Bidding capacity under 7.6.

- 7.2 The bidder should have had Average Annual Financial Turnover of **₹30.64** Crore on Civil/Electrical construction work during the last three consecutive years as per the balance

sheets duly audited by Chartered Accountant. Year in which no turnover is shown would also be considered for working out the average. The value of annual turnover figures shall be brought to current value by enhancing the actual turn over figure at simple rate of 7% per annum.

7.3 The bidder should not have incurred any loss (profit after tax should be positive) in more than two years during available last five consecutive balance sheets, duly certified and audited by the Chartered Accountant. (standalone financial statement).

7.4 The bidder should have a Banker's certificate from a Commercial Bank for **₹40.86** Crore certified by his Bankers. (Not required if applicant is a CPWD registered contractor of appropriate class) or the bidder should submit Net worth Certificate of minimum 10% (**₹10.21 crore**) of ECPT issued by the certified Chartered Accountant (on the format prescribed in form B-1).

7.5 The bidder should have sufficient number of Technical and Administrative employees for the proper execution of the contract. The bidder shall have to submit a list of these employees stating clearly how these would be involved in this work within 15 days of award of work.

7.6 Bidding Capacity (applicable for CPWD enlisted contractors also): The bidding capacity of the contractor should be equal to or more than the estimated cost of the work put to tender. The bidding capacity shall be worked out by the following formula:

$$\text{Bidding Capacity} = \{[A \times N \times 1.5]B\}$$

Where,

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

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

B=Value of existing commitments and ongoing works to be completed during the period of completion of work for which bids have been invited.

Note: The bidder should submit bidding capacity as per Form 'C-3'

- a) Bidding capacity, for CPWD contractors who are enlisted based on rules 9.6.3 & 9.6.4 of Enlistment Rules-2024 i.e. new entity based on previously enlisted entity for three years from date of issue of enlistment order, is as follows: -

Annual turnover of newly enlisted entity shall be in proportion to the shareholding of partners/directors in the original enlisted entity at the time of enlistment of the newly enlisted entity. Within three years from the date of issue of enlistment order, the newly enlisted entity has to develop its own bidding capacity and thereafter the general bidding capacity formula being used for other entities shall be applicable to it for calculation of bidding capacity. Newly enlisted

entity may like to follow general bidding capacity formula even before period of three years, if it so chooses.

Bidding Capacity for newly enlisted entity based on rules 9.6.3 & 9.6.4 enlistment rules - 2024 shall be as follows :-

$$\text{Bidding Capacity} = \{(A' \times N \times 1.5) - B\}$$

Where,

A' = Proportionate share of newly enlisted director/partner in originally enlisted company/firm multiplied by the factor A, as given below. Value of A' will be mentioned in the enlistment order by member secretary of Advisory committee for Enlistment Authority, it will remain same for three years.

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

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

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

- b) Enlisted entities based on rules 6.1.7, 9.6.3 or 9.6.4 of enlistment rules-2024 can submit MoU from agency having requisite experience for structural system technology if the enlisted entity does not have required experience.
- c) Evaluation of performance: Evaluation of the performance of contractors for eligibility shall be done by NIT approving authority or a Committee constituted by him. All the eligible similar works executed and submitted by the bidders in support of eligibility and any one of the ongoing works, may be got inspected by a committee which may consist of client or any other authority as decided by NIT approving authority. The marks for the quality shall be given based on this inspection, if inspection is carried out.

8 Evaluation Criteria for Technical Qualification

- 8.1 The details submitted by the bidders will be evaluated in the following manner.
- 8.2 The initial criteria prescribed in para 7.0 above in respect of experience of eligible similar works completed, loss, Net worth, financial turnover and bidding capacity etc. will first be scrutinized and the bidder's eligibility for the work be determined.
- 8.3 The bidders qualifying the initial criteria as set out in Para 7.0 above will be evaluated for following criteria by scoring method on the basis of details furnished by them:

(a)	Financial strength (Form “A” & “B-1”)	Maximum 20 Marks
(b)	Experience in eligible similar nature of work during last Seven years (Forms “C”)	Maximum 20 Marks
(c)	Performance on work (Form “D”)- Time over run	Maximum 20 Marks
(d)	Performance on work (Form “D”)- Quality	Maximum 40 Marks
	Total	100 Marks

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

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

Note: The average value of performance of works for time overrun and quality shall be taken on the basis of performance report of the eligible similar works.

9.0 Financial Information

- 9.1 Bidder should furnish the: Annual Financial Statement for the last five years in Form “A” and Solvency Certificate in Form “B” or Net worth certificate in Form “B-1” from Chartered Accountant.

10.0 Experiences of Similar works

- 10.1 Bidder should furnish the list of eligible similar nature of works successfully completed during last Seven years ending last date of the month previous to the one in which tenders are invited in Form ‘C’ and ongoing works as well (**Form - C1**).

11.0 Organization Information

- 11.1 Bidder is required to submit the following information in respect of his organization (in form ‘E’).

12.0 Construction Plant & Equipment

- 12.1 Bidders should furnish the list of construction plant and equipment including steel shuttering, cantering and scaffolding to be used in carrying out the work. Details of any other plant & equipment required for the work not included in NIT and available with the bidder may also be indicated

13.0 Letter of Transmittal

- 13.1 The bidder should submit the letter of transmittal attached with the document

14.0 Opening of The Financial Bid

- 14.1 After evaluation of applications, a list of short-listed agencies qualified in technical evaluation will be prepared. Thereafter, the financial bids of only the qualified and technically acceptable bidders shall be opened at the notified time, date and place in the presence of the qualified bidders or their representatives.

15.0 Award Criteria

- 15.1 The employer reserves the right, without being liable for any damages or obligation to inform the bidder, to:
- (a) Amend the scope and value of contract.
 - (b) Reject any or all of the applications without assigning any reason.
- 15.2 Any effort on the part of the bidder or his agent to exercise influence or to pressurize the employer would result in rejection of his bid. Canvassing of any kind is prohibited.

PROFORMA -I**Eligibility and Evaluation Criteria**

Criteria for Evaluation of the performance of contractors for pre-eligibility

S.No.	Attributes		Marks	Evaluation			
(a)	Financial Strength: Maximum 20 Marks						
	(i)	Average annual turnover	16 Marks	(i) 60% marks for minimum eligibility criteria (ii) 100% marks for twice the minimum eligibility criteria or more. In between (i) & (ii)- on pro-rata basis			
	(ii)	Net worth Certificate	4 Marks				
(b)	Experience in similar class of work: Maximum 20 Marks						
	Experience in similar class of work		20 marks	(i) 60% marks for minimum eligibility criteria (ii) 100% marks for twice the minimum eligibility criteria or more. In between (i) & (ii)- on pro-rata basis.			
(c)	Performance on works - Time Over Run (TOR): Maximum 20 marks						
	Parameter		Calculation for points	Score			Maximum Marks
	If TOR =			1.00	2.00	3.00	>3.50
	(i) Without levy of compensation			20	15	10	10
	(ii) With levy of compensation			20	5	0	-5
	(iii) Levy of compensation not decided			20	10	0	0
	TOR = AT/ST, where AT =Actual Time; ST= (Stipulated Time in the Agreement plus+ justified period of extension of time) Note: Marks for value in between the stages indicated above is to be determined by straight line variation basis.						
(d)	Performance of works (Quality) as Assessment in Form D-1. (40 marks)						
	Completed works (Max.25 marks)		Ongoing works (Max. 15 marks)		Total marks assessed.		

Note: Performance of work (Quality) certified as “satisfactory” will be treated as “good”.

SECTION - III

LETTER OF TRANSMITTAL

From

To

The Executive Engineer
Meerut Division, CPWD,
Income Tax Office Campus
Bhainsali Ground Meerut UP - 250001

Name of Work: - Construction of Babugarh campus of ICAR-CIRC at Babugarh Hapur, UP. (SH:C/o Administration cum Laboratory building and Farmers Training Hostel i/c Land development at Site A, in EPC Mode -I)

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

1. I/We hereby certify that all the statements made and information supplied in the enclosed forms A to F and accompanying statement are true and correct.
- 8 I/we have furnished all information and details necessary for eligibility and have no further pertinent information to supply.
- 9 I/we submit the requisite certified solvency certificate and authorize the Executive Engineer, Meerut Division, CPWD, Income Tax Office Campus, Bhainsali Ground Meerut UP-250001 to approach the Bank issuing the solvency certificate to confirm the correctness thereof. I/We also authorize Executive Engineer, Meerut Division, CPWD, Income Tax Office Campus, Bhainsali Ground Meerut UP-250001 to approach individuals, employers, firms and corporation to verify our competence, work experience, and general reputation.
- 10 I/we submit the following certificates in support of our suitability, technical knowledge and capability for having successfully completed the following eligible similar works:

Name of work	Certificate from

- 11 I/we hereby certify that I/we will use following structural system technology in the work
.....

Addition: NIL Correction: NIL
Overwriting: NIL Deletion: NIL

AE(P)

AE(E)P

EE(P)

- 12 I/we submit the certificate in support of having successfully completed the following work with the technology proposed to be used in the work

Name of work	Certificate from

- 13 I/we hereby attaching copy of type test report conducted in respect of precast concrete construction system technology proposed to be used in the work (Applicable if precast concrete construction system technology is proposed by bidder).
- 14 I/We hereby submit undertaking on structural stability and soundness as per prescribed format Form F.

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

Enclosures:

Date of submission

Seal of bidder&
Signature(s)
of bidder(s)

FORM 'A'**FINANCIAL INFORMATION**

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

(Fig in Lakhs Rs.)

Sl. No.	Particulars	Financial Years				
		2020-21	2021-22	2022-23	2023-24	2024-25
i)	Gross Annual Turn Over on construction works					
ii)	Profit / Loss (standalone financial statement)					

- II. Financial arrangements for carrying out the proposed work.

Signature of Chartered Accountant with Seal

Signature of bidder (s)

FORM- 'B'**BANKER'S CERTIFICATE FROM A COMMERCIAL BANK**

This is to certify that to the best of our knowledge and information that M/s./Shri..... having marginally noted address, ...as a customer of our bank are/is respectable and can be treated as good for any engagement up to a limit of Rs.....(Rupees.....).

This certificate is issued without any guarantee or responsibility on the bank or any of the officers.

(Signature) For the Bank

NOTE:

1. Banker's certificate should be on letter head of the Bank, addressed to Executive Engineer, Meerut Division, CPWD, Income Tax Office Campus, Bhainsali Ground Meerut UP-250001.
2. In case of partnership firm, certificate should include names of all partners as recorded with the Bank.

FORM 'B-1'**FORM OF CERTIFICATE OF NETWORTH FROM CHARTERED
ACCOUNTANT**

“It is to certify that as per the audited balance sheet and profit and loss account during the financial year.....,the Net worth of M/s.....(Name & Registered address of the individual/firm/company),as on.....(the relevant date) is Rs.....after considering all liabilities. It is further certified that the Net Worth of the company has not eroded by more than 30% in the last three year ending on (the relevant date)”

Unique Document Identification Number (UDIN).....

(Signature of Chartered Accountant)

Name of the Chartered Accountant

Membership no of ICAI

Date & Seal

FORM 'C'**DETAILS OF ELIGIBLE SIMILAR NATURE OF WORKS COMPLETED DURING THE
LAST SEVEN YEARS ENDING PREVIOUS DAY OF LAST DAY OF SUBMISSION OF
TENDERS**

S. No.	Name of work / project and location	Owner or sponsoring organization	Cost of work in crores of Rupees	Date of commencement as per contract	Stipulated date of completion	Actual date of completion	Litigation/ arbitration cases pending /In progress with details*	Name and Address/ telephone number of officers to whom reference may be made	Whether the work was done on back-to-back basis Yes/No
1	2	3	4	5	6	7	8	9	10

* Indicates gross amount claimed and the amount awarded by the Arbitration Tribunal.

SIGNATURE OF BIDDER(S)

FORM 'D'
PERFORMANCE REPORT OF WORKS REFERRED TO IN FORMS "C".

1.	Name of work / Project & Location		
2.	Agreement No.		
3.	Estimated Cost		
4.	Tendered Cost		
5.	Date of Start		
6.	Date of completion		
	i)	Stipulated Date of Completion (as mentioned in work order)	
	ii)	Actual Date of Completion	
7.	Amount of compensation levied for delayed completion, if any		
	i)	Whether case of levy of compensation for delay has been decided or not	Yes/ No.
	ii)	If decided:	
		a) Justified period of extension	
		b) Amount of compensation levied for delayed completion, if any.	
8.	Amount of reduced rate items, if any		
9.	Performance Report		
	1) Quality of Work		Outstanding /Very Good/Good/Poor
	2) Financial Soundness		Outstanding /Very Good/Good/Poor
	3) Technical Proficiency		Outstanding /Very Good/Good/Poor
	4) Resourcefulness		Outstanding /Very Good/Good/Poor
	5) General Behaviour		Outstanding /Very Good/Good/Poor

Dated:

Executive Engineer or Equivalent owner authority of Work/Project

FORM 'C-1'**PROJECT UNDER EXECUTION**

S. No .	Name of work/ Project and location	Owner or sponsoring organization	Cost of work in crores of rupees	Date of commenc ement as per contract	Stipulated date of completion	Up to date percentage progress of works	Slow progress if any and reason thereof	Name and address/ telephone number of officers to whom reference may be made	Remarks
1	2	3	4	5	6	7	8	9	10

Signature of Bidder(s)

FORM- 'C-(b)'**AFFIDAVIT**

I/We undertake and confirm that eligible similar work(s) has/have not been got executed through another contractor on back-to-back basis. Further that, if such a violation comes to the notice of Department, then I/we shall be debarred for bidding 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 (Scanned copy to be uploaded at the time of submission of bid).

Signature of bidder(s) with stamp

FORM 'C-2'

**DETAIL OF ONE WORK IN SUPPORT OF HAVING SUCCESSFULLY
COMPLETED WITH THE STRUCTURAL SYSTEM TECHNOLOGY
PROPOSED TO BE USED IN THE WORK**

S. No .	Name of work/ Project and location	Owner or sponso ring organi zation	Cost of work in crores of rupees	Date of commen cement as per contract	Stipula ted date of compl etion	Actual date of completi on	Type of structur al system Technol ogy used	Litigation/ arbitration cases pending / In progress with details*	Name and address/ Telepho ne number of officers to whom referenc e may be made	Whether the work was done on back-to- back basis Yes/No
1	2	3	4	5	6	7	8	9	10	11

* Indicates gross amount claimed and the amount awarded by the Arbitration Tribunal.

Signature of Bidder(s)

FORM 'C-3'

Calculation of bidding capacity
Details of existing commitments and ongoing works.

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

Total (B) =

Maximum turnover in last seven years =Rs.

Updated value of turnover (A) =Rs.

No. of years (N) = ...

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

Certified

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

Signature of Bidder(s)

with stamp

FORM 'D-1'**Assessment of Quality for completed as well as ongoing works****Name of Work: -****Date of Inspection: -****Date of submission of report: -**

A.	General Observation & Operational Aspects	Yes/ No
1	Availability of approval from local bodies in case of Construction of Private Buildings.	
2	Availability of approved Structural drawings	
3	Observation on seepage/ leakage in the building	
4	Whether Line & level Maintained	
5	In case of observation on seepage, if any.	
6	Any Structural defects / distress observed. If yes give details	
7	Whether safety measures adopted at site as per CPWD Safety Code and or govt. guidelines are adequate or not.	
8	Whether the Welfare facilities provided to labour as per Clause 19 H of GCC for CPWD Works/and or govt. guidelines are adequate or not.	
9	Whether AHU getting automatically switched off and fire dampers closed in case of fire signal	
10	Whether thimbles used for termination of wires in DBs, EBDs & Panels?	
B.	Quality of Work	Marks Assessed
1	Quality of plaster/ finishing	
2	Quality of RCC / CC Work	
3	Quality of Flooring	
4	Quality of Wood Work	
5	Quality of Steel Work / Aluminium Work	
6	Quality of Plumbing and Sanitary Installation	
7	Quality of Workmanship	
8	Quality of Waterproofing	
9	If cladding done, observation on efficiency/ quality of cladding /Brick work	
10	Quality of internal electrification work	
11	Quality of DBs, EBDs& Panels	
12	Quality of E&M equipment, panels & feeder pillar.	
13	Quality of fire alarm system/ firefighting system	
14	Quality of Air Conditioning work.	
15	Quality of Sub-station based on complete live diagram, capacitor panel, power factor, insulating Mat, cleanliness, cable termination, earthing pits, earthing of transformer / DG sets.	
16	Any Other aspect (To be elaborated)	

Average Marks (To be awarded out of 100 Marks based on average of marks assessed on each attribute mentioned at B above).

Note: -

1. All the above parameters may be considered for assessing the overall quality of work executed by the contractor. Each attribute shall be assessed on maximum marks of 10 under B above.
2. In case, any attribute is not applicable, the same may not be included in assessment and mentioned as not applicable (N/A).
3. The works as assessed above shall be converted on a scale of 25/15 marks for completed/ongoing works respectively.

In case of eligible completed works being more than one the average marks assigned for eligible completed works shall be considered for marking purpose. Only one ongoing work to be assessed.

**Signature of Executive Engineer or
authority who inspected the Work / Project with stamp**

FORM 'D-2'**CERTIFICATE OF EXPERIENCE IN SUPPORT OF HAVING SUCCESSFULLY
COMPLETED ONE WORK WITH THE STRUCTURAL SYSTEM
TECHNOLOGY PROPOSED TO BE USED IN THE WORK**

1. Name of work/project and location
2. Owner or sponsoring organization
3. Cost of work in crore of rupees
4. Date of commencement as per contract
5. Stipulated date of completion
6. Actual date of completion
7. Type of structural system Technology used
8. Litigation/arbitration cases Pending/in progress with details
9. Name and address/telephone number of officers to whom reference may be made
10. Whether the work was done on back-to-back basis (yes / no)

Certified that M/s has completed the above work with the structural system technology as per details mentioned above.

To be signed with date and seal of the owner /
Sponsoring organization

FORM 'E'
STRUCTURE & ORGANIZATION

1. Name & Address of the bidder
2. Telephone No./Telex No./Fax No.
3. Legal status of the bidder (scan and upload copies of original document defining the legal status).
 - (a) An Individual
 - (b) A proprietary firm
 - (c) A firm in partnership
 - (d) A limited company or Corporation
4. Particulars of registration with various Government Bodies (Scan & upload attested photocopy).

ORGANIZATION/PLACE REGISTRATION	OF	REGISTRATION No.

5. Names and Titles of Directors & Officers with designation to be concerned with this work.
6. Designation of individuals authorized to act for the organization.
7. Has the bidder, or any constituent partner in case of partnership firm, limited company/Joint Venture, ever been convicted by the court of LAW? If so, give details.
8. In which field of Civil Engineering construction, the bidder has specialization and interest?
9. Any other information considered necessary but not included above.

Signature of bidder(s) with stamp

FORM- 'F'**Undertaking on Structural Stability and Soundness of
already completed Buildings and Infrastructure Projects**

I/we undertake and confirm that any building /infrastructure constructed by our firm /partnership firm/ company has not suffered any failure, making it unfit for intended use, either due to structural design and defects or due to use of sub-standard materials or execution of sub-standard work, poor workmanship or any other reason during the last 25 (twenty-five) years.

I/we, further, undertake that if such information comes to the notice of CPWD, then Engineer-in-Charge shall be free to terminate the bid/agreement and to forfeit the entire amount of earnest money deposit, performance guarantee and security deposits.

I/we, also undertake that in addition to above, the Engineer-in-Charge shall be free to debar us forever from tendering in CPWD.

The decision of Engineer-in-Charge or any higher authority shall be final and binding.

Signature of

Signature of bidder or notary with seal

authorized person of the
firm with stamp

Note: Affidavit to be furnished on a 'non-judicial' stamp paper of Rs. 200/- (scanned copy of the notarized affidavit to be uploaded at the time of submission of bid)

FORM 'G'**EMD RECEIPT FORMAT****Receipt of deposition of original EMD**

Receipt No.....*/..... /Date.....*/.....

Name of Work: - Construction of Babugarh campus of ICAR-CIRC at Babugarh Hapur, UP. (SH:C/o Administration cum Laboratory building and Farmers Training Hostel i/c Land development at Site A, in EPC Mode -I)

1. **NIT No : 10/CE(GZB)/NIT/2026-27**
2. **Estimated Cost:** Rs.102,13,30,153/- (Civil work -Rs.73,56,78,489/- + Electrical work- Rs. 28,56,51,664/-)
3. **Earnest Money Deposit:** Rs.1,12,13,302/- (to be refunded after receiving the performance guarantee)
4. **Last date of submission of bid:15:00 Hrs. on 31.07.2026**
(* To be filled by Tender inviting authority/NIT approving authority at the time of issue of NIT and uploaded along with NIT)

(1) **Name of Bidder:**#(2) **Form of Earnest Money Deposited:** #

- (i) In the form of Insurance Surety Bonds or
Account Payee Demand draft or Banker's Cheque or
Fixed Deposit Receipts
Rs.....Vide Date.....
- (ii) In the form of Bank Guarantee including e- Bank Guarantee (for balance amount as prescribed) from any of the Commercial Bank
Rs.....issued by..... Date.... (as per Form- G)

(3) **Amount of Earnest Money Deposit:** #(4) **Date of submission of EMD:**..... #

Signature,
Name and Designation of EMD receiving officer
(EE/or duly authorised AE(P)/AAO along with Office stamp.

(To be filled by EMD receiving EE)

Form- 'G-1**FORM OF EARNEST MONEY DEPOSIT (BANK GUARANTEE BOND)**

WHEREAS, Bidder..... (Name of Bidder) (herein after called "the Bidder") has submitted his bid dated (date) for the construction of (name of work) (herein after called "the bidder")

KNOW ALL PEOPLE by these presents that we (name of bank) having our registered office at (herein after called "the Bank") are bound unto Executive Engineer, Meerut Division, CPWD, Income Tax Office Campus, Bhainsali Ground Meerut UP-250001 in the sum of Rs. (Rs. in words) for which payment well and truly to be made to the said Executive Engineer, Meerut Division, CPWD, Income Tax Office Campus, Bhainsali Ground Meerut UP-250001 the Bank binds itself, his successors and assigns by these presents.

SEALED with the Common Seal of the said Bank this day of 2.... THE CONDITIONS of this obligation are:

If after bid opening of bid; the Bidder withdraws, his bid during the period of validity of bid (including extended validity of bid) specified in the Form of Bid;

If the Bidder having been notified of the acceptance of his bid by the Executive Engineer, Meerut Division, CPWD, Income Tax Office Campus, Bhainsali Ground Meerut UP-250001 fails or refuses to execute the Form of Agreement in accordance with the Instructions to Bidder, if required; or fails or refuses to furnish the Performance Guarantee, in accordance with the provisions of bid document and Instructions to Bidder,

We undertake to pay to the Executive Engineer, Meerut Division, CPWD, Income Tax Office Campus, Bhainsali Ground Meerut UP-250001. either up to the above amount or part thereof upon receipt of his first written demand, without the Executive Engineer, Meerut Division, CPWD, Income Tax Office Campus, Bhainsali Ground Meerut UP-250001. having to substantiates his demand, provided that in his demand the Executive Engineer, Meerut Division, CPWD, Income Tax Office Campus, Bhainsali Ground Meerut UP-250001. will note that the amount claimed by him is due to him owing to the occurrence of one or any of the above conditions, specifying the occurred condition or conditions.

This Guarantee will remain in force up to and including the date * after the deadline for submission of bid as such deadline is stated in the Instructions to Bidder or as it may be extended by the Executive Engineer, Meerut Division, CPWD, Income Tax Office Campus, Bhainsali Ground Meerut UP-250001,

notice of which extension(s) to the Bank is hereby waived. Any demand in respect of this Guarantee should reach the Bank not later than the above date.

DATE SIGNATURE OF THE BANK

WITNESS SEAL

(SIGNATURE, NAME AND ADDRESS)

*Date to be worked out on the basis of validity period of 6 months from the last date of uploading the bid.

FORM- 'G-2'

Form of Performance Security (Guarantee)
Bank Guarantee Bond

In consideration of the President of India (hereinafter called "The Government") having offered to accept the terms and conditions of the proposed agreement between _____ and _____ (hereinafter called "the said contractor(s)" for the work of _____ (hereinafter called "The said agreement") having agreed to production of a irrevocable Bank Guarantee for Rs. _____ (Rupees _____ only) as a security/guarantee from the contractor(s) for compliance of his obligations in accordance with the terms and conditions in the said agreement, we _____ (indicate the name of the bank) (hereinafter referred to as "the Bank) hereby undertake to pay to the Government an amount not exceeding Rs. _____ (Rupees _____ only) on demand by the Government.

2. We _____ (indicate the name of the bank) do hereby undertake to pay the amounts due and payable under this Guarantee without any demure, 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(s). 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. _____ (Rupees _____ only).

3. We _____ (indicate the name of the bank) the said bank further undertakes to pay to the Government any money so demanded notwithstanding any dispute or disputes raised by the contractor(s) in any suit or proceeding pending before any court or Tribunal relating thereto, our liability under this present being absolute and unequivocal.

The payment so made by us under this bond shall be a valid discharge of our liability for payment there under and the contractor(s) shall have no claim against us for making such payment.

4. We _____ (indicate the name of the bank) further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said agreement and that it shall continue to be enforceable till all the dues of the government under or by virtue of the said agreement have been fully paid and its claims satisfied or discharged or till Engineer-in-charge on behalf of the Government certified that the terms and condition of the said agreement have been fully and properly carried out by the said contractor (s) and accordingly discharges this guarantee.

5. We _____ (indicate the name of the bank) further agree with the Government that the government shall have the fullest liberty without our consent and without effecting in any manner our obligations hereunder to vary any of the terms and conditions of the said agreement or to extend time of performance by the said contractor(s) 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(s) and to for bear 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(s) or for any for-bearance, act of omission on the part of the Government or any indulgence by the Government to the said contractor(s) or by any such matter of thing whatsoever which under the law relating to sureties would, but for this provision, have effect of so relieving us.

6. This guarantee will not be discharged due to the change in the constitution of the Bank or the contractor(s).

7. We _____ (indicate the name of the bank) lastly undertake not to revoke this guarantee except with the previous consent of the Government in writing.

8. This guarantee shall be valid up to _____ unless extended on demand by Government. Not with standing 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 six months of the date of expiry or the extended date of expiry of this guarantee all our liabilities under this guarantee shall stand discharged.

Date the _____ day of _____ for _____.

(indicate the name of Bank)

FORM- 'H'**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 specialized E&M works of Lifts & DG Sets, HVAC that “OEM shall unconditionally support the lowest tenderer technically throughout the execution of contract as well as for Maintenance/Comprehensive Maintenance Contract for the useful life of the system, and they shall also provide all the spares required for healthy functioning of the equipment for at least seven years from the date of supply of equipment”.

Signature of bidder(s) with stamp

FORM-I**Memorandum of Understanding (MOU) for Associated Contractor
(Part of Bid Document)**

M/s. (Name of the firm with full address)

(Henceforth called the Main Contractor)

And

M/s. (Name of the firm with full address)

(Henceforth, called the Associated Contractor)

Name of work:

.....

NIT No.

This MoU is made at..... on
 between the
 (herewith called the main contractor) and (herewith called the
 Associated contractor).

Whereas the main contractor has agreed to entrust the STRUCTURAL SYSTEM of opted technology only to the associated contractor.

We state that MoU 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 this agreement for execution of the STRUCTURAL SYSTEM of opted technology only in respect of above work. Both of us shall be responsible for the execution of STRUCTURAL SYSTEM as per the agreement to the extent this MoU allows. In case of any delay in the payment by the main contractor, the associated contractor can apply to the CPWD to release the payment under Clause 7B and deduct the same from the bills of the main contractor. In case of any dispute, either of us will go for mediation by the CE or SE (as the case may be) and his decision shall be final and binding on both of us.

We have further agreed as under:

1. The Associated Contractor will execute STRUCTURAL SYSTEM of opted Technology works as per terms and conditions of this agreement.
2. All the machinery and equipment, tools and tackles required for execution of the STRUCTURAL SYSTEM of opted Technology works, as per this MoU, shall be the responsibility of the Associated Contractor.
3. The site staff required for the execution of STRUCTURAL SYSTEM of opted Technology work shall be arranged by the Associated Contractor as per terms and conditions of this MoU.
4. All the correspondence regarding execution of the STRUCTURAL SYSTEM of Opted Technology work shall be done by the department with the main contractor. In case of non-compliance of the provisions of agreement of the work by the associated contractor, the main contractor shall be held responsible and action will be taken against him as per agreement provisions.
5. In case of non-performance, associated contractor will be debarred from participation or association in the CPWD tenders by the CPWD.

(Authorized Signatory)

(Authorized Signatory)

SIGNATURE OF THE MAIN CONTRACTOR

SIGNATURE OF ASSOCIATED CONTRACTOR

Date:

Date:

Place:

Place:

1. Witness with address

1. Witness with address

2. (From main contractor side)

2. (From associated contractor side)

PART-III

FINANCIAL BID

GOVERNMENT OF INDIA

CENTRAL PUBLIC WORKS DEPARTMENT

STATE: UP
ZONE: Ghaziabad

BRANCH: B & R
DIVISION: Meerut Division

EPC (Turn Key) Bid

Name of Work: Construction of Babugarh campus of ICAR-CIRC at Babugarh Hapur, UP. (SH:C/o Administration cum Laboratory building and Farmers Training Hostel i/c Land development at Site A, in EPC Mode -I)

To be uploaded up to 15:00 Hrs. On 31.07.2026 on website: www.tenderwizard.com/cpwd

To be opened in the presence of bidders who may be present at 15:30 Hrs. On 31.07.2026 in the office of The Executive Engineer, Meerut Division, CPWD, Income Tax Office Campus, Bhainsali Ground Meerut, (UP) 250001.

BID

I/We have read and examined the notice inviting bid, schedule-A, B, C, D, E, F& G etc. Specifications applicable, Drawings & Designs, General Rules and Directions, Conditions of Contract for CPWD Works, of 2024 with amendments up to the last date of submission of bids, clauses of contract, Special conditions, Bill of Quantities & other documents and Rules referred to in the conditions of contract and all other contents in the bid document for the work.

I/We hereby bid 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 respect with the specifications, designs, drawing and instructions in writing referred to in Rule-1 of General Rules and Directions and in Clause 11 of the Conditions of contract of 2024 FOR EPC PROJECT with amendments up to the last date of submission of bids and with such materials as are provided for, by, and in accordance with, such conditions so far as applicable.

We agree to keep the bid open for **Seventy-Five (75)** days from the date of opening of technical bid and not to make any modification in its terms and conditions.

A copy of receipt of deposition of earnest money **₹1,12,13,302/-** in Insurance Surety Bonds, Account Payee Demand draft or Banker's Cheque or Fixed Deposit Receipts or/ and Bank Guarantee including e- Bank Guarantee (for balance amount as prescribed) from any of the Commercial Bank is scanned and uploaded. 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 bid 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 (as modified) of the bid 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-bidding process of the work.

I/we undertake and confirm that eligible similar work(s) has/have not been got executed through another agency on back-to-back basis. Further that, if such a violation comes to the notice of Department, then I/we shall be debarred for bidding 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 Deposited/Performance Guarantee.

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

Dated: ** Signature of Bidder **

Witness: **

Address: ** Postal Address **

Occupation: **

[** to be filled by Bidder]

ACCEPTANCE

(To be signed by EE (Meerut Division))

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

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

- (a)
- (b)
- (c)

For & on behalf of President of India

Signature

Dated: Designation

Signature of
Executive Engineer
Meerut Division, CPWD,

Proforma of Schedules: A To F

(CIVIL and ELECTRICAL)

SCHEDULE 'A'

Schedule of financial quote combined rates for Civil, Electrical works and ancillary works as per page 615- 617.

SCHEDULE 'D' Extra schedule for specific requirements/documents for the work, if any.

-NIL-

SCHEDULE 'E'

Reference to General Conditions of Contract: General Conditions of Contract 2024 for EPC Projects in CPWD as amended / modified up to previous day of the last date of submission of Bid.

Name of Work: Construction of Babugarh campus of ICAR-CIRC at Babugarh Hapur, UP. (SH:C/o Administration cum Laboratory building and Farmers Training Hostel i/c Land development at Site A, in EPC Mode -I)

Estimated cost of work Rs.102,13,30,153/- (Civil work -Rs.73,56,78,489/- + Electrical work - Rs. 28,56,51,664/-)

Earnest Money: Rs.1,12,13,302/-

(ii)	Performance Guarantee	(a) 5% of tendered value or Estimated Cost Put to Tender (ECPT) (whichever is higher). (b) Where the tendered amount is less than eighty percent (80%) of the Estimated 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 bid: Executive Engineer Meerut Division, CPWD, Income Tax Office Campus, Bhainsali Ground Meerut (UP)-250001.

Applicable Mode of EPC contract	Mode -1
Type of Building	Permanent
List of approved construction technologies	As per table 1-A of circular 17/SE(TAS)/BMTPC /2022/105-H Dated 24/03/2022 amended from time to time. Sl. No. 11 of Table IA is deleted.

Definitions:

2(vi)	Engineer-in-Charge for Civil works	Executive Engineer Meerut Division, CPWD, Income Tax Office Campus, Bhainsali Ground Meerut (UP)-250001
	Engineer-in-Charge for E&M Works	Executive Engineer (E), Hindon Electrical Division Ghaziabad, CPWD,
2(viii)	Accepting Authority	Chief Engineer (GZB) CPWD, CGO -1, Hapur Road Ghaziabad Uttar Pradesh - (201002)
2(x)	Percentage on cost of materials and labour to cover all overheads and profits	15%
2(x)(b)	Standard Schedule of Rates Civil work,	DSR 2023 and Plinth area rates 2025 (Civil + Electrical) with amendments up to the previous date of the last date of submission of bids.
	Electrical work	Delhi Schedule of Rate 2025- (E&M) with amendments up to the previous date of the last date of submission of bids.
2(xi)	Department	Central Public Works Department (CPWD)
9(ii)	Standard CPWD contract Form GCC 2024, CPWD Form as modified & corrected up to date.	General Conditions of Contract-2024 for EPC Projects in CPWD corrected up to the previous date of the last date of submission of bids.

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.	07 (Seven) days
(ii)	Maximum allowable extension with late fee @ 0.1% per day of Performance Guarantee amount beyond the period provided in (i) above	03 (Three) days with late fee @ 0.1% per day of the PG amount (non-refundable)

Clause 2

(i)	Authority for fixing compensation under clause 2	Chief Engineer (GZB) CPWD, CGO -1, Hapur Road, Ghaziabad (U.P.)

Clause 5

(i)	Authority to convey the decision of shifting of milestone and extension of time.	Executive Engineer Meerut Division, CPWD, Income Tax Office Campus, Bhainsali Ground Meerut (UP)-250001
(ii)	Authority to decide rescheduling of milestone and extension of time.	Chief Engineer (GZB) CPWD, CGO -1, Hapur Road, Ghaziabad (U.P.)
(iii)	Authority to decide shifting of date of start in case of delay in handing over of site.	Chief Engineer (GZB) CPWD, CGO -1, Hapur Road, Ghaziabad (U.P.)

Time allowed for execution of work: : **20 months.**

Number of days from the date of issue of letter of acceptance for reckoning date of start Mile Stone as table given below : **10 (Ten) days**

Table of Mile stones

Sl. No.	Description of Mile stone	Time allowed in days (From date of start)	Amount to be withheld in case of non-achievement of mile stone (% of T.A.)
1.	Submission and approval of Architectural drawings including Layout plan form Local Body (HPDA) approval including vetting of structural design from any IIT, approval of MEP drawing from Engineer-in-charge (E) and all approval & permissions of services shifting and tree cutting from appropriate local authorities.	120	0.25 %
2.	25% of Total work in Financial Terms	200	1.00 %
3.	50% of Total work in Financial Terms	300	1.00 %
4.	75% of Total work in Financial Terms	400	1.00 %
5.	90% of Total work in Financial Terms	500	1.00 %
6.	All civil, electrical & mechanical work completed in all aspects in Administration cum Laboratory building and Farmers Training Hostel with services Fire NOC, Safety Certificate for Sub-station, lifts etc., clearances from local body/ completion certificates (Occupancy Certificate from Local Body) etc. required to declare buildings and campus authorized for occupation.	600	0.75 %

Note: Withheld amount shall be released if and when subsequent milestone is achieved within respective time specified. However, in case milestones are not achieved by the Bidder for the work, the amount shown against milestone shall be withheld.

Monthly recovery for delay in submission of the monthly progress report within specified period Rs. 50,000/- per month for each month default

PROFORMA OF SCHEDULES Clause 5 Schedule of handing over of site

Part	Portion of site	Description	Time Period for handing over reckoned from date of issue of letter of intent.
Part A	Portion without any hindrance	100 %	10 days
Part B	Portions with encumbrances	N.A.	N.A.

Part C	Portions dependent on work of other agencies	N.A.	N.A.

Schedule of issue of Designs Not Applicable

Part	Portion of Design	Description	Time Period for issue of design reckoned from date of receipt of tenders
Part A	Portion already included in NIT	Available	---
Part B-1	Portions of Architectural Designs to be issued	To be submitted by bidder for approval of Engineer-in-charge	
Part B-2	Portions of Civil Designs to be issued		
Part B-3	Portions of E&M Design to be issued		

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	Rs. 2.25 Cr.
Clause 7A	
(i) Whether clause 7A shall be applicable.	Yes

Clause 8

S. No.	Details of building/infrastructure project to be completed early for use:	Remarks
1.	Administration cum Laboratory building	Simultaneously
2.	Farmers Training Hostel	
3.	Competent Authorities to inspect and issue part/final completion certificate.	Chief Engineer (GZB) CPWD, CGO -1, Hapur Road, Ghaziabad (U.P.)

Clause 8A

(i)	Authority to decide compensation on account if contractor fails to submit completion plans.	Chief Engineer (GZB) CPWD, CGO -1, Hapur Road, Ghaziabad (U.P.)

Clause 10B (ii)

Whether clause 10B(ii) shall be applicable	Yes

Clause 10B (iii)

Whether clause 10B(iii) shall be applicable	No

Clause 10CC: Applicable

a. For construction Period

S. No.	Relevant Component of Material/ Labour for price escalation	Percentage of total value of work
1	Cement Component	15%
2	Labour Component	25%
3	Civil component other construction material	20%
4	E & M (Electrical and Mechanical) component of construction materials	20%
5	POL (Diesel) component	5%
6	Reinforced steel bars/TMT bars/structural steels (including strands and cables) component	15%
	Total	100%

a. For Maintenance Period

Not Applicable**Clause 11**

Specifications to be followed for execution of work	Civil work: CPWD Specifications 2019 Volume- I & II with corrections slips up to the previous date of the last date of submission of bids. CPWD Green Rating Manual 2021 with correction slips up to the previous date of the last date of submission of bids. CPWD Hand book on Safety, Health and Environment with correction slips up to the previous date of the last date of submission of bids. CPWD Manual on Accessible Built Environment 2019 with correction slips up to the previous date of the last date of submission of bids.
	Electrical work: CPWD General Specification for Electrical Works Part I Internal - 2023. CPWD General Specification for Electrical Works (Part II External)-2023.

	CPWD General Specification for Electrical Works (Part III Lifts & Escalators)-2003. CPWD General Specification for Electrical Works Part IV Substation - 2013. CPWD General Specification for Electrical Works Part V Wet riser & sprinkler system - 2020. CPWD General Specifications for Electrical Works Part -VI Fire Detection and Alarm System – 2018. CPWD General Specification for Electrical Works Part VII DG Sets - 2013. CPWD General Specification for Electrical Works Part VIII Gas Based Fire Extinguishing System - 2013. (I) All above specifications shall be applicable with corrections slips up to the previous date of the last date of submission of bids. (II) Wherever the CPWD Specification are not given, the works shall be executed as per the additional Specification & terms & conditions mentioned in the NIT. (III) The direction of the Engineer-in-Charge shall be followed in absence of the above two at Serial No. I & II.
Building information model (BIM) is applicable	Yes

Clause 12

Deviation limit beyond which clause 12.2 and 12.3 shall apply for building work	(i) 30% of total plinth /built-up area as mentioned in Area statement. (ii) Variation / deviations up to 0.25% (zero-point two five percent) of the accepted tendered amount shall be deducted from overall variations / deviations for making payment.

Clause 16

Competent Authority for deciding reduced rates.	Chief Engineer (GZB) CPWD, CGO -1, Hapur Road, Ghaziabad (U.P.)

Clause 19 Competent Authority to decide penalty for each default– Executive Engineer- Meerut.

Clause 19C	Penalty for each default	Rs. 5,000/-
Clause 19D	Penalty for each default	Rs. 1,000/-
Clause 19G	Penalty for each default	Rs. 1,000/-
	Enhanced penalty per day for continuous default	Rs. 5,000/-
Clause 19K	Penalty for each default	Rs. 1,000/- per tradesman per day

Clause 25

(i)	Conciliator:	ADG(RL), CPWD or his successor thereof.
(ii)	Arbitrator appointing authority:	Chief Engineer (Ghaziabad), CPWD or his successor thereof.
(iii)	Place of arbitration	Meerut

Clause 32**“Requirement of Technical Representative (s) and Recovery Rates”**

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 36 (i)
	Qualification	Strength (Major + Minor component)			
1	Graduate Engineer	1 No	20 (and having experience of one similar nature of work)	Project Manager	Rs.60,000/- per Month/person
2	Graduate Engineer	2+1 Nos	12 (and having experience of one similar nature of work)	Deputy Project Manager	Rs.40,000/- per Month/ person
3	Graduate Engineer or Diploma Engineer	4+2 Nos	5 or 10 respectively	Project/site Engineer	Rs. 25,000/ per month/ person

4	Graduate Engineer	1+1 Nos	08 (and having experience of one similar nature of work)	Quality Engineer	Rs. 25,000/ per month/ person
5	Diploma Engineer	1 Nos	08 (and having experience of one similar nature of work)	Surveyor	Rs. 15,000/ per month/ person
6	Graduate Engineer	1+1 Nos	06 (and having experience of one similar nature of work)	Project planning /billing Engineer	Rs. 20,000/ per month/ person

Note:

Assistant Engineers retired from Government services, who are holding Diploma will be treated at par with Graduate Engineers. Diploma holder with minimum 10-years relevant experience with a reputed construction company can be treated at par with Graduate Engineers for such deployment subject to the condition that such diploma holders should not exceed 50% of requirement of degree engineers. The Bidder shall submit a certificate of 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 of regular physical availability of such engineers on the above project if at any times so required by the Engineer-in-charge.

Minimum recovery for not deploying Building information Model (BIM) professional shall be Rs. Three Lac per month.

Clause 38

- (i) (a) Schedule/statement for determining theoretical quantity of cement & bitumen on the basis of **Delhi Schedule of Rates 2023** printed by CPWD with up-to-date correction slips till last date of submission of tender.
- (ii) Variations permissible on theoretical quantities:
 - a) Cement
 - (i) For works with estimated cost put to 3% plus/minus tender not more than Rs. 25 lakhs
 - (ii) For works with estimated cost put to 2% plus/minus tender more than Rs 25 lakh
 - b) Bitumen for all works. 2.5% on plus side only & nil on minus side
 - c) Steel Reinforcement and structural steel sections for each diameter, section and category. 2% plus/minus
 - d) All other materials. Nil

Schedule of Recovery

S.N.	Descriptions	Recovery Rate	Reference
1.	Obtain ERP (Enterprise Resource Planning) Training from CPWD, as applicable, within Two months from the date of receipt of award	Rs. 1,000/- per week	Para 1 (S) Page No. 18
2.	Monthly recovery for delay in submission of the monthly progress report within specified period	Rs. 50,000/- per month	Note below Table of Mile Stones Page No. 76
3.	Minimum recovery for not deploying Building information Model (BIM)	Rs. 3,00,000/- per month	Note Below Clause 32 Page No. 81
4.	Recovery for not providing Inspection Vehicles	Rs. 70,000/- per number	Note: Point no. 5. Page No. 91
5.	One technical representative of consultant/architect will always be available at site during execution of work	Rs. 50,000/- per month	Note: Page No. 146
6.	For non-using of corrosion resistant steel bar (The agency should take prior permission for not using Low alloy/ CR Steel from competent authority)	Rs. 6.00 per Kg or difference between CRS bars & TMT bars based on the actual invoices given by the contractor/prevaling market rates, whichever is higher	Page No. 179
7.	Anywhere else mentioned in the NIT	As per NIT	As per NIT



भारत सरकार
केंद्रीय लोक निर्माण विभाग
तकनीकी अनुप्रयोग एवं मानक एकाई
कमरा सं० 418 ए-विंग, निर्माण भवन, नई दिल्ली।
टैलीफ़ैक्स-011-23062339 ईमेल-delsetascsq.cpwd@nic.in



F. No. 17/SE(TAS)/BMTPC/2022/ 105-180

Dated: 24/03/2022

कार्यालय ज्ञापन

Subject: Adoption of New & Emerging Technologies in construction works undertaken by CPWD- reg.

Reference:

1. OM No. 133/SE(TAS)/DSR/2018-19/464-H dated 06.11.2018
2. OM No. 133/SE(TAS)/DSR/2018-19/519-H dated 16.11.2018
3. OM No. 133/SE(TAS)/DSR/2018-19/16-H dated 07.01.2019
4. OM No. 133/SE(TAS)/DSR/2019/115-H dated 12.03.2019
5. OM No. 17/SE(TAS)/BMTPC/2019/531-E dated 03.04.2019
6. OM No. 133/SE(TAS)/DSR/2019/376-H dated 17.09.2019
7. OM No. 17/SE(TAS)/BMTPC/2020/381-H dated 23.09.2020

Structural system of any building is based on the capacity of the materials used to bear the imposed loads and vulnerability of the site where the structure is to be constructed. Above referred OMs were issued from time to time to authorize use of new and emerging technologies in public works. In order to streamline and in supersession of above OMs, it is now decided to categorize these technologies as per structural systems into Permanent Structures-Concrete and Steel Structural Systems Table-1A & 1B respectively, Semi-permanent Structures-Structural Systems Table-2 and Construction Materials Table-3. The Tables 1A, 1B & 2 also show the suitability of the technology with respect to seismic zone and restrictions on number of storey for each technology for guidance.

Table-1A
Permanent Structures- Concrete Structural System Technologies

S. No.	Name of Technology	Seismic zone Suitability	Maximum number of Storeys
1	2	3	4
	A. Precast Concrete Construction Systems		
1	Pre-cast concrete system with columns, beams, walls, slabs, hollow core slabs & also 3D Volumetric components- Technology needs special transport logistics	All zones except zone V	Any number
2	3D Modular casting using steel mould and high performance concrete of building modules in factory. These modules are transported to the construction site & assembled - Technology needs special transport logistics	All zones except zone V	Any number
3	Modules with 3D volumetric precast concrete unit, various units make a house - Technology needs special transport logistics	All zones except zone V	Any number
4	Precast Large Concrete Panel (PLCP) system with structural members (wall, slab etc.) cast in a factory / casting yard and brought to the building site for erection & assembling	All zones except zone V	Any number
5	Industrialized 3-S system using RCC precast with or without shear walls, columns, beams, Cellular Light Weight Concrete Slabs/Semi-Precast Solid Slab.	All zones except zone V	Any number

6	Pre-cast sandwich panel system & light weight precast concrete slab (Wall is sandwich panel comprising of structural concrete inside panel, insulation layer & finishing external layer) Light weight concrete slab (comprises of bottom concrete / mortar layer, Light weight concrete blocks & reinforcement & in-situ concrete)	All zones except zone V	Any number
7	Large Hollow wall prefab concrete panel (Lightweight, interlocking, concrete panel) using factory produced large standard hollow interlocking concrete block	All zones except zone V	Any number
B. Cast-in-Situ Structural Systems			
8	'Tunnel form' construction technology, a cast-in-situ RCC system, based on the use of high-precision, re-usable, room-sized, steel forms or moulds for monolithic concrete construction	All zones	Any number
9	Monolithic Concrete Construction system using Aluminum formwork	All zones	Any number
10	Monolithic Concrete Construction system using Plastic Aluminum formwork	All zones	Any number
11	Deleted		
12	Factory Produced PVC stay in place formwork with in-situ concrete & reinforcement in walling units and cast-in-situ RCC Slab	All zones	Any number
13	Stay in place preassembled PVC wall forms along with cast-in-situ RCC slab	All zones except zone V	Any number
14	Structural Stay in Place Galvanized Steel formwork system for walling with the same bottom single layer formwork for slabs/in-situ slab	All zones except zone V	G+3
C. Others			
15	Use of confined Masonry	All zones	G+3

Table-1B
Permanent Structures- Steel Structural System Technologies

S. No.	Name of Technology	Seismic zone Suitability	Maximum number of Storeys
1	2	3	4
D. Steel Structural systems			
16	Prefabricated Steel Structural systems with appropriate wall system -PEB- Pre-Engineered Buildings using a combination of built-up sections, hot rolled sections and cold formed elements with various options for walling & flooring	All zones	Any number
17	Factory made fast track modular building system -Hot rolled steel frame structure with different walling components	All zones	Any number
18	Speed floor System- Hot rolled steel frame with speed floor	All zones	Any number
19	Hot rolled steel section / frame with prefabricated fibre reinforced sandwich panels.	All zones	Any number

Table-2
Semi-Permanent Structures-Structural System Technologies

S. No.	Name of Technology	Seismic zone Suitability	Maximum number of Storeys
1	2	3	4
E. Light Gauge Steel Structural System			
20	Light Gauge Steel Framed Structure (LGSFS)	All zones except zone V	G+3

21	Light Gauge Steel Frame structure with infill concrete Panel—the light weight concrete (using a special mixing & pumping machine) is filled in between two prefabricated concrete panels	All zones except zone V	G+3
F. Precast Concrete Construction Systems			
22	Vertical Structural modules cast in plant/casting yard are assembled together through casting of floor panel at site-Technology needs special transport logistics	All zones except zone V	G+3
23	Prefabricated interlocking Technology (without mortar) with Roofing as Mechanized Precast R.C. Plank & Joist system	All zones except zone V	G+3
G. Cast-in-Situ Structural Systems			
24	Expanded-steel panel reinforced with all-galvanized steel wire-Struts serving both as load-bearing steel structures and as stay-in-place steel formwork filled with EPS-alleviated concrete	All zones except zone V	G+3
25	Factory made prefab Glass fibre reinforced Gypsum (GFRG) cage panels suitable for wall & slab with reinforcement & concrete in cavities as per the requirement	All zones with specified restrictions on number of storeys	1. G+9 for all seismic zones except seismic zone IV & V 2. G+5 storeys in seismic zone-IV & V.
26	Fully Load bearing walls with 150 mm monolithic concrete core sandwiched inside two layers of EPS as walling. The forms are open ended hollow polystyrene interlocking blocks which fit together to form shuttering system	All zones with specified restrictions on number of storeys	1. Higher than G+3 as per structural design for all seismic zones except seismic zone V 2. G+3 storeys in seismic zone-V.
27	Fast Bloc, insulated Concrete Form (ICF), acting as formwork for concrete and rebar, Column/post and beam construction, creating a strong skeleton in the walls	All zones with specified restrictions on number of storeys	1. Higher than G+3 as per structural design for all seismic zones except seismic zone V 2. G+3 storeys in seismic zone-V.
28	Formwork system "Plaswall" with Two fibre cement boards (FCB) & HIMI (High Impact Molded Inserts) bonded between two sheets of FCB and erected to produce a straight-to-finish wall with in-situ concrete	All zones with specified restrictions on number of storeys	1. Higher than G+3 as per structural design for all seismic zones except seismic zone V 2. G+3 storeys in seismic zone-V.

H. Prefabricated Panel System			
29	Advanced building system-EMMEDUE – Factory made panels consisting of self-extinguishing expanded EPS sandwiched between two welded high strength galvanized wire fabric mesh	All zones except zone V	G+ 3
30	Rapid panels–It is a prefabricated assembly of high-strength steel wire, which is bent into a zig-zag shape	All zones except zone V	G+ 3
31	Reinforced EPS Core Panel System	All zones except zone V	G+3
32	Concrewall panel system	All zones except zone V	G+3
33	Bau panel system	All zones except zone V	G+3
34	Fly ash EPS (Beads) cement sandwich panels	All zones except zone V	G+1
35	Pre-fab PIR (Poly-isocyanurate) based Dry wall panel system as non-load bearing wall- Suitable with Steel frame.	All zones	G+1
36	SRPL Building System (Waffle- Crete)	All zones except zone V	G+3
37	Robomatic Hollow concrete wall panel	All zones except zone V	G+1
38	Wall tech Hollow core concrete panel	All zones except zone V	G+1
39	Quick Build 3D panels	All zones except zone V	G+3
40	EPS Cement sandwich wall/roof/floor light weight solid core panel	All zones except zone V	G+1
41	Sandwich panels as wall & slab	All zones except zone V	G+3

Note: Any Prefabricated panels can be used as non load bearing partitions, paneling etc. in steel frame or RCC frame buildings irrespective of number of storeys depending upon the design and functional requirements.

Table-3
Construction Material Technologies

S. No.	Name of Technology
42	Use of self compacting concrete
43	Use of C&D waste Products in Constructions
44	Block Masonry using AAC blocks
45	Brick Masonry using fly-ash bricks
46	Reinforced soil Technology using Technical Textiles
47	Stamping Concrete
48	Rigid EPS (Cellular plastic material) blocks
49	Crushed Sand (As per IS 383 :2016 amended from time to time)
50	Manufactured Sand (The extent of utilization shall be as per IS 383:2016 amended from time to time).

Note:

- G+3 may be read as "Ground storey (stilt is ground storey) plus three storeys above ground storey.
- Basements, if to be provided, shall invariably be of cast-in-situ reinforced cement concrete.
- Seismic zone suitability and number of storey restriction is based on MoHUA OM No. I-11019/05/2019-HFA-V-UD-(FTS-9058698) dated 28.05.2019 & BMTPC OM No. BMT/ED/Misc./2021 dated 24.11.2021, BMTPC PACS of corresponding technology and BMTPC publications.

4. As per NDMA guidelines on Hospital safety; flat slab, pre-stressed floor systems, precast construction, pre-engineered structures, large cantilever, long span and unreinforced masonry structural systems shall be prohibited for use in new hospitals.
5. This OM shall be applicable for NITs uploaded /invited after the date of issue of OM.

This issues with the approval of competent authority.

केलोनवि तथा लोनवि दिल्ली के सभी अधिकारियों को आवश्यक सूचना एवं कार्यवाही हेतु।
(केलोनवि वेबसाईट के माध्यम से)

g/c

Divakar
(दिवाकर अग्रवाल)

अधीक्षण अभियंता(टास)

W
24/03

Appendix-I

ESTABLISHING SITE LABORATORY AND TESTING OF MATERIALS

Equipment's for conducting necessary tests (as per CPWD Specifications 2019 Volume-I) shall be provided and installed at site in the well-furnished site laboratory by the agency at his own cost. The following laboratory equipment should be in general or as and when required be set up at site laboratory: -

S.No.	Equipment	Numbers
1.	100MT compression testing machine, electrical-cum-manually operated)	1
2.	Slump cone, steel plate, tamping rod, steel scale, scoop	10
3.	Vicat Apparatus with Desk pot	3
4.	Megger & earth resistance tester	3
5.	Pumps and pressure gauges for hydraulic testing of pressure Pipes	2
6.	Weighing scale platform type 100 Kg capacity	As per requirement
7.	Graduated glass measuring cylinder	As per requirement
8.	Sets of sieves of 450mm internal dia. for coarse aggregate [100mm, 80mm, 40mm; 2mm; 12.5mm, 10mm; 4.75mm complete with lid and pan]	3
9.	Sets of sieves of 20mm internal dia. for fine aggregate [4.75mm; 2.36mm; 1.18mm; 600 microns; 300 microns & 150 microns, with lid and pan]	3
10.	Sieve Brushes and sieve shaker capable of 20mm and 300mm dia. sieves, manually operated with timing switch assembly	3
11.	Cube mould size 70mmx70mmx70mm	30
12.	Cube mould size 150 mm x 150 mm x 150mm	30
13.	Ultrasonic Test Equipment (For concrete)	3
14.	Hot air oven temp. Range 50°C to 300°C- sensitivity 1 degree	3
15.	Electronic balance 600gx0.1g., 10kg and 50 kg	3
16.	Physical balance weight up to 5 kg	3
17.	Digital thermometer up to 150oc	4
18.	Air Content of concrete testing machine	As per requirement
19.	Measuring jars 100ml, 20ml, 500ml	5 Nos each size
20.	Gauging trowels 100mm & 20mm with wooden Handle	12
21.	Spatula 100mm & 20mm with long blade wooden handle	12
22.	Vernier callipers 12" & 6" size	6 each
23.	Digital PH meter least counts 0.01mm	6 each
24.	Digital Micrometre least count. 0.01mm	6 each
25.	Digital paint thickness meter for steel 500 microns Range	3
26.	GI tray 600x450x50mm, 450x300x40mm, 300x250x40mm	3 Nos each

27.	Electric Motor mixer 0.25 cum capacity	4
28.	Rebound hammer test digital rebound hammer	4
29.	Screw gauge 0.1mm-10mm, least count 0.05	6
30.	Water testing kit	3
31.	Motorized sieve shaker	3
32.	Pruning Rods 2 Kg weight length 40 cm and ramming face 25 mm ²	4
33.	Extra Bottom plates for 15 cm cube mould	30
34.	Standard Vibration Table for gauging the cubes	2
35.	Pocket concrete penetrometer 0 to 50kg/ sq.cm	2
36.	Concrete temperature measuring thermometer with Brass protection sheath 0- 100 degree centigrade	4
37.	Mortar Cube vibrator	2
38.	Dial type spring balance preferable with zero correction knob capacity 100 kg. reading to ½ kg.	2
39.	Counter scale capacity 1 kg and 10 kg	2
40.	Iron Weight of 5 kg, 2 kg, 1 kg, 500 gm, 20 gm, 100 gm	2 each
41.	Brass Weight of 50 gm, 2 gm, 10 gm, 5 gm, 2 gm, 1 gm	2 each
42.	Measuring cylinder TPX or Poly propylene capacity 100 ml, 500 ml, 250 ml, 100 ml	2 each
43.	Pyrex, corning or Borosil beakers with cover capacity 500 ml, 20 ml, 50 ml	3 each
44.	Wash Bottles capacity 500 ml	12
45.	Thermometers 1-100 degree centigrade / max. and Min/ Dry and wet with table	6
46.	Set of box spanner ratchet	3
47.	Hammer 1lb & 2lb	3 each
48.	Distance metre (of 100 metre)	2
49.	Hacksaw with 6 blades	3
50.	Measuring tape (5 metre)	4
51.	Depth gauge 2 cm	6
52.	Shovels& Spade	6
53.	Steel plates 5 mm thick 75x75 cm	6
54.	Plastic or G.I. Buckets 15 Liter, 10 Liters, 5 Liters	3 each
55.	Wheel Barrow	12
56.	Floor Brushes, hair dusters, scrappers, wire brush, paint brushes, shutter steel plat oil, kerosene with stove etc.	12 each
57.	Any other equipment for site tests as outlined in BIS codes and as-directed by the Engineer-in-charge.	

Appendix-II

LIST OF MINIMUM PLANT AND EQUIPMENT REQUIRED AT SITE

Sl. No.	Equipment	Numbers
1.	Builders hoist	2
2.	Centralized concrete batch mix plant of capacity 30 cum per hour (fully automatic with computer control and computerised batch slip arrangement) and RO plant for water.	1
3.	Excavator cum loader (JCB 3D model or equivalent).	As per requirement
4.	Compressor machine minimum 20 CFM with rock Breaker.	As per requirement
5.	DG set of minimum capacities of 62.5 KVA.	As per requirement
6.	Mini batching plant (6 cum./hr.).	2
7.	Transit mixers.	As per requirement
8.	Concrete pump	As per requirement
9.	Needle Vibrators.	05
10.	Screed leveller.	05
11.	Plate Vibrator	05
12.	Automatic Ring making machine (Reinforcement)	As per requirement
13.	Dumper/Tipper	
14.	Reinforcement bending machine & Rebar tying machine	
15.	Reinforcement cutting machine.	
16.	Power driven earth rammer (Soil compactor).	
17.	Total station.	
18.	Water tanker (Minimum capacity of 5000 Liters)	
19.	Welding machine 400 Ampere	
20.	Screener for coarse sand and fine sand	
21.	Centrifugal mono block water pump minimum capacity 2 HP	
22.	Road roller 8 to 10 tons	
23.	Vibratory roller	
24.	Drilling machine	
25.	Shuttering with necessary props	5000 sq.mt.
26.	Double steel scaffolding and staging materials	5000 sq.mt.
27.	Air compressor	As per requirement
28.	Floor grinding/polishing machines	
29.	Granite cutting machine	
30.	Ceramic tile cutting machine	
31.	Granite polishing machine	
32.	Granite hand polishing machine	
33.	Automatic rendering/plastering machine	
34.	Mobile tower crane	
35.	Software- AutoCAD latest version for CPWD office	
36.	Structural Design software on which structural design shall be submitted by Agency for use of CPWD	02 Nos.

37.	Inspection Vehicles XUV/SUV along with driver, fuel and maintenance of vehicle for CPWD having compliance with BS 6 norms	02 Nos.
38.	Laser Distance Meters 300 feet range and Bluetooth enabled for CPWD Engineers	04 Nos
39.	Any other machinery required for completion of the work as per decision of Engineer-in-charge.	As per Actual requirement

Note:

1. The above list is only indicative and not exhaustive. The Bidder may be required to deploy more T&P as per requirement of work.
2. All the above plants & Equipment are to be deployed as and when required or as directed by Engineer-in-Charge.
3. Recovery for not providing Inspection Vehicles will be Rs. 70,000/- per month per vehicle.

Rules for working out plinth area from plans

Calculation of Plinth Area

- 1.1 Measurement will be done on the basis of actual plinth area constructed. Guidelines to calculate plinth area shall be as per PAR 2025 is which is reiterated below, However the modifications from the PAR provisions for working out are for payment purpose is given in notes below the images of PAR Provisions

Plinth Area Rates 2025

ANNEXURE-V**GUIDELINES FOR WORKING OUT PLINTH AREA**

(As per IS: 3861-2002 with upto date amendments as may be issued from time to time)

In order to ensure the adoption of a uniform method of working out Plinth Area from plans, the following guidelines are laid down. These guidelines are general in nature. These are based on the fundamental principle that the plinth area of a building should present a true picture of the covered floor area provided in the plans.

1. Terminology**1.1 Plinth Area :**

The plinth area shall mean the built-up covered area measured at the floor level of basement or of any storey.

1.2 Balcony :

A horizontal projection with a hand-rail, balustrade or a parapet.

1.3 Mezzanine Floor:

An intermediate floor in between two main floors having minimum height of 2.2 m from the floor and having a proper and permanent access to it.

Note: Where rules of the local bodies permit intermediate floor of minimum 1.8 m clear height, may also be considered as mezzanine floor for the purpose of measurement.

1.4 Mumty (Stair Cover) :

It is a structure with a roof over a staircase and its landing, built to enclose only the stairs for the purpose of providing protection from weather and not used of human habitation.

1.5 Loft

A structure providing, intermediate storage space in between two main floors without having a permanent access and at a height not less than 2.0 m from the floor below.

1.6 Porch

It is a covered structure supported on pillars or otherwise for the purpose of pedestrian or vehicular approach to a building.

2. General

2.1 Linear measurement shall be measured to nearest 0.01 m, and areas shall be worked out to the nearest 0.01 m²

2.2 The areas of each of the following categories shall be measured separately and shall not be clubbed together so as to enable the cost computation at different rates per unit area as worked out for varied heights or categories.

- a) Basement
- b) Floor without cladding (stilted floor)
- c) Floors including top floor which may be partly covered;
- d) Mezzanine floor including additional floor for seating in assembly building/theatre, auditorium etc.
- e) Garage
- f) Accommodation for service staff
- g) Mumty (Stair cover)
- h) Machine room
- i) Porch
- j) Towers, turrets, domes projecting above the terrace level at terrace.

3. Method of measurement of Plinth Area

The total Plinth area shall be the sum total of built up covered areas measured at each floor level of the buildings for the categories mentioned under 3.1 below and excludes the areas given in 3.2

Plinth Area Rates 2025

3.1 For the purpose of plinth area, following shall be included:

- a) Area of the wall at the floor level excluding plinth offsets, if any; when the building consists of columns projecting beyond cladding, the plinth area shall be taken upto the external face of cladding (in case of corrugated sheet cladding outer edge of corrugation shall be considered) (Refer sketch-1)

Note: In case, a common wall is owned jointly by two owners, only half the area of such walls shall be included in the plinth area of one owner.

- b) Shafts for sanitary, water supply installations, garbage chute, telecommunication, electrical, fire-fighting, air-conditioning and lifts.
- c) Stair case: Main stair case, open spiral/service stair case/fire escape stair case etc.
- 100 percent of the plan area of main / service / fire escape stair (enclosed in defined stair hall and mummy at top)
 - 50 percent of the plan areas of service /fire escape/ open stairs (without any enclosure around and mummy at top).

Note:- Any type of steps, ladder/cat-ladder, spiral/flat, with or without side guard rails created for the purpose of approaching inaccessible terrace or from terrace to top of bulk water storage tanks or otherwise for maintenance purposes shall not account for plinth area.

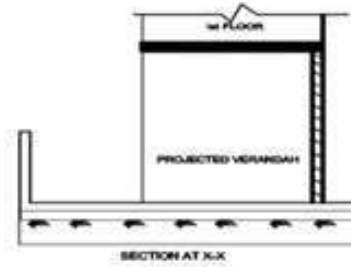
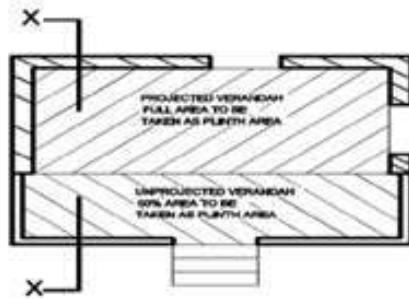
- d) In case of open verandah with parapets (Refer sketch-2):
- 100 percent areas for the portion protected by the projections above, and
 - 50 percent area for the portion unprotected from above.
- e) In case of balcony projections with railing / parapets (Refer sketch-3):
- 100 percent area of the balcony covered by projection above
 - 50 percent area of the uncovered balcony
- f) In case of alcove made by cantilevering a slab beyond external wall:
- 25 percent of the area for the alcove of height upto 1 m.
 - 50 percent of the area for the alcove of height more than 1 m and upto 2 m, and
 - 100 percent of the area for the alcove of height more than 2 m.
- g) Mezzanine floors shall be measured as different floor levels with deduction for lesser floor heights than the standard heights.

3.2 The following shall not be included in the plinth area

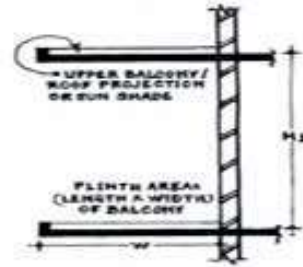
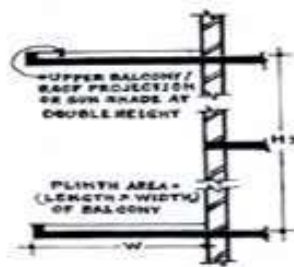
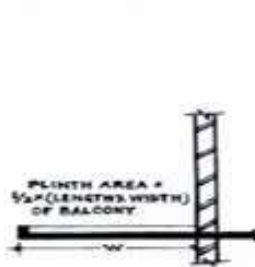
- Area of loft
- Area of architectural band, cornice, etc.
- Area of vertical sun breaker or box louvre projecting out and other architectural features, for example slab projection for flower pot, etc. (Refer sketch-5)
- Terrace
- Open platform on ground
- Towers, turrets, domes projecting above terrace level.
- Area of mummy and machine rooms (Refer sketch-4)



Sketch -1



Sketch -2

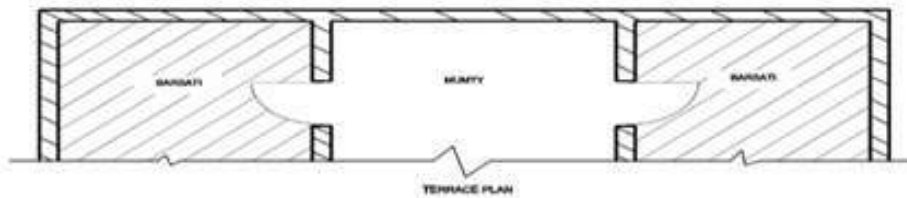


Uncovered balcony

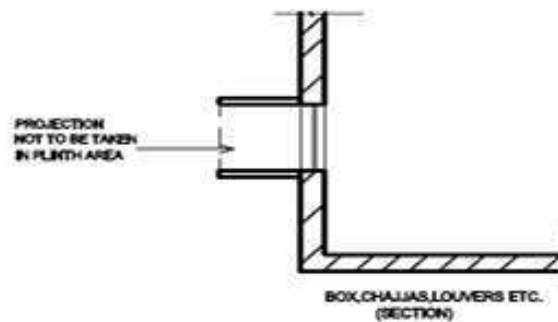
Covered balcony

H-1 refers to floor height & H-2 refers to double the floor height in case of staggered balconies.

Sketch -3



Sketch -4



Sketch- 5

Notes (Over and above the norms given above for the Purpose of Payment):

- I) Area of the covered/ uncovered ramps/ Steps/ platform/ covered parking in and around building (and also on service floor) and substation building joining roads/ pathways to the building shall not be measured separately and their rates are inclusive in Rates of respective building.
- II) Rates of development work including levelling, Internal development work with paver blocks, external Bituminous Road, Path, Covered Parking, Sewerage, filtered water supply, storm water drain, Rain Water Harvesting, Trenches of services, external connections of all services, etc. are included in the rates of building and shall not be paid separately.

PART-B

CHAPTER-A

Scope & Specifications of Planning and Designing

SCOPE OF WORK

Brief particulars of the work

1. Admin cum Laboratory building and Farmer Training hostels are to be constructed **at Babugarh, Hapur, (UP)**. This area falls under the jurisdiction of Hapur, Pilkhuwa Development Authority, Hapur (UP.) The location plan is as under:



2. The present tender is for **“Planning, Design and Construction of** Administration cum Laboratory building (G+6), Farmers Training Hostel(G+1) & Land development 1,05,200sqm (approximate) at Site A.
The scope of work includes related external development works and other allied works on Engineering, Procurement and Construction (EPC) basis within controlled architectural parameters. The details of complete scope of work are covered in this tender document.



3. The EPC Contractor has to design the building on the basis of Conceptual Architectural design and Architectural Plan and minimum acceptable specification of buildings available in the NIT documents by adopting the latest technologies available in the OM No.:
4. The execution will be done on the basis on design, planning, drawings and details of works, to be prepared by the EPC Contractor himself or by the Compressive Architectural Consultant associated by the him. The complete proposal shall be got approved from CPWD before start of the execution work at site.
5. The scope of work includes architectural design, structural design, and design of all required Civil, E & M services, Laboratory furniture & horticultural services and design of all required services, obtaining permission for Tree Cutting / or Translocation of Trees required as per site conditions, obtaining mandatory approvals from local bodies/authorities required for commencing the work, execution of work & services, subsequently handing over of the assets after making them habitable in all aspects and operation, maintenance for one year during defect liability period of three years and further the work is to be executed on EPC (Turn Key) basis.
6. The scope is inclusive of topographic survey, Geo-technical soil investigation and all Preparatory / Ancillary works. The cost of labour, material, tools and plants and machinery required for execution of the whole project as per approved Layout plan & detailed design and drawings is in the scope of this work. The buildings are to be constructed to meet FIVE STAR GRIHA/ Equivalent CPWD GHAR Green rating and conforming to UPECBC code 2017 amended up to date and obtaining the certification of the same.
7. The sub soil investigation provided here in is indicative, tentative for guidelines purpose only. The EPC Contractor has to carry out his/ their own independent sub soil investigation at the stated site location to ascertain the actual site soil parameters to determine the required engineering properties for deciding the structural system and design thereof along with the availability of ground water table and impact thereof to the structural components of building including lateral structural frame work, if any, required from slope stability consideration. However, the lower of the SBC values out of given in the attached indicative soil investigation report with tender documents and soil investigation reports carried out (up to 15m depth by the contractor is to be followed for structural design.
8. The scope is inclusive of topographic survey, sub soil investigation and all ancillary works. The Agency is required to connect all the external services like Water Supply, Sewerage, Drainage, Electric Supply, LAN, Telephone Lines etc. to the main lines of the authorities/service providers like HAPUR PILAKHUWA DEVELOPMENT AUTHORITY/BSNL or any other agency and this shall be considered as integral part of

Scope of work and deemed to be included in the quoted price of the agency. The Agency shall obtain all the mandatory approvals including occupation and completion certificate from concerned local Authorities. The department will make the payment of any such fees likely to be paid to local authorities. The drawings details etc shall be supplied by the agency, the responsibilities to obtain occupancy certificate rest with the agency or any other document required to declare all assets eligible for bringing it in use. The cost of labour, material, tools and plants and machinery required for execution of the whole project as per approved Layout plan & detailed design and drawings is within the scope of this work.

9. All works has to be executed as per specifications provided in the bid document, CPWD Specifications-2019 Vol-I & II and National Building Codes 2025, (in case of difference if any, stringent / higher specification of the two shall be followed. In absence of CPWD Specification, IS Codes, MoRTH Specifications, National Building Code 2025, Specifications, PWD Specifications & sound engineering practices and other standard specifications suitable for modern Administration cum Laboratory building and Farmers Training Hostel and latest technology shall be adopted as per order of precedence defined in the contract.
10. The scope of works & specifications is given in general but they are not exhaustive i.e. does not mention all the incidental works required to be carried out for complete execution of the work. The work shall be carried out, all in accordance with true intent and meaning of the specifications and the drawings taken together, regardless of whether the same may or may not be particularly shown on the drawings and/ or described in the specifications, provided that the same can be reasonably inferred there from.
11. There may be several incidental works, which are not mentioned in the contract document/specifications but will be necessary to complete the item and make it functional in all respect. All these incidental works/ costs which are not mentioned, but are necessary to complete the work shall be deemed to have been included in the overall amount quoted by the contractor for various components of work. No adjustment of rates shall be made for any variation in quantum of incidental works due to variation/change in actual working drawings. Also, no adjustment of rates shall be made due to any change in incidental works or any other deviation in such element of work (which is incidental to the items of work and are necessary to complete such items in all respects) on account of the directions of Engineer-in- charge. Nothing extra shall be payable on this account.
12. In case, some of descriptions are missing in the scope of work or specifications in the bidding document, works shall be executed as given in the CPWD Specifications, NBC-2025, BIS Codes or according to sound engineering practices so as to make the building including related services fully functional. No claim what so ever may be entertained at later stage. All cost of providing and making buildings with services fully complete in all aspect unless specifically

mentioned in the contract document and making buildings with services fully functional are included in the cost tendered for this work.

13. All cost of providing and making buildings with services fully complete in all aspect unless specifically mentioned in the contract document and making buildings with services fully functional are included in the cost tendered for this work.
14. The Contractor shall have to use properly designed barricading system of MS Framework with Galvanised sheets to barricade the all around of 26 acre proposed develop area and the cost of same deemed to be inclusive in the overall contract cost. The height of such barricading system should not less than 6 metre or confirm to the latest CPCB/SPCB and NGT Guide lines whichever is higher. Such barricading shall only be removed from the premises after completion of the work.
15. The Technical Specifications, Drawings and conditions for each component like Civil, Electrical, Plumbing, Fire, STP, ETP, External Development, Landscape, Street lighting, Lift, Pressurization etc. are elaborated in this tender document.
16. The Design Basis Reports are the minimum standards that the construction agency has to fully comply with. If there is any change or departure from DBR/s, the same shall be got approved from CPWD.
17. The Agency is required to complete the project on EPC (Turn-Key) basis within controlled architectural norms as mentioned in the Scope of Work, Technical Specifications & Architectural Drawings including development of entire site area shown in drawings attached with this document in Vol. III.
18. The scope of work is to complete in all respect including services and rates quoted by the Agency shall be considered for entire scope of work which includes all activities/work starting from the given concept to completion till handing over of completed project in habitable state from all perspective.
19. The defect liability period shall be three years after acceptance of original work as complete by the competent authority. The Agency is required to connect all the external services like Water Supply, Sewerage, Drainage, Electric Supply, LAN/WAN, Telephone Lines etc. to the main lines of the authorities/service providers like Nagar Palika, HAPUR PILAKHUWA DEVELOPMENT AUTHORITY, (UP)/BSNL or any other agency and this shall be considered as integral part of Scope of work and deemed to be included in the quoted price of the agency. The Agency shall obtain all mandatory approvals including "Occupation and Completion" or any other document required to declare all assets eligible for bringing it in use. The fees payable to local bodies for such approvals shall be paid by the departments.

20. It shall be deemed that the Agency has satisfied himself with the nature and location of the work, general and local conditions and particularly those pertaining to transport including restriction of movement of traffic/ vehicles etc., handling, availability and storage of materials, availability of labour, weather conditions at site and general ground/sub soil conditions. Agency is expected to quote their rates accordingly and nothing extra shall be payable for any reason/s whatsoever it may be.
21. CPWD shall bear no responsibility for the lack of such knowledge and also the consequences thereof to the Agency. The information and site data shown in the drawings and mentioned in the tender documents are furnished for general information and guidance only. The Engineer-in-Charge in no case shall be held responsible for the accuracy thereof or/and deductions, interpretations or conclusions drawn there from by the Agency and no claim shall be entertained whatsoever on this account; if the site conditions/information is different or otherwise incorrect. It will be presumed that the Agency has satisfied himself for all possible contingencies, situations, bottlenecks and acts of coordination which may be required between the different agencies. Neither any hindrance shall be entertained because of these constraints if so, occurs at any stage.
22. The Planning, Design and Construction of Admin cum laboratory building, Farmer training hostel along with Land development 1,05,200 sqm (approximate) at Site A has been planned in single phase, therefore, the work/s for above may be taken up in parallel. Accordingly, Agency shall plan parallel construction of all blocks as per directions of Engineer-in-charge.
23. The Layout Plan, location of Administration cum Laboratory building and Farmers Training Hostel, designs and soil test report, forming part of this NIT are indicative only. There can be changes in the scope of work as per requirement of Local body, HAPUR PILAKHUWA DEVELOPMENT AUTHORITY, Fire Services etc. Agency shall carryout such changes which occur due to Building byelaws or statutory requirements.
24. Design of all civil, electrical, mechanical, horticulture, office furniture, & design of laboratory Furniture for all labs (**furniture to be provided only in Nine typical laboratories in this work**) and their integration and installation and commissioning. Development of area, social infrastructure, internal roads, Street lighting, Parks, Cycle track and other amenities etc. required for safe living including following the instructions of CPWD (Central Govt.)/Nagar Palika/HAPUR PILAKHUWA DEVELOPMENT AUTHORITY etc. for connections of internal roads with public roads.

Although furniture is to provide in nine designated typical labs of admin building but services including civil & electrical are so designed and provided considering all labs would be functional.

25. Obtaining FIVE-Star GRIHA/Equivalent GHAR rating. Agency is obliged to follow directions given by the competent authority/s while giving Environment Impact clearance.
26. Site shall be Handed over to the Agency on as & where it is basis. All existing assets for the purpose of demolition shall be handed over with fixtures in the existing structures / premises except the property of service providers such as city services passing through the site such as property of BSNL, Nagar Palika, HAPUR PILAKHUWA DEVELOPMENT AUTHORITY, IGL etc. Guidelines issued from time to time by the competent authority for demolition and handling of C & D waste if required shall be followed by the Agency for which nothing extra shall be payable.
27. Construction of all Civil, Electrical, Mechanical, their integration and installation and commissioning including development of area, internal roads, street lighting, parks and other amenities etc. as required having compliance to the relevant statutory norms, compliances, functionality and safety requirement etc. are in the scope of building.
28. Structural Design of the building and design of all civil, electrical & mechanical and required to make the building functional. The structural design of the building structure should be compliant to all latest modifications, corrigendum, addendum of the relevant BIS Codes in general i.e. IS : 456 IS 1893:2016, 13920:2016, IS 800-2007 and other relevant BIS Codes with up-to-date revisions. Thought process of the structural design needs to be adequate enrichment of handling the complex structure of life period sustenance by iteration process of dynamic modelling behaviour of the building to avoid resonance. Structural Design prepared by the agency shall be got vetted by civil engineering department of any IIT.
29. Execution of the works and construction as per approved drawings, design and plans as well as obtaining clearances required for occupation of the building from the local bodies and three years of defects liability period from Date of Completion.
30. A copy of the interim soil investigation report of the site of proposed buildings is also attached. The report is indicative only in nature to give a general idea of the soil characteristics in the area and for guidance purpose only. The Contractor needs to conduct detail survey and soil investigation of the site after award of work.
31. The agency shall also retain the 200 mm top layer of earth for its utilization as per GRIHA Norms.
32. Sub-Soil ground water table may vary. The water level may vary due to rainy season or due to dewatering etc. In order to avoid possibility of building being getting uplifted/damaged due to water pressure, the contractor shall make adequate arrangement for pumping out the water to lower the ground water table below the proposed foundation level as approved by Engineer-

in-charge. Sub soil water table shall be maintained at least 50 cm below the P.C.C. level during lying of P.C.C., water proofing treatment, lying of raft foundation including filling of required depth of earth/sand. The water table shall not be allowed to rise above base of raft level until completion of outer retaining walls including water proofing of vertical surface of walls and back filling along the walls and until the structure attains such height to counterbalance the uplift pressure. Rate of all items are inclusive of pumping out or bailing out water, if required. Nothing extra on this account whatsoever shall be paid to him unless otherwise specified. The sequence of construction shall be got approved from the Engineer-in-charge. The EPC contractor need to take all safety precautions by using properly designed diaphragm wall / sheet pile works or other alternate arrangement duly got proof check from any IIT to avoid any caving in of the adjoining side slope of the excavated area. The EPC contractor may have to adopt the soil / rock anchors in the design of the earth retaining structure and in design of the raft foundation as well. Nothing extra on this account whatsoever shall be paid to the contractor.

33. The Agency shall hand over the assets after completion of work with as built drawings, services route plans, Maintenance manuals, Warrantees / Guarantees or any other document required by the Engineer-in-charge for maintaining these establishments.

34. **The various component of the building covered in the scopes above work is as given below: -**

Description		Approximate Built-up Area (to be constructed as per details given in this Tender document)
1.	Admin cum laboratory building	15421.66 sqm
2.	Farmer training hostel	3262.40 sqm
	Total	18684.06 sqm
3	Development (Site A)	1,05,200sqm (approximate). Area in between Road No. 5,6,7,8,9,10, 11,12, 13,14,15,16,17,25,27 and 26. As per attached drawing.
4.	Miscellaneous	Furniture work in designated labs (Nine typical labs). Other labs E&M services to be designed and provided as per the requirement of lab and provided upto/from inlet/outlet points in the lab.

5.	Miscellaneous & Allied Works as per norms of NBC 2025 and mentioned in this document: (i) Plumbing & Sanitary (ii) External Water Supply & Sewerage, Storm Water Drainage System, Rain Water Harvesting including Recharge Wells (iii) Lifts (iv) Electrical Services, Substation equipment's, LT distribution system, DG sets, rising mains, UPS. (v) Fire Fighting & Fire Alarm system. (vi) Water supply Pumps. (vii) Site Development & Landscaping including roads and CC Pavement, Foot paths. (viii) STP/ETP, Over Head Tank, Underground water tank with pump house etc. (ix) External Lighting, Signage works, CCTV, External Service Connections
6.	Electric Sub Stations and other allied services as per requirements of service provider or regulatory body.
A.	CIVIL COMPONENT
1.	Admin cum laboratory building
	(G+6)
2.	Farmer training hostel
	(G+1)
3.	Development (Site A)
	1,05,200 sqm (approximate) Area in between Road No. 5,6,7,8,9,10,11,12,13,14,15,16,17,25,27 and 26. As per attached drawing.
B.	Furniture work in designated typical labs
C.	EXTERNAL DEVELOPMENT AND BULK SERVICES
	Development of Site
a)	Levelling
b)	Internal roads & paths CC Pavement with reinforcement
c)	Footpath with Kerb Stone and paver blocks
d)	Sewer
e)	Filter water supply
f)	Distribution lines 100mm dia. and below
g)	Peripheral Grid 150mm to 300mm dia pipes
h)	Unfiltered water supply distribution lines
i)	Storm water drains

j)	Rain Water Recharging / Rain Water Harvesting System duly connected with roof discharge and surface discharge
k)	Street Lighting
l)	Supplying installation testing and commissioning of LED street/compound/ High mast / pathway/ landscape lighting for the entire campus
m)	Entry/Exit sign board i/c electric Signage.
n)	SMC Panel Over Head Water Storage Tank 04 Nos each capacity 21000 liters for Administration cum Laboratory building and Farmers Training Hostel.
o)	Underground Sump (2.5 lakh litre). The fire reserve will be kept as per local bylaws of fire department or as directed by Engineer-in-charge.
q)	Providing and designing of 02 Nos. bore well of MS pipe 200mm dia with minimum 90 metres depth of bore etc. and the parameter shall be worked out by the agency and the same will accordingly be approved by the department. (with adequate filter media complete as per DSR 2023).
r)	Road No.4,3 and 2 are also be constructed.
D.	Bulk Services
a)	Electric Sub Station
b)	Uninterrupted Power Supply
c)	Water cooler including R.O System floor wise.
d)	LED Lighting
e)	DG Set
E.	AMENITIES
a)	VRF/VRV System
b)	CCTV System
c)	EPBAX
d)	Local Area Net Work
e)	Digital Display/ Signage Units

Note-

- The above scope is indicative and suggestive. The EPC Contractor may have to execute required works at his own cost, if left omitted in above scope, for making the building fit for occupation and functional use by the user department. For details, Part-B, C, D, E & F may be referred. The schematic details as assessed from the conceptual architectural plan and the preconstruction as well as construction programming with monitoring mechanism are indicated as under:
- Architectural designing, planning, making of drawings, 3D & 4D (BIM) Modelling of building & services including time management to control the project to avoid time over run, obtaining all statutory/local body approvals required to start the construction work.
- All Good for construction drawing shall be issued after BIM Model comprising of all civil and electrical services is finalized and approved by Engineer-In-Charge.

GENERAL CONDITIONS FOR PLANNING & DESIGN

1. Consultancy

The role of the bidder himself or through outsource associate consultant is to provide consultancy services for “Construction of Babugarh campus of ICAR-CIRC at Babugarh Hapur, UP. (SH: C/o Administration cum Laboratory building and Farmers Training Hostel i/c Land development at Site A, in EPC Mode -I) i/c Planning, Designing and Construction of RCC Buildings ,Internal Water supply, Sanitary Installations, Drainage, Development works like Terrace water Tanks, Rain water harvesting system, Internal Roads, Pathways, Water Supply Lines, Storm Water Drains, External Sewerage System, Service Trenches and all E&M Services such as Internal Electrical Installations, Lift, Fire Alarm System, Firefighting system, Sub-Station, DG sets, UPS,VRV/VRF AC System , Solar water heating system, solar photo voltaic power generation system, CCTV system , LAN system, IP based EPBAX system, Street lightening with LED, Water supply pumps, STP plant, Emergency light and illuminated signages, RO water plant, Split AC & other Misc. works all complete on Engineering, Procurement and Construction basis including development of BIM models and shall be involved for the entire duration of the project till its final commissioning and handing over. He should prepare BIM model by combining all the services drawings and issue GFC drawings only after approval of Engineer-In-Charge.

- 1.2 The bidder himself or through engaged reputed Firm/Consultant shall provide consultancy services. The said consultant having the in-house capabilities in consultancy work and fulfilling the minimum eligibility criteria as defined in later paragraph shall be eligible to be engaged by the bidder.
- 1.3 The bidder himself or through outsource associate consultant shall provide comprehensive consultancy services in Project covering space utilization, functional relations, preparation of master plan including obtaining its statutory and local bodies approval, detailed architectural drawings, detailed structural analysis, design and detailing including designing and detailing of all services, their drawings & approval, external development works, landscaping, etc. Consultant shall prepare and supply all the coordinated good for construction drawings duly proof checked and approved. The Consultant shall be associated till completion of the project and obtain completion certificate from the concerned local body.
- 1.4 The firm/consultant which should be an Indian consultancy firm and should have in- house architectural/Engineering capabilities with minimum experience of 5 years in the field of Consultancy.
- 1.5 The Firm/Consultant should have completed following Consultancy works during the last seven years ending last date of the month previous to the one in which tenders are invited:

Three Consultancy works of similar nature each involving either plinth area of minimum 40% of Total plinth area or project cost of 40% of ECPT ₹ 40.86 Crore

or

Two Consultancy works of similar nature each involving either built up plinth area of minimum 60% of Total plinth area or project cost of 60% of ECPT ₹ 61.28 Crore

or

One consultancy work of similar nature involving either built-up plinth area of minimum 80% of Total plinth area or project cost of 80% of ECPT ₹ 81.71 Crore.

- 1.6 Similar works mean “Successful completion of Comprehensive Consultancy work (Architectural, Structural and Building Services) including obtaining local body approval of drawings (occupancy certificate from local bodies) in a single contract”.

Note: The value of executed work(s) shall be brought to the 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 receipt of tenders of this work.

- 1.7 In case of non-availability of in-house capabilities in consultancy for any component of Engineering services, the Firms/Consultants will submit intention to engage/associate eligible sub consultant/firms having domain specific specialization and submit the MOU/agreement with such specialized firms within fortnight of award of work.
- 1.8 The successful contractor shall submit the required documents of eligible Architectural/Engineering firm within 15 days of issue of LOA. The contractor will sign the agreement with selected consultant within a week of communication of selection by CPWD Copy of same shall be submitted to the department.
- 1.9 Firms/Consultants either should have his own office in NCR or will have to setup a site office at Hapur within 45 days of signing of agreement with consultant during whole period of execution of consultancy work.
- 1.10 In case in house personnel of required experience is not available with the contractors or with the associated architectural/Engineering firms, the main contractor shall have to enter into agreement with consultant for design of E&M sub heads. Copy of such agreement shall be submitted to EE(E) in charge of work as well as to EE(C) In case of change of associate consultant, then in contractor has to enter into agreement with the new consultant to be associated by him. Agreement should be drawn as per Performa.
- 1.11 The performance of the consultant(s) is not of satisfactory qualities and standard or they fail to adhere to the time line specified in the bid document, the main contractor will take timely suitable necessary action against the consultant(s) as per the terms and conditions of agreement between them. However, this will not absolve the main contractor from the levy of liquidated damaged use delay in the project and department will be free to take action as per relevant clauses of agreement. In the case of termination of the contract with the consultant(s) by the main contractor, the process of selection of new consultants(s) will be same as provided in the bidding document. All additional cost associated with this will be borne by the contractor. They will not be eligible for any extra time/extension of

time for delay in this process. Any loss of time in the process shall be made good within the mile stones fixed in the bidding document.

2. Consultancy Services for Proof Consultant

- 2.1 Bidder shall engage reputed Firm/Consultant (whether titled as an Architectural firm or Engineering firm) approved by department for proof checking of the design submitted by the contractor from engineering and architectural aspects, out of eligible consultant (minimum three) proposed by the contractor immediately after the award of work.

This proof checking architectural or engineering firm shall be independent from the main architectural/engineering consultant engaged to design the project. The department reserves the right to approve any of the proof consultants out of the proposed ones as deemed fit and decision shall be firm and binding on the EPC Contractor. The said proof consultant having the in-house capabilities in consultancy work and fulfilling the minimum eligibility criteria as defined earlier shall be eligible to apply subject to compliance to eligibility.

- 2.2 The successful contractor shall submit the required documents of eligible proof checking Architectural/Engineering firms within 15 days of issue of LOA. The contractor will sign the agreement with selected proof checking consultant within a week of communication of selection by CPWD. Copy of same shall be submitted to the department.
- 2.3 The Contractor will also get additional proof checking/vetting of structural drawings from any IIT. The Contractor will liaison and co-ordinate with such Institute approved by Engineer-in-Charge and when required and as per the direction of Engineer-in-charge. Any changes suggested at later stage in architectural drawings / structural drawing shall be incorporated in the design and required structural drawing shall be proof checked without any extra cost.

3. Role of the Consultant

- 3.1 The Role of the bidder himself or through outsource associate consultant is to provide consultancy services for “Construction of Babugarh campus of ICAR-CIRC at Babugarh Hapur, UP. (SH: C/o Administration cum Laboratory building and Farmers Training Hostel i/c Land development at Site A, in EPC Mode -I) i/c Planning, Designing and Construction of RCC Buildings ,Internal Water supply, Sanitary Installations, Drainage, Development works like Terrace water Tanks, Rain water harvesting system, Internal Roads, Pathways, Water Supply Lines, Storm Water Drains, External Sewerage System, Service Trenches and all E&M Services such as Internal Electrical Installations, Lift, Fire Alarm System, Firefighting system, Sub-Station, DG sets, UPS,VRV/VRF AC System , Solar water heating system, solar photo voltaic power generation system, CCTV system , LAN system, IP based EPBAX system, Street lightening with LED, Water supply pumps, STP plant, Emergency light and illuminated signages, RO water plant, Split AC & other Misc. works all complete on Engineering, Procurement and Construction basis including development of BIM models and shall be involved for the entire duration of the project till its final commissioning and handing over. He should prepare BIM model by

combining all the services drawings and issue GFC drawings only after approval of Engineer-In-Charge.

- 3.2 The bidder himself or through outsource associate consultant shall provide comprehensive consultancy services in project conceptualization covering space utilization, functional requirements, preparation of LOP, Project cost estimation, Detailed Architectural drawings, structural drawings and various services design, Detailed Project Report including schedule of quantities etc. The project report shall cover all project components in detail. The details of the scope of the work involved mentioned in this Bid Document are broad and suggestive. Notwithstanding the details of the scope of the work and role of agency mentioned elsewhere in this Bid Document, the agency is required to provide drawing and design on all aspects of the work for completing comprehensive planning and designing for proposed construction of Building.
- 3.3 The EPC Contractor's consultant shall take all necessary statutory approval from all authorities including local authority, Pollution Control Board, Dept. of Forest & environment, Department of Fire Services, CEA, Lift Inspector, Air Port Authority etc. Preparation of all submission drawings/materials/3D-walk through as per Govt. Norms and models for these approvals will be the responsibility of the consultant. The statutory approvals shall include obtaining Fire Clearance from CFO and Occupancy Certificate for the completed building from the local bodies.
- 3.4 All Environmental Impact and Social Impact Assessment, if required has to be done by the consultant.
- 3.5 The consultant and his sub consultant shall have constant and regular interaction with the CPWD for formulating the design philosophy and parameters, preparation of cost estimate, designs/drawings and specifications.
- 3.6 The consultant shall have to carry out detailed topographical survey and the survey of all existing services and other constraints existing in and around the site for proper design of all the services.
- 3.7 The Consultant shall have to performing an efficient, orderly and professional manner and shall deploy necessary qualified and Skilled persons according to the requirement of the services.
- 3.8 The Consultant and the Sub-Consultants shall visit the works during execution stage to ensure that the works are being executed as per approved scheme and render appropriate advice and carry out all site related modifications in the designs and drawings.
- 3.9 The consultant shall have to assist Engineer-in-charge in preparing presentations and presentation materials during execution of work.
- 3.10 The consultant shall have to prepare design philosophy and the design methodology, listing out relevant codes, related references, sound-engineering practices etc.

- 3.11 The consultant/contractor shall have to get the structural analysis/design and design of services from internationally accepted software's like E tab, Staad Project and drawings checked by the proof consultant and thereafter vetted by any IIT through engineer-in-charge. Similarly, the proof consultant will also vet the architectural drawings. The detailed design notes shall be submitted along with design philosophy to Engineer-in-Charge.
- 3.12 The Consultant shall comply with all applicable laws, bye-laws, and statutory provisions, codes and specifications etc. in the performance of the consultancy assignment and in the execution of the project.
- 3.13 The Consultant shall comply with the applicable norms of local as well as Central Govt. Bodies.
- 3.14 The consultancy services shall be provided through the Team Leader supported by experienced professionals. The Consultant will deploy adequate number of professionals and other staff to deliver the requisite services as per time schedule. The Consultant shall have to submit an organization chart giving details of proposed team detailing the roles/work to be performed by each personnel, their tentative duration, inter-relationships of each personnel etc. Details of key personnel to be deployed by the consultant shall be as per Table Below.

List of Key Personnel with Experience

Sl. No.	Field of Specialization	Desired No.	Experience
1	Lead Architect	1	Minimum experience of 20 years
2	Architect	2	Minimum experience of 10 years
3	Lead Structural Engineer	1	Minimum experience of 20 years
4	Structural Engineer	2	Minimum experience of 10 years
5	Lead Electrical Engineer	1	Minimum experience of 20 years
6	Electrical Engineer	2	Minimum experience of 10 years
7	Fire Fighting and Fire Alarm	1	Minimum experience of 10 years
8	HVAC	1	Minimum experience of 10 years
9	Water Supply and Sanitary Expert	1	Minimum experience of 10 years
10	Landscape/ Horticulture	1	Minimum experience of 10 years
11	Green Building Consultant	1	Minimum experience of 10 years
12	I.T. Software/Hardware Engineer	1	Minimum experience of 10 years
13	Waste and Disposal Management system	1	Minimum experience of 10 years
14	Mechanical Engineer	1	Minimum experience of 10 years
15	Electronic & Instrumentation Engineer	1	Minimum experience of 10 years

- 3.15 The Consultant shall get the conceptual approval of the Department/client or both through presentations, physical models, computer walk-through etc. Comments and suggestions or alternate proposal of the client and his representatives shall be evaluated and suitably in corporate till the concept design accepted and frozen.
- 3.16 The Consultant shall develop the concept drawings for each of the building for submission to all the statutory authorities/bodies, incorporate changes, if suggested by the statutory authorities/bodies and obtain approvals from all regulatory authorities.
- 3.17 The Consultant shall ensure that the various building/engineering services are suitable designed without any discrepancies between the structure and finishes, and the requirements of service installation.
- 3.18 The Consultant shall ensure that the nature, position, and appearance of all controls of piped services and electrical installation satisfy user and aesthetic requirements, and ensure that adequate coordination drawings are included. He shall also ensure that the various building/engineering services are designed without any discrepancies between the structure and finishes and the requirements of service installation.
- 3.19 The Consultant shall comply with Building Information Modelling (BIM 3D & 4D) Specification to co-ordinate with the department and attend meetings with the department as and when required including meeting with the contractors. The consultant shall obtain fire clearance from CFO on completion of the construction work after incorporating the modifications in the drawing and services as suggested by them.
- 3.20 The consultant shall prepare the completion drawing after incorporating the suggestions/modifications and shall obtain completion certificate from local bodies. The Consultant shall maintain constant, regular and proactive interaction with the department, and structural / services proof consultants for formulating the design philosophy and parameters, preparation of preliminary designs/working drawings/specifications etc.

4. Scope of Services

- 4.1 The consultant shall plan & design the building & all other services with reference to conceptual drawings, layout plan, minimum acceptable specification, standards, fittings & fixture prescribed in tender documents & keeping into the account the description given in the different sub heads of Civil and Electrical in respective parts of the NIT.
- 4.2 The consultant shall provide Comprehensive Consultancy Services in the following areas. The consultant/agency shall appoint specialized consultants for which in-house arrangement is not available:
- 4.3 All Architectural Services including building plans/ all hard and soft Landscaping/Signages, Audio Visual (AV) equipment design.
- 4.4 All Quantity Surveying Services

- 4.5 All Civil & Structural Engineering Services including all proof checking work for structural.
- 4.6 All Electrical Engineering Services.
- 4.7 All Mechanical Engineering Services.
- 4.8 All Public Health Engineering Services.
- 4.9 All Waste Water treatment and Management System.
- 4.10 Green Building Concept (Norms to be followed as per GRIHA FIVE STAR RATING)/Equivalent CPWD GHAR rating to be certified by Accredited bodies).
- 4.11 Administration cum Laboratory building and Farmers Training Hostel and their related services
- 4.12 Equipment/fixtures/fittings for all buildings including rooms, kitchens, Conference Hall, specific like Labs etc.
- 4.13 All interiors and all acoustical treatments.
- 4.14 All Signage's
- 4.15 All water supply, sewerage & drainage system
- 4.16 All IT Service.
- 4.17 3D Modelling of building & services (to identify the clashes of services and finalizing the actual placement of equipment/fitting and the routes for the services.) BIM Specs. 3D & 4D
- 4.18 Any other services which are required but not specifically indicated.
- 4.19 Reconfirming design of external bulk services (provided by Agency for the whole campus of Admin cum laboratory building & Farmer training hostel, Hapur (UP) like water supply, Electrical Power supply, sewerage system, storm water drains, Boundary wall, Gates, underground parking, underground water tanks, rainwater harvesting, STP, ETP, roads, paths, horticulture, street furniture, paths, differently-abled person friendly corridors, signage, Landscape as per green area norms for whole campus of Administration cum Laboratory building and Farmers Training Hostel at Hapur (UP)in such a manner that the segmental operations of services is possible during the course of construction of this phase and other phases too.
- 4.20 Schematic planning and designing of Internal Electrification, Automatic Fire Alarm System, wet risers, fire-fighting system, Sprinklers, CCTV, access control system, UPS, TV, Point wiring, Dish antenna, HVAC, Lifts, Electric Sub Station building with all

equipment's and DG Sets and load factor / DG Set specifications, external lighting, solar power generation and any other essential services as per requirement of the engineer-in-charge and also required for satisfactory completion of project.

- 4.21 The consultant shall provide comprehensive consultancy services broadly described here in after. However, it should be clearly understood that the description of services is only indicative and the Consultant shall be required to perform any other services which may be required whether or not expressly mentioned here in after in this contract document of this work up to the entire project requirement and satisfaction of the client.
- 4.22 The Consultant(s) shall perform all the Architectural, Structural design work design of services, landscaping, horticultural works by utilizing the most economical, effective and widely accepted engineering concepts/practices and shall at all times show a high degree of professionalism in his work.
- 4.23 The Consultant will be fully responsible for the design of all the Civil, Electrical & Mechanical & structural works including landscaping and horticultural services

5. Building Information Modelling (BIM)

- 5.1 Brief Scope of Work for BIM
- 5.2 The EPC Contractor shall prepare and update 3D and 4D BIM models of the project on a fortnightly period basis for full construction period for developing latest model based BOQ of construction materials for Quantity Survey (QS), Material and Manpower Management and Project Management Support.
- 5.3 The EPC Contractor shall provide continued support during project implementation period through sharing of interactive walk thru's, 3D cut sections, 2D Coordinated drawings, display of interplay of various MEP services to facilitate and ease the construction and erection work at site and assist in project progress, monitoring & control etc.
- 5.4 The EPC Contractor shall prepare & submit, on completion of construction work, 'As built'
- 5.5 3D BIM model to be given as softcopy & 'as-built' drawings extracted from 'As-built' 3D BIM model, to Engineer-in-Charge of CPWD for maintenance, repair & modification purposes.
- 5.6 For carrying out the assignment, the EPC Contractor's architects, engineers, designers and technicians involved with developing BIM models under the contract, must be trained and experienced in using BIM technology and processes & meet the mandatory terms & conditions mentioned in Annexure 'A'.
- 5.7 The EPC Contractor may also engage specialized BIM consultant, duly approved by Engineer-in-Charge of CPWD fulfilling the criteria as mentioned in Annexure A, for

carrying out the 3D BIM and 4D BIM Modelling work, coordination & clash detection, BOQ extraction of construction materials, updating models during construction phase, preparation & updating go base line schedule for project progress, monitoring, & control purposes, 4D BIM simulation & development of “As Built Model and “As Built Drawings”.

- 5.8 Terms of Reference for 3D Building Information Modelling.
- 5.9 The EPC Contractor’s BIM Team is required to do BIM modelling, clash detection, screen shots, renders and quantity take off, incorporating all disciplines - Architectural, Structural, MEP which includes HVAC, Plumbing, Fire Fighting, Electrical & Lift, facade, and other specialized services such as Lighting Design, Landscape etc. broadly the points given below are to be followed:
- 5.10 Development of 3D models of architecture, landscape and engineering drawings like structure, MEP etc., showing all elements of the works of the super structure of buildings and site.
- 5.11 Extraction BOQ of modelled items from BIM software and exporting it in excel for easier analysis and review for all the disciplines mentioned above.
- 5.12 Extraction of 2D CAD drawings from clash free 3D BIM model to be issued for construction.
- 5.13 Views/screen shots (JPEG) or any other appropriate format for the conflict points to be generated for review by the decision taking parties.
- 5.14 The Modelling Team will prepare the Model in Auto desk Revit software or Archi CAD of Graph is or equivalent using the project information.
- 5.15 Deliverables & work flow

6. The BIM Modelling process shall be performed in the following steps:

- 6.1 Stage-1: (Architectural and Structural) BIM model of architectural and structural disciplines of the project based on drawings and specifications.
 - 6.1.1 Submission of BIM Model for review.
- 6.2 Stage -2 (MEP & Other services BIM model)
 - 6.2.1 BIM model of MEP disciplines of the project based on drawings and specifications.
 - 6.2.2 Appropriate revisions to the Architectural & Structural model resulting due to MEP & other services Modelling.

- 6.2.3 Conflict report between all architectural, civil & structural and (MEP and other services) work.
- 6.2.4 Submission of BIM Model and conflict report for review.
- 6.3 Stage-3: Resolution of conflict/ queries by the already appointed architectural consultant or through different consultants available with him.
- 6.4 Stage-4: First Revision of BIM model based on changes above and submission of revised model by EPC Contractor's BIM Team.
- 6.5 Stage-5: Resolution of conflict/ queries by different design stakeholders raised & submission of final model by EPC Contractor's BIM Team and calculation n & submission of bill of quantities of main civil & MEP items except reinforcement.
- 6.6 Stage-6: Creation of 2D drawings extracted from 3D engineered intelligent Models, in CAD plan sections, elevations and other relevant details (based on specific engineering disciplines) on which the actual construction will be carried out.
- 6.7 Stage-7: Submission of final 'As-built' model by EPC Contractor's BIM Team.

7. The EPC Contractor's BIM team shall develop the following Models: -

7.1 Geometric Model

7.2 Architectural

Using BIM Authoring software applications, the Agency will deliver 3D geometric models of the components listed below. The Agency will properly use available intelligent objects to embody information, including, but not limited to, material properties, functions, coding (naming conventions, standards, and dimensions). The following sections describe in more detail the specific discipline requirements for 3Dgeometric modelling.

The EPC Contractor's BIM Team will provide a 3D BIM created with architectural components that embody proper object information and parametric relationships in accordance with good architectural practice. These components include, but not limited, to slabs/floors, walls, roofs, doors, windows, stairs, elevators, finishes, ceilings, etc.

7.3 Structural

The EPC Contractor's BIM Team will provide a 3D BIM created with structural components that embody proper object information and parametric relationships in accordance with good structural engineering practice. These components include, but not limited to, all substructure and superstructure components. The object information will include member profile and dimension information.

7.4 **Mechanical**

The EPC Contractor's BIM Team will provide a 3D BIM created with mechanical components that embody proper object information and parametric relationships in accordance with good mechanical engineering practice. These components include, but not limited, to all major mechanical equipment, cooling to weirs, chillers, air handling units, pumps, terminal boxes, hydrants, HVAC piping and duct work, hangers, and other HVAC equipment. Piping ends are to be modelled for coordination with other trades.

7.5 **Plumbing**

The EPC Contractor's BIM Team will provide a 3D BIM created with plumbing components that embody proper object information and parametric relationships in accordance with good mechanical engineering practice. These components include, but not limited to, all major plumbing equipment, fixtures, boilers, pumps, piping over 2", hangers, and other plumbing equipment. Pipe bends are to be modelled for coordination with other trades.

7.6 **Fire Protection**

The EPC Contractor's BIM Team will provide 3DBIM created with fire protection components that embody proper object information and parametric relationships in accordance with good mechanical and electrical engineering practice. These components include, but not limited to, fire alarm devices, fire detection system, fire alarm panels, the main sprinkler piping risers and related devices with piping 1½" or larger in diameter, control valves, fire suppression equipment, pumps, hangers, and other equipment. Pipe bends are to be modelled for coordination with other trades.

7.7 **Underground Utilities (Civil)**

The EPC Contractor's BIM Team will provide a 3DBIM for underground utilities created with civil components that embody proper object information and parametric relationships in accordance with good civil engineering practice. These components include all underground utilities, underground sump, STP, ETP, Sewerage system, Water supply system, Overhead tanks, vaults, manholes, and other civil features.

7.8 **Site (Civil and Landscape)**

- (i) The EPC Contractor's BIM Team will provide 3DBIMs for site design with both civil and landscape components that embody proper object information and parametric relationships in accordance with good civil engineering and landscape architecture practice. These components include, but not limited to, topographic grading, streetscape, landscape including trees, planting stock (including roof), storm water drainage features, exterior lighting, and other pertinent site features.
- (ii) The EPC Contractor's BIM Team has to adopt 3DBIM modelling process for spatial coordination among architectural, structural & MEPF design drawings for different buildings and the Architects for the project is expected to issue construction drawings, which are well

coordinated & complete for execution of the project. Preparation of ‘as-built’ model to be given as soft copy at the end of project execution/construction of the project.

7.9 Deliverables for the project:

- (i) RFI Reports
- (ii) Discrepancy/Clash Report so fall the disciplines
- (iii) 3D Views/snap shots of critical areas.
- (iv) Soft copy of 3D model views able in Navis works/Demo version or equivalent by using appropriate BIM software.

8. (4D BIM) Time Schedule & Progress

8.1 The EPC Contract or shall take full advantage of the 3D object at tributes available in the BIM environment to prove construction, fabrication and program as required by the Engineer-in-Charge. Engagement modalities for project management functions including 4D BIM requirements are as below:

- (i) EPC Contractor shall allocate Project Coordinate or who would be a single-point contact for Engineer-in-charge or his representative for monitoring and resolving concerns of CPWD for day-to-day progress of the project.
- (ii) Ensure that the BIM model shall be accurate enough so that it can be used for quantification and scheduling purposes.
- (iii) Create the BIM Execution Plan (BEP) of the project for smooth BIM implementation and execution of the project.
- (iv) EPC Contractor shall allocate Project Coordinate or who would be a single-point contact for Engineer-in-charge or his representative for monitoring and resolving concerns of CPWD for day-to-day progress of the project.
- (v) Ensure that the BIM model shall be accurate enough so that it can be used for quantification and scheduling purposes.
- (vi) Create the BIM Execution Plan (BEP) of the project for smooth BIM implementation and execution of the project.
- (vii) EPC Contractor shall create Work Break down Structure (WBS) for its scope of work in the master project plan schedule period of completion for project.
- (viii) EPC Contract or shall create all the relationships between various activities to generate the critical path for the execution of the project within stipulated time frame.

- (ix) The project plan will be detailed or reflect the planned construction progress linked with the 3D BIM model. EPC Contractor's project plan will be required at sufficient level of detail of connect the 3D BIM model with the schedule and the resource plan.
- (x) The EPC Contractor shall develop Baseline Construction Schedule along with resources (material, manpower & machinery) using 4D simulation software package. Trimble Vico Office Suite, which shall be submitted to the Engineer-in-Charge, for construction monitoring & control purposes and also make periodical updates as per actual construction at site for various activities & submit to the Engineer-in-charge.
- (xi) Base line Construction Schedule shall contain Time and Progress Chart along with resource deployment plan (material, manpower & machinery) and would be in direct relation to the time stated in the contract documents for completion of items of the works. It shall indicate the forecast (mile-stones) of the dates of commencement and completion of various items, trades, sections of the work and may be amended as necessary by agreement between the Engineer-in-Charge and the EPC Contractor within the limitations of overall time stipulated in the contract documents, within first 90 days after award of the work.
- (xii) The EPC Contractor has to adopt an organized approach to divide the project in to work locations. Location based planning and management shall ensure that trade crews flow smoothly from pre requisite to success or tasks without interference and quantities by location to be used in scheduling and procurement. This may be presented using 4D simulation software package. Trimble Vico Office Suite.
- (xiii) The EPC Contractor shall be required to furnish key budget/planned mile stone billing details along with resources (manpower & machinery) planned to be deployed for base line program & actually being deployed on project site from time to time. Level of details for time plan, budget/planned mile stone billing details and resources required from the Contractor will be as per the payment schedule indicated in the contract document.
- (xiv) The EPC Contractor shall also monitor the progress of work on project site on a fortnightly basis, along with photographs & videos identifying delays, if any, with respect to overall construction schedule, identifying lapses/deviations in the progress of work, devising remedial measures, preparing revised schedules and revised resource requirements etc. These reports shall be submitted to Engineer-in-Charge as per critical even noticed by the contractor but not later than 3 days of such occurrence or as decided and communicated by Engineer-in-Charge from time to time.
- (xv) During the execution stage, the contractor shall update in required frequencies the works measurements or percentages, works mile stone status, any deviations in the quality or BOQ (which will impact the bill book) and geo-located snap shot pictures of the actual construction progress.
- (xvi) The EPC Contractor shall up date and revise their works schedule on the integrated master schedule, subject to directions & approval from Engineer-in-charge. Also, the BIM model along with the updated progress and quantity reports should be submitted along with every RA Bill submission on except mobilization advance payment.

- (xvii) During the execution of the work, the EPC Contractor shall submit a detailed monthly progress & program report to the Engineer-in-charge by 5th of every month. The format of monthly progress & program report shall be as approved by the Engineer-in- Charge.
- (xviii) The EPC Contractor need to have a state-of-the-art Computer system along with stable Internet Connection (with bandwidth of around 8 Mbps) at site of work for the Data to be seamlessly transferred between all stake holders.

9. For 3D/4D/5D BIM Work

- (i) The firm performing the BIM services should have successfully completed 3D/4D/5D BIM modelling assignments on domestic projects in the last 7 years. Completion Certificate and/ or copy of work order with C.A. certificate of having received full fee should be submitted along with the proposal as a token of proof thereof.
- (ii) The firm performing the BIM services fulfilling the following requirements shall be eligible for selection.
 - (a) Firm should have satisfactorily completed the works as mentioned below during the last seven years ending pervious day of last date of submission of bids.

Three similar works, each having total built-up area not less than 40 % (of the plinth area of this project).

OR

Two similar works, each having total built-up area not less than 60% (of the total plinth area of this project)

OR

One similar work having total built-up area not less than 80% of the (Total plinth area of this project).

Similar work shall mean “3D BIM modelling consultancy work”

STAGES OF CONSULTANCY WORK

1. Preliminary Stage

- (a) Carry out topographical survey and the survey of all existing services and other constraints existing in and around the site.
- (b) Carry out soil investigation of the site to establish the soil characteristics i/c rock profile and other parameters required for the foundation design of multi-storey buildings. Types of investigation/tests and their qualities shall be get approved from Engineer-in-Charge. Soil investigation agency should be experienced, specialized and should be got approved from Engineer-in-charge.
- (c) The contractor/consultant shall also get curtailed the liquefaction potential of soil to required depths using modern methodology e.g. Spectral Analysis of Surface Waves (SASW) tester any other method and combination of tests approved by Engineer-in-charge and suggest remedial measures and account for same while suggesting the foundation system and suggesting bearing capacity/load carrying capacity.
- (d) The soil report shall be got vetted/proof checked from the Institute of repute as per the contract document or as approved by Engineer-in-charge.

2. Master Plan/Lay Out plan

- (a) Submission of the revised Master Plant of local bodies and incorporating changes, if any, suggested by them and re-submitting the same.

3. Concept Design

- (a) Interact with the user departments of client and finalize the functional plan.
- (b) Development of the concept design. Submission of the draft concept design and make presentation of the scheme.
- (c) Modifications of the draft concept plans taking into account the comments, suggestions etc. of the client and the Department.
- (d) Submission of the final concept design along with models, photographs, 3D-walk through hand as per the requirement etc. The cost of such models, walk through, photographs, etc. shall be borne by the consultant. Obtaining approval of the Concept design from the CPWD.

4. Approval Stage

- (a) Development of the Submission Plans. Submission of the design, drawings and related documents if required, to concerned local body authorities, HAPUR PILAKHUWA DEVELOPMENT AUTHORITY, Fire Service- HAPUR, UP Jal Palika, UPSEB, NCRTC, Airport authority, Environmental Clearance, Tree cutting permission etc. Modifications of the design, drawings etc. taking into account the comments, suggestions etc. of the local bodies.
- (b) Re-Submission & obtaining approval of the design, drawings etc. from local bodies. Carrying out Environment Impact Assessment, submission of the same and getting approval from concerned authorities. Obtaining necessary approval of the project from Local authority.

5. Detailed Design Stage

(i) Architectural Services

- (a) Prepare drawings, schedules and specification of materials and workmanship, in sufficient detail. The drawings & documents shall include detailed site plan, detailed drawings for each building including floor plans, elevations, door & window schedules, finishing schedules, wall profiles, Staircases, ramp and lift details, details of important building parts/areas, landscape & horticulture details etc. As far as possible standards of quality performance requirement and descriptive names shall be used rather than specific products or brand names.

6. Layout Plan showing:

- (a) All proposed buildings, playfields, green area, location of tank, STP, ETP, Sump, RWH, Elect. Sub-Station etc. Central AC Plant, Fire Pump House, CCTV Central Room, Location of AHU Rooms, Audio Visual system, Public Address system, various shafts for E&M services like Low Voltage Shaft Electrical Riser Shaft, Fire Fighting Shaft, Lift Shafts etc. and any other Laboratory related services etc.
- (b) Blow up of road junction/ parking area and other such area as required.
- (c) Coordinated External services.

7. Detailed Drawings

- (a) Floor plans, fully coordinated with all services/disciplines.
- (b) Elevations
- (c) Sections

- (d) Wall profiles
- (e) Doors & Window details
- (f) Stairs/ Ramps/ Lifts details
- (g) Details of building parts, areas, critical special treatments.
- (h) Toilet details
- (i) Flooring pattern and details
- (j) Dado details
- (k) Roof flow, drainage system including rain water harvesting system underground tank
- (l) Any other detailed require by the engineer in charge.
- (m) Landscape i/c water bodies & Horticulture works of whole campus including around the buildings.
- (n) Drawings of landscape including blow up of critical areas/ landscapes /plant scapes in detailed coordination with all external services.

(ii) Horticulture details

- (a) Checking and certifying the Architectural drawings, technical specifications, services and all other drawings to ensure their completeness/correctness.
- (b) Finalizing finishing schedule, elevation treatment, fixtures, colour scheme of all buildings Integration of design with the existing landscape including water bodies and suggest modification if any other details required for completion of the buildings/services.
- (c) Attend meetings during execution to give clarifications, if any and to modify the drawings as per the site/construction requirements.

8. Civil and Structural Engineering Services

- (i) Design Basis
 - (a) Conduct surveys, tests and other investigations as required to determine the basis to accomplish safe designs as per latest specifications & codes.
 - (b) Planning for the structural arrangements with the architectural design.

- (c) The building shall be analysed as a 'Space Frame'. The building shall be modelled using structural engineering software package ETABS /STRAP /STAAD or any other standard proven software. SI units should be followed for entire analysis and design. The modelled space frame should be analysed for Dead Loads (DL), Live Loads (LL), Wind Loads (WL), Earthquake Loads (EQ), Temperature load stresses and their combinations as per latest IS:1893-2016(part-1) and IS:13920(2016), IS800-2007 and other applicable BIS codes revised up to date. The building should also be checked for storey drift. All supports (foundations) of the building column and shear walls shall be considered as fixed joints for analysis. Effective length of columns shall be considered as per the standard codes of practice. This structure should be designed and detailed as per Indian codes of practice. All disaster managements practices as specified in NBC to be followed.
- (d) As the structure is RCC & Steel structure the lateral loads will be significant. Transfer of lateral loads is very important & special care must be taken to transfer these loads in superstructure and foundation. Sufficient numbers of shear walls should be provided for force transfer in lateral direction & to control the deflection due to lateral loads. The temperature stresses evaluation be given during consideration in structural design.
- (e) As the vertical & lateral loads are quite high, there may be danger of liquefaction in the foundation as soil indicated. Reinforced concrete bored cast-in-situ piles or any suitable foundation system may be the alternative solution and same can be analysed for the columns and shear walls loads in this multi-storeyed building.
- (f) Co-ordination & finalization of structural arrangement.
- (g) Foundation system
- (h) Beam & Column Shear Walls location
- (i) Beam & Column size Shear Walls finalization
- (j) Slab profiles
- (k) All other detailing required for the finalization of design
- (l) Finalization of design basis & structural systems.

- (m) Proof checking of structural design/drawings from proof consultant and subsequently vetting from any IIT and issuing the “Good for construction” drawings. The consultant shall also submit the structural design/details (input/ output) by the structural consultant and the proof checking thereof along with comments etc. of proof consultant. If any modification in design/drawings is needed as per site conditions or subsequent to proof checking, the contractor shall do/redesign the design and proof checking without any extra cost. The decision of the Engineer-in-charge in this regard shall be final and binding. No claim whatsoever on this account will be entertained.

(ii) Structural Design Development

- (a) Design of all the structural and non-structural elements.

(iii) Drawing Stage

- (i) Foundation plans & details
- (ii) Column, walls, i/c diaphragm wall and beam layout plan i/c Shear Walls
- (iii) Floor framing plans, fully coordinated with all disciplines
- (iv) Floor slab structural details
- (v) Column Shear Wall & beam structural details
- (vi) Staircases, ramps, lifts shafts and machine room details, rain water harvesting chamber.
- (vii) Requirement of Green Building Concept.
- (viii) All other details and sketches required for proper execution of the works.
- (ix) Expansion joint details.

Note: One technical representative of consultant/architect will always be available at site during execution of work. Recovery @ Rs. 50,000/- per month calculated on per day basis will be done for non-availability of such representative.

9. Public Health Engineering

- (i) All the design and drawings should be well coordinated with Architecture, structure and other services drawings. All designs shall be as per the latest Indian Standards, Local bye-laws and Statutory norms/regulation. Design of Public Health & Engineering services taking into account various topographical, meteorological, Hydrological etc. reports, identify the source and quality of water, conduct survey of existing water supply system,

Sewerage system, Drainage system, Fire- fighting system, other site development works etc. for planning of services.

- (ii) The services shall include following major components:
 - (a) Water Supply System including underground water tanks and pumps.
 - (b) Sewerage System including sewerage treatment plant.
 - (c) Drainage System i/c water harvesting, absorption trenches etc.
 - (d) Fire Fighting & Fire Suppression System with peripheral grid around each building connected with fire main grid.
 - (e) Dual plumbing system i/c untreated water supply system from STP for horticultural operations.
 - (f) Soil waste management.

10. Services

- (i) Water Supply System
 - (a) Calculation of water requirements for office building and other services for the buildings and services for the scope of present bidding document.
 - (b) Design and prepare working drawings of internal and external dual water supply system including Underground tank, Overhead tank, Water treatment plant, pumping stations, rising mains, distribution system and internal plumbing, recycling of treated waste water etc.
 - (c) Untreated water supply system for horticultural works i/c design of sprinkler and drip irrigation system.
 - (d) Prepare specifications.
 - (e) Detailed drawings and data sheets of suppliers/ manufacturers. Incorporation of suggestion/ modification in the drawings will be submitted to Engineer-in-charge for approval.
- (ii) Internal Sanitary Installations
 - (a) Design and prepare working drawings of internal sanitary installations.

- (b) Identify, design and prepare working drawings of handicapped friendly toilets and sanitary installations, if required.
- (c) Prepare specifications.
- (d) Detailed drawings and data sheets of suppliers/ manufacturers. Incorporation of suggestion/ modification in the drawings will be submitted to Engineer-in-charge for approval.
- (iii) Sewerage System
 - (i) Calculation for quantity of waste water generated from different sources and design waste water treatment plant.
 - (ii) Design and prepare the drawings for pre-treatment of waste water from kitchen and dining halls before connecting to sewage system i/c. management of solid waste, oil & grease etc.by suitable treatment and disposal system.
 - (iii) STP of 50 KLD & ETP of 20KLD of latest technology or as specified in the NIT.
 - (iv) Obtain approval from statutory and local bodies for waste disposal.
 - (v) Prepares specifications.
 - (vi) Check and approve detailed drawings and data sheets of suppliers/ manufacturers.
 - (vii) Detailed drawings and data sheets of suppliers/ manufacturers. Incorporation of suggestion/ modification in the drawings will be submitted to Engineer-in-charge for approval.
- (iv) Drainage
 - (a) Design and prepare working drawings for storm water drainage including roof drainage, service is a drainage and surface drainage.
 - (b) Design and prepare working drawings for rain water harvesting systemic/rain water harvesting pits, trenches and perforated absorption drains.
 - (c) Obtain approval from statutory and local bodies for drainage connections and rainwater harvesting scheme etc.
 - (d) Prepare specifications.

- (e) Detailed drawings and data sheets of suppliers/ manufacturers. Incorporation of suggestion/ modification in the drawings will be submitted to Engineer-in-charge for approval.
- (v) Solid Waste Management
 - (a) Survey, design and prepare the working drawings and system plan for solid waste collection, treatment and disposal through appropriate technology.
 - (b) Design and drawings for composting of organic waste for production of manure/vermicompost for utilization for horticultural use.
 - (c) Design and drawing for utilization for organic waste for other useful products.
 - (d) Other ways for recycling and disposal of non-organic and organic waste.
- (vi) Site Development Works
 - (i) Design and prepare working drawings (longitudinal & cross-section) for roads/ footpaths/ parking areas etc.
 - (ii) Design and prepare working drawings of irrigation system for horticulture/c. sprinkler and drip irrigation system.
 - (iii) Prepare specifications of same.
 - (iv) Vetting of detailed drawings of suppliers/manufacturers from expert in field.
- (v) Other Services
- (vi) Project Documentation
 - (vii) Prepare and submit required number of copies of monthly progress accomplishment reports of the project.
 - (viii) Ensure the preparation of AS-BUILT drawings and record all approved deviations and changes in drawings. Provide any other services not explicitly mentioned but reasonably required for project development.
 - (ix) Design, calculations and drawing so fall services shall be proof checked from any IIT. If any modification in design/ drawings is needed as per site conditions or subsequent to proof checking, the contractor shall do/redesign the design and proof checking without any extra cost. The decision of the Engineer-in-charge in this regard shall be final and binding. No claim what so ever on this account will be entertained.

11. Green Building Design

- (i) The buildings are to be designed for 5-star green building rating wise GRIHA/EQUIVALENT CPWD “GHAR” Green rating system.
- (ii) The consultant has to develop a green building Design as per GRIHA/ Equivalent CPWD GHAR Green evaluation procedure in conjunction with ECBC norms and National Building Code.

12. Number of Documents and Copyrights

- (i) All the documents/drawings, designs, reports and any other details envisaged under this agreement shall be supplied in six copies. All drawings as required for submission to all the local bodies and other authorities shall be submitted as per the requirement of local body. All the drawings for the comments, discussion and approval of employer shall be submitted in triplicate. Six copies of all the final drawings shall be submitted to the Engineer-in-Charge along with one reproducible in A-1 or large size along with a soft copy in DVD. If there is any revision in any drawing/document for any reason, six copies of drawing/document shall be re-issued along with soft copy in CD without any extra charges. All these drawings will become the property of the Engineer-in-Charge. The Engineer-in-Charge may use the se drawings in part or full in any other work without any notice to the consultant and without any financial claim of the consultant.
- (ii) The drawings cannot be issued to any other person, firm or authority or used by the Consultant for any other project. No copies of any drawings or documents shall be issued to anyone except the Engineer-in-Charge and/or his authorized representative.
- (iii) Architectural Design should cover the following general requirements:
 - (a) To cater for different functional requirements of user with creative indoor spaces, surroundings, better circulation and flexibility in space planning.
 - (b) Integrated designs of electrical, mechanical and other services with structural system and construction methodology with Bare minimum maintenance/maintenance free mechanism.
 - (c) Claim at responsive Architecture with integration of day light and electrical light, the normal comfort, ventilation and highest performance and for work space efficiency.
 - (d) Use of low embodied energy materials and local/reused materials and consideration of green building principles.

- (e) Water and solid waste management with waste water recycling, water conservation and rain water harvesting.
- (f) Development of surroundings with site terrain consideration, traffic circulation, indigenous vegetation and plantation.
- (g) The building(s) proposed to be developed should be amenable to latest systems of construction technologies for enabling repeatability and fast track and ease in construction, keeping in mind a lower embodied energy of material and lower energy consumption in the proposed complex.
- (h) All the spaces in the building provided shall be adequately ventilated for light and air.
- (i) Suitable escapes for fire shall be planned as per the requirement specified in NBC and other applicable standard codes of practice.
- (j) The setbacks and height of the building shall conform to all regulatory authority rules.
- (k) Premium quality materials shall be provided for walls, floors, windows, doors etc. in tune with the industry standards of similar buildings.
- (l) Proper care shall be taken to plan movement logistics to avoid crises-crossing traffic.
- (m) The façade of the building shall be appealing, by judiciously mixing the use of energy efficient glass, cladding materials, wall appropriate to the use of the building. The ratio of glass to wall shall vary depending the direction and as required for FIVE STAR GRIHA/ Equivalent CPWD GHAR Green rating system.
- (n) Space planning for required services in particular to the Conference Hall, Multipurpose, Auditorium if any, shall be given importance.
- (o) Service routing and ducts shall be planned for easy access, maintenance and scale ability.
- (p) Green building materials shall use as far as possible for obtaining FIVE 5- STAR GRIHA/Equivalent CPWD GHAR Green rating system.
- (q) Sufficient space for parking of vehicles as per the norms shall be provided
- (r) Vertical circulation shall be well planned to provide quick access to upper floors by suitable location of stairs and bank of elevators.

13. Structural Design Should Cover the Following General Requirements

- (i) The structural design shall be carried out in terms of latest editions and up-to-date correction/amendment/errata of BIS Codes (Bureau of Indian Standards), other relevant seismic/other codes for making Building Earthquake Resistant, sound engineering practices and as desired by the client/ Employer. The Contractor will also get proof checking of structural drawings from proof consultant and subsequent vetting from any IIT. The Contractor will liaison and co-ordinate with such Institute approved by Engineer-in-Charges and when required and as per the direction of Engineer-in-charge. Any changes suggested at later stage in architectural drawings shall be incorporated in the design and required structural drawing shall be proof checked without any extra cost.
- (ii) If any modification in design/drawings is needed as per site conditions or subsequent to proof checking, the contractor shall do/redo the design and proof checking without any extra cost. The decision of the Engineer-in-charge in this regard shall be final and binding. No claim what so ever on this account will be entertained.
- (iii) Submission of all design calculations in hard and soft copies as per the direction of Engineer-in-charge.
- (iv) Any other designing and detailing required for comprehensive planning a designing of the proposed buildings & campus.
- (v) The required buildings along with internal and external services have to be planned to achieve minimum cost of operation, minimum maintenance cost and lowest consumption of energy, water & electricity etc.
- (vi) One combined integrated drawing of all services will be prepared. (For internal & external services separately). For services being laid in false ceiling, an integrated plan of all services will also be prepared to avoid interference from each other.
- (vii) The EPC contactor will get prepared the Digitized data of all the services including drawings in soft & hard copy format and will submit to the Engineer in charge at the time of completion of work to enable locating the services in the building for smooth maintenance operations during the lifetime of building. Such drawings will be part of the completion plan of the building.

14. Presentations and Models:

- (i) Preparation of Model(s) to scale 1: 200 or any other suitable scale decided by Engineer in charge.
- (ii) Preparation of 3D views and blow ups of typical and critical areas and walk through.

- (iii) 3D/4D Modelling of building & services (to identify the clashes of services and finalizing the actual placement of equipment/fitting and the routes for the services.)

15. Approval From local Authorities:

- (i) The EPC contract or will take original as well as revision in the statutory approval, if necessary, from all local authorities including NGT, CFO, UP State, Pollution Control Board, Environmental, AAI clearances etc. Preparation of all submission drawings (any numbers)/ material sand models as per the required size/scale as required by local bodies.
- (ii) The EPC contractor shall take all necessary statutory approval of 'Completion Plan' from all local authorities including HAPUR PILAKHUWA DEVELOPMENT AUTHORITY, CFO, UP State, Pollution Control Board, Environmental Clearances, Lift inspection, NOC of Firefighting equipment etc. for occupation of the buildings after completion of construction Consultancy works and preparation fall submission drawings (any numbers)/materials and models for these approvals.
- (iii) All statutory payments required for these approvals from local authorities shall be made by the Engineer-in-charge. For saving of time if the payment is required to be made urgently the contractor/consultant should make the payment and the amount will be reimbursed by the department after production of voucher & receipts.

16. Submission of Datasheet:

- (i) Preparation of Data sheet showing Room wise and building wise finishing, flooring and Door window, and another high-end Inventory schedule.

17. Tree Cutting Permission

- (i) All necessary approvals required for tree cutting, shall be taken by the Agency. The compensation fee, cost of compensatory plantation or any other such fee payable to Government Body shall be reimbursed to the Agency by CPWD. However, the efforts shall be made to Transplant maximum trees on the site in consultation with UP Government Forest Department. The cost of transplantation shall be borne by the agency.

18. Adherence to Approved plans

- (i) The agency shall adhere to the building plan which has been approved by various Authorities and plan accordingly.

19. CPWD Site Office

- (i) Scope of work includes construction/ providing of site office (semi-permanent structure) with modern outlook for use by Engineer-in-charge and his staff consisting of 6 rooms with 2 toilets and one conference Room with toilet having area not less than 300 Sqm for CPWD officers & staff. The location and plan shall be got approved from Engineer-in- Charge.

Specification for the site office shall be suitable and matching for running an office which shall be got approved from Engineer-in-charge. The EPC Contractor shall provide a typical plan of site office & conference room (having light fixtures, wiring &, AC etc.) with specification within 15 days of award of work and shall construct within 45 days of approval accorded by Engineer-in-Charge. All running cost & charges (i/c two office attendants, two data entry operators, BIM (Building Information Modelling) personal in two shifts for 3D.

- (ii) (Clash free virtual construction of building) and 4D for time management & resource management and AMC etc.) for office including providing **Two nos. office attendant, two data entry operators**, Two Nos inspection vehicle till actual completion of work plus six month (with driver and fuel), Electricity bill, water supply bills, RO/drinking water bills etc. shall be provided and all cost shall be borne by the EPC Contractor. The EPC Contractor shall provide the following furniture (new) and other equipments/machinery/vehicles for use of CPWD staff at site office.

S.No.	Articles	Quantity
1.	Executive table (wooden) with side racks	4 Nos.
2.	Executive Chair	8 Nos.
3.	Office Tables	8 Nos.
4.	Office Chairs	8 Nos.
5.	Steel Almirah	10 Nos.
6.	Conference table (for 30 seats)	1 Nos.
7.	Conference chairs	40 Nos.
8.	Digital display arrangement (with projection system & sound system for conference room)	1 set
9.	Computer all device (Like: monitor, laptop, printer, UPS, mouse, keyboard etc. with Wi-Fi connection.	5 set
10	CCTV cameras IP enabled for online monitoring of progress	1set with number of cameras required to cover whole site.
11	Laser Distance meters (300 feet range and Bluetooth enabled)	4 nos.
12	Inspection vehicles for supervisory staff and engineering team.	(1 no. Innova Crysta and 1 no. Mahindra XUV 700 or equivalent) with driver i/c salary and all consumables (fuel/oil) etc. all complete.

CHAPTER-B

Conditions & Specifications of Civil Works

Additional Conditions of Civil Works

1.0 General

- 1.1 Agency(s) shall before commencement of any item of work the agency shall correlate all the relevant architectural and structural drawings, and specifications etc. and satisfy himself that the information available is complete and unambiguous. The agency alone shall be responsible for any loss or damage occurring by the commencement of work based on any erroneous and or incomplete information and no claim whatsoever shall be entertained on this account.
- 1.2 Agency(s) shall provide permanent bench marks, flag tops and other reference points for the proper execution of work and these shall be preserved till the end of the work. All such reference points shall be in relation to the levels and locations, given in the Architectural and plumbing drawings. On completion of work, the Agency(s) shall submit six prints of “as built” drawings to the Engineer-in-Charge (Hard & soft copy both)
- 1.3 The Agency (s) should engage approved, licensed plumbers for the work and get the materials (fixtures/fittings) tested, by the municipal Body/Corporation authorities wherever required at his own cost. The Agency(s) shall submit for the approval of the Engineer-in-Charge, the name of the plumbing Agency proposed to be engaged by him.
- 1.4 The agency shall give performance test of the entire installation(s) as per the specifications in the presence of the Engineer-in-charge or his authorized representative before the work is finally accepted and nothing extra what-so-ever shall be payable to the agency for the test.
- 1.5 The work of services will be executed simultaneously. The agency shall minimize the scope of making recesses, holes, opening etc. as the same shall be planned and necessary grooves/niches shall be provided in shuttering of RCC.
- 1.6 The agency shall conduct his work, so as not to interfere with or hinder the progress or completion of the work being performed by other agency(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 agency simultaneously working 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.
- 1.7 If the work is carried out in more than one shift or during night, no claim on this account shall be entertained. The agency must take permission from the police authorities etc. if required for work during night hours, no claim / hindrance on this account shall be considered if work is not allowed during night time.
- 1.8 The agency shall be responsible for the watch and ward / guard of the building’s safety, fittings and fixtures provided by him against pilferage and breakage during the period of installations and thereafter till the building is physically handed over to the department. No extra payment shall be made on this account.

- 1.9 Sample of building materials, fittings and other articles required for execution of work shall be got approved from the Engineer-in-Charge before use in the work. The quality of samples brought by the agency shall be judged by standards laid down in the relevant CPWD/ BIS specifications. All materials and articles brought by the agency 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.
- 1.10 BIS marked materials except otherwise specified shall be subjected to quality test at the discretion of the Engineer-in-Charge besides testing of other materials as per the specifications described for the item/material. Wherever BIS marked materials are brought to the site of work, the agency shall, if required, by the Engineer-in-Charge, furnish manufacturer's test certificate or test certificate from approved testing laboratory to establish that the material / procured by the agency for incorporation in the work satisfies the provisions of specifications / BIS codes relevant to the material and / or the work done.
- 1.11 The agency shall procure the required materials in advance so that there is sufficient time to testing of the materials and clearance of the same before use in the work. The agency shall provide at his own cost suitable weighing and measuring arrangements at site for checking the weight / dimensions as may be necessary for execution of work.
- 1.12 Regarding testing of civil & electrical materials, the testing of materials shall be conducted in Govt. Laboratory/ Govt. colleges/ IITs/NITs or from the laboratory approved by competent authority. The charges of testing of materials in approved laboratory shall be borne by the agency.
- 1.13 Agency shall submit minimum "Quality Assurance" plan within 45 days after award of work which shall be consisting of:
- 1.14 Lot size, number of required tests and frequency of testing. While deciding these criteria CPWD Specifications & Provisions of BIS Code and Standard Practices may be referred. Volume of work, Practical Difficulties and Site Conditions etc. may also be kept in view. The lot size, number of tests and frequencies of testing can be altered or modified by the Engineer-in-charge from the prescribed limits
- 1.15 It should clearly indicate the Machinery and other Tool & Plants required to be deployed at site by the agency. Entire Machinery and T&P may not be required at the start of work, therefore, a proper time schedule by which each Machinery & T&P is to be brought at site should also be indicated.
- 1.16 All the registers of tests carried out at Construction Site or in outside laboratories shall be maintained by the agency, which may be inspected by Engineer-in-charge or his/her designee at any point of time. The Agency shall allow access to Third Party Quality Assurance Agency (TPQAA) engaged by Engineer-in-charge to have a control on quality and methodology of execution. At least 25% of Samples of materials including Cement Concrete Cubes shall be taken jointly by Agency and TPQAA / Engineer-in-charge or his authorized representative. All arrangements for transporting and getting them tested shall be made by the Agency.

- 1.17 All the test in field lab setup at Construction Site shall be carried out by the Quality control team to be engaged by the Agency which can be witnessed by Engineer-in-charge or his/her designee. A daily report of Tests to be conducted on a day shall be submitted to Engineer-in-charge or his/her designee. All the entries in the registers will be made by the designated Engineering Staff of the Agency. Agency shall be responsible for safe custody of all the test registers.
- 1.18 Submission of copy of all test registers, Material at Site Register and hindrance register along with each alternate Running Account Bill and Final Bill shall be mandatory.
- 1.19 All material received at site shall be entered in MAS Register and copy of Supply order, MTC & Bill-invoice shall be maintained in order. The MAS Registers including Cement and Steel Registers shall be maintained by a qualified staff of Agency which may be inspected by Engineer-in-charge or his/her designee at any time. The daily report of receipt of material shall be sent to Engineer-in-charge or his/her designee.
- 1.20 The agency shall submit a 'Methods statement' for each important activity for the approval of the Engineer-in-charge soon after the award of work to him. The 'Methods statement' is a statement by which the construction procedures for any activity of construction are formulated and stated in chronological order. The 'Methods statement', should have a description of the item with elaborate procedures in steps to implement the same, the specifications of the materials involved, their testing and acceptance criteria, equipment to be used, Precautions to be taken, steps of measurement, etc. as and when any important item is taken up for execution, the Agency shall submit the specifications and develop a checklist and Pour card. This sample checklist should be got approved from the Engineer-in-charge and should be used at site. This check list should be shown to the Engineer-in-charge or his/her designee during inspection. This procedure is to be followed for all hidden items, CC/RCC work, Steel-reinforcement, shuttering, cast-in-situ mosaic flooring, doors & windows, plumbing, including water supply pipe lines, roof treatment, earth filling etc. (Sample attached in Vol. II)
- 1.21 The agency shall render all help and assistance in documenting the total sequence of this project by way of photography, slides, audio-video recording etc. nothing extra shall be payable to the agency on this account.

2.0 Safety, Health and Environment (SHE)

2.1 Protection of Environment

- 2.1.1 The Agency shall take all reasonable steps to protect the environment on and off the Site and to avoid damage or nuisance to persons or to property of the public or other resulting from pollution, noise or other causes arising as a consequence of his methods of operation. The Agency shall be required to follow all the rules/norms of National Green Tribunal applicable to this work.
- 2.1.2 During continuance of the contract, the Agency and his sub-agencies shall at all times, abide by all existing enactments on environmental protection and rules made there under, regulations, notifications and bye-laws of the State or Central Government, or

local authorities and any other law, by-law, regulations that may be passed or notification that may be issued in this respect in future by the State or Central Government or the local authority. However, Salient features of some of the major laws that are applicable are given below:

- 2.1.3 Water Pollution is to be prevented as per The Water (prevention and Control of Pollution) Act, 1974 which provides for the prevention and control of water pollution and the maintaining and restoring of wholesomeness of water. 'Pollution' means such contamination of water or such alteration of the physical, chemical or biological properties of water or such discharge of any sewage or trade effluent or of any other liquid, gaseous or solid substance into water (whether directly or indirectly) as may, or is likely to, create a nuisance or render such water harmful or injurious to public health or safety, or to domestic, commercial, industrial, agricultural or other legitimate uses, or to the life and health of animals or plants or of aquatic organisms.
- 2.1.4 Air Pollution is to be prevented as per The Air (prevention and Control of Pollution) Act, 1981 which provides for prevention, control and abatement of air pollution. 'Air Pollution' means the presence in the atmosphere of any 'air pollutant', which means any solid, liquid or gaseous substance (including noise) present in the atmosphere in such concentration as may be or tend to be injurious to human beings or other living creatures or plants or property or environment.
- 2.1.5 Environment is to be protected as per The Environment (Protection) Act, 1986 which provides for the protection and improvement of environment and for matters connected therewith, and the prevention of hazards to human beings, other living creatures, plants and property. 'Environment' includes water, air and land and the inter-relationship which exists among and between water, air and land, and human being, other living creatures, plants, micro-organism and property.
- 2.1.6 The public Liability Insurance Act, 1991: This provides for public liability insurance for the purpose of providing immediate relief to the persons affected by accident occurring while handling hazardous substances and for matters connected herewith or incidental thereto. Hazardous substance means any substance or preparation which is defined as hazardous substance under the Environment (Protection) Act 1986, and exceeding such quantity as may be specified by notification by the Central Government.

2.2 Conditions of National Green Tribunal

- 2.2.1 The agency shall not store/ dump construction material or debris on the metalled road.
- 2.2.2 The agency shall get prior approval from Engineer-in-Charge for the area where the construction material or debris can be stored beyond the metalled road. This area shall not cause any obstruction to the free flow of traffic /inconvenience to the pedestrians/public in general. It should be ensured by the agency that no accidents occur because of such permissible storage.

- 2.2.3 The agency shall take appropriate protection measures like raising wind breakers of appropriate height on all sides of the plot/area to ensure that no construction material dust fly outside the plot area.
- 2.2.4 The agency shall ensure that all the trucks or vehicles of any kind which are used for construction purposes/or are carrying construction material like cement, sand, earth and other allied material are fully covered. The agency shall take every necessary precaution that the vehicles are properly cleaned and dust free to ensure that enroute their destination, the dust, sand or any other particles are not released in air/contaminate air.
- 2.2.5 The agency shall provide mask to every worker on the construction site and involved in loading, unloading and carriage of construction material and construction debris to prevent inhalation of dust particles.
- 2.2.6 The agency shall provide mask to every worker working on the construction site and involved in loading, unloading and carriage of construction material and construction debris to prevent inhalation of dust particles.
- 2.2.7 The agency shall compulsorily use wet jet in grinding and stone cutting.
- 2.2.8 The agency shall comply with all the preventive and protective environmental steps as stated in the MoEF guidelines, 2010.
- 2.2.9 The agency shall carry out on-Road-Inspection for black smoke generating machinery. The agency shall use cleaner fuel.
- 2.2.10 The agency shall ensure that all DG set comply emission norms notified by MoEF.
- 2.2.11 The agency shall use vehicles having pollution under control certificate. The emissions can be reduced by a large extent by reducing the speed of a vehicle to 20 Kmph. Speed bumps shall be used to ensure speed reduction. In case where speed reductions cannot effectively reduce fugitive dust, the agency shall divert traffic to nearby paved areas.
- 2.2.12 The agency shall ensure that the construction material is covered by tarpaulin. The agency shall take all other precaution to ensure that no dust particles are permitted to pollute air quality because of such storage.
- 2.2.13 The paving of the path for plying of vehicles carrying construction material is more permanent solution to dust control and suitable for longer duration projects.
- 2.2.14 As per EIA Notification of 2006, sufficient green belt around the building shall be provided. Such green belts shall be in existence prior to applying for occupancy certificate and handing it over.

- 2.2.15 Any violation of orders of MoEF including guidelines of State Government, SPCB or any officer of any department shall lead to stoppage of work for which Agency shall be responsible and no hindrance shall be accounted in this regard.

2.3 Covid-19 Case.

- 2.3.1 **The agency shall take all necessary precautions regarding COVID-19 and follow all the Govt. direction issued in this regard.**
- 2.3.2 The Agency shall take all necessary precautions to prevent any nuisance or inconvenience to the owners, tenants or occupiers of adjacent properties and to the public in general and to prevent any damage to such properties and any pollution. He shall make good at his own cost and to the satisfaction of the Engineer-in-charge, any damage to roads, paths, drainage works or public or private property whatsoever caused by the execution of the work or by traffic brought thereon by the Agency. All waste or superfluous materials shall be cleaned away by the Agency without any reservations entirely to the satisfaction of the Engineer-in-charge at no extra cost.
- 2.3.3 The site shall be kept clean of all debris, rubbish and dirt & surplus/waste material all the time. It also includes maintenance, cleaning & de-silting the pipe lines laid by the agency for all internal services etc. executed by the agency to the entire satisfaction of the Engineer-in-charge during the maintenance periods. Cleaning and de-silting will also be done by the agency before handing over the completed structures to CPWD. All machines, equipment and labour for this purpose will be arranged by Agency at no extra cost to CPWD.

2.4 Security of the Site

- 2.4.1 The Agency shall be wholly responsible for security of site and works. The Agency shall be responsible for keeping unauthorized persons off the Site; and Authorized persons shall be limited to the Employees of the Agency, Sub Agency or persons authorized by the Engineer-in-Charge.
- 2.4.2 The contractor shall provide sufficient lighting at project site, of the right type and at the right place / location for it to be properly effective. Lighting ought not to introduce the risk of electric shock. Therefore, 230V supplies should be used for those fittings, which are robustly installed, and well out of reach e.g. flood lighting or high-pressure discharge lamps. The contractor shall ensure that luminaries should always be so placed that no person is required to work in their own shadow and that the local light for one person is not a source of glare for the others. Strongly made clamps should be available for attaching luminaries to poles and other convenient supports.
- 2.4.3 Luminaries shall be robust, resistant to corrosion and rain proof especially at the point of the cable entry. The correct type of lamp for each luminary should be used and when lamps need to be replaced, it shall be in accordance with the supply voltage. Lamp

holders not fitted with a lamp should be capped off. The contractor shall take every effort to illuminate the work site as per the direction of Engineer-in-charge.

2.5 Traffic Management

- 2.5.1 The basic objective of the following guidelines is to lay down procedures to be adopted by contractor to ensure the safe and efficient movement of traffic and also to ensure the safety of workmen at construction sites.
- 2.5.2 All construction workers should be provided with high visibility jackets with reflective tapes as most of construction activities shall be done within right-of-way of the roads. The conspicuous of workmen at all times shall be increased so as to protect them from speeding vehicular traffic.
- 2.5.3 The Agency shall provide safety helmet, safety shoe and high visibility clothing for all employee including workmen, traffic marshal and other employees who are engaged for any work under this contract as per the following requirement:

All employees of the Agency including workmen	Traffic marshals
i) Hard hat with company Logo ii) Safety boots iii) Hi-visibility waistcoat covering upper body and meeting the following requirements as per BS EN 471:1994: (a) Background in fluorescent orange red in colour. (b) Two vertical green strips of 5cm wide on front side covering the torso at least 5cm. (c) Two diagonal strips of 5 cm wide on back in an 'X' pattern covering at least 5cm (d) Horizontal strips not less than 5cm wide running around the bottom of the vertical strip in front and 'X' pattern at back.	i) Hard hat with company Logo ii) Safety boots iii) Hi-visibility jacket upper body and meeting the following requirements as per BS EN 471:1994: (i) Background in fluorescent orange-red in colour (ii) Jackets with full-length sleeves with two bands of retro reflective material, which shall be placed at the same height on the garment or those of the torso. The upper band shall encircle the upper part of the sleeves between the elbow and the shoulder: the bottom of the lower band shall not be less than 5 cm from the bottom of the sleeve. (iii) Two vertical green strips of 5cm wide on front side covering the torso at least 500 cm

(e) The bottom strip shall be at a distance of 5cm from the bottom of the vest. (f) Strips must be retro reflective and fluorescent (g) Waistcoat shall have a side adjustable fit and a side and front tear away feature on vests made of nylon.	(iv) Two diagonal strips of 5cm wide on front side covering the torso at least 500cm (v) Horizontal straight not less than 5cm wide running around the bottom of the vertical strip in front and 'X' pattern at back. (vi) The bottom strip shall be at a distance of 5cm from the bottom of the vest. (vii) Strips must be retro reflective and fluorescent

- 2.5.4 Wherever operations undertaken are likely to interface with public traffic, specific traffic management plans shall be drawn up and implemented by the agency in consultation with the prior approval of local police authorities, and /or the concerned metropolitan/civil authorities as the case may be.
- 2.5.5 Such traffic management plans shall include provision for traffic diversion and selection of alternative routes. If necessary, the agency shall carry out road widening before commencement of works to accommodate the extra load. The agency shall be responsible for getting the "Traffic Management Plan" approved from Traffic Police before taking up any construction activity on the road.
- 2.5.6 The guiding principles to be adopted for safety in construction zone are to Warn the road user clearly and sufficiently in advance, provide safe and clearly marked lanes for guiding road users and marked buffer and work zones. The agency shall provide adequate measures that control driver behaviour through construction zones.
- 2.5.7 The primary traffic control devices used in work zones shall include signs, delineators, Barricades, cones, pylons, pavement markings and flashing lights, deployment of sufficient number of Marshalls on diversion roads.
- 2.5.8 Regulatory signs impose legal restriction on all traffic and they are to be used only after consulting the local police and traffic authorities.
- 2.5.9 Warning signs in the traffic control zone shall be utilized to warn the drivers of specific hazards that may be encountered.
- 2.5.10 The contractor shall place detour signage at strategic locations and install warning signs. In order to minimize disruption of access to residences and business, the contractor shall maintain at least one entrance to a property where multiple entrance/exist.
- 2.5.11 A warning sign shall be installed on all secondary roads which merge with the primary road where the construction work is in progress at sufficient distance before it merges with the primary road so as to alert the road users regarding the "Construction Work in Progress".

- 2.5.12 Materials hanging over/ protruded from the chassis / body of any vehicle especially during material handling shall be indicated by red indicator (red light/flag) to indicate the caution to the road users.
- 2.5.13 The required number of traffic guards /marshals as decided by Delhi Traffic Police /Engineer-in-charge shall be provided during construction period so as to ensure safe movement of traffic without any extra cost to CPWD. In case of default, the traffic guards/ marshals shall be provided by CPWD and cost thereof shall be recovered from the Agency in addition to recovery for violation of tender provisions. No claim whatsoever shall be entertained on this account
- 2.5.14 Incidental Works Such as Bailing-Out Water, Shoring etc.
- 2.5.15 For execution of any items of work where incidental works such as bailing out water, shoring etc. are actually required but not specifically stated in the scope of item and/ or tender document, it is to be understood that the contract amount quoted by the agency shall cover such charges also and nothing extra on account of such incidental charges, if any, shall be paid.

2.6 Various Ancillary Provisions at Site

- 2.6.1 Traffic cones of 500mm, 750mm and 1000mm height and 300mm to 500mm in diameter or in square shape at base and are often made of plastic or rubber and normally having retro-refractories red and white band shall be used wherever required.
- 2.6.2 Drums about 800mm to 1000mm high and 300mm in diameter can be used either as channelizing or warning devices. These are highly visible, give the appearance of being formidable objects and therefore command the respect of drivers
- 2.6.3 The barricading of 6.0-meter height (or as directed by NGT from time to time) all along the periphery of the project site shall be constructed by the Agency with G.I./Galvanized profiled sheet with structural steel framework, as per design & drawings, for full length of the periphery and around construction area. The barricading shall be aesthetically maintained by regular cleaning and painting by the Agency as directed by the Engineer-in-charge, cost of which is deemed to be included in the rate quoted by the Agency. The structural dimension of the barricade, material and composition, its colour scheme, CPWD logo and other details shall be in accordance with the drawing and the direction of Engineer-in-charge, for which nothing extra will be paid to the Agency.
- 2.6.4 The barricading shall be provided continuously during the execution of the entire work till completion and shall not be removed at any stage without prior approval of the Engineer-in-Charge. All barricades shall be conspicuously visible in the dark/night time by the road users so that no vehicle hits the barricade. Conspicuous shall be ensured by affixing retro reflective stripes of required size and shape at appropriate angle at the bottom and middle portion of the barricade at suitable gap. In addition,

minimum one red light or red-light blinker should be placed at the top of each barricade. The barricading shall include the following without any extra cost:

- 2.6.5 Traffic signals during construction at site for day and night, reflective signs, direction boards, marking, glow lamps, marking, caution tape, traffic signage as per requirement, flags, Traffic Marshals etc. as directed by the Engineer-in-Charge. However, traffic police signals shall not be the responsibility of the Agency.
- 2.6.6 Cleaning of barricading every fifteen days with water and detergent so as to ensure that there is no dirt or splashes on the barricading. The dust accumulated along the barricades on the carriageway shall be removed every week.
- 2.6.7 Installation of temporary warning signs/lamps on all barricades during the hours of darkness and kept it lit there at all times during these hours.
- 2.6.8 Shifting and re-fixing in position as per the direction of Engineer-in-Charge and all incidentals to execute the job as many times as directed by Engineer-in-Charge.
- 2.6.9 Repainting of the barricading after regular interval as directed by Engineer-in-Charge and Proper maintenance of the barricading till completion of the work by repairing/replacing the damaged barricade. They shall be maintained in one line and level
- 2.6.10 Barricading is also required to be erected by the Agency at his own cost for segregating the area of work and deep excavation from the movement of man and machinery.
- 2.6.11 Fixing of Lit and Non-lit boards on the barricades of various sizes and design as per the direction of Engineer-in-charge and kept the boards lit at all times during hours of darkness.
- 2.6.12 The barricade shall be allowed to erect on the boundaries marked for the work of phase-I on the drawing. However, agency may be allowed to barricade in the area which does not fall under his work's jurisdiction but required to carry out the work of phase-I. This extra barricading shall be allowed on temporary basis but shall be removed after the completion of the work so that the work of other phases does not get affected.
- 2.6.13 The Agency shall ensure the cleanliness of roads and footpaths by deploying proper manpower for the same. The Agency shall have to ensure proper brooming, washing of roads and footpaths, at all the time, throughout the entire stretch till the currency of the contract including disposal of sweeping without any extra cost.

2.7 Existing Services & Storage/Labour Camps within Site

- 2.7.1 **Existing Services** 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/ maintained against the damage by the Agency. The Agency shall identify all underground / overhead services and take necessary measures to protect the services

before starting any excavation / activity. All temporary supports and other measures required to protect and maintain the services during construction period as per direction of Engineer-in-charge, shall be deemed to be included in the quoted rate / amount of the Agency and nothing extra shall be paid on this account. For any permanent shifting, CPWD shall arrange to shift the services as and when required. However, in the interest of work, if CPWD decides to get it shifted by the Agency, then Agency shall be paid separately at the rates as decided by the Engineer-in-charge based on the actual quantum of the work involved in shifting such utilities/services. The decision of the Engineer-in-Charge in this regard shall be final and binding.

2.8 Land for Storage/Labour Camps/RMC

- 2.8.1 Agency shall manage all activities within the land portion shown in the drawing. CPWD is not obliged to make any other land available for Batch Mix Plant, Store, Preserving Top Soil etc.

2.9 Agency's care of the Works

- 2.9.1 The Agency shall bear full risk in and take full responsibility for the care of the Works and Materials, goods and equipment for incorporation therein from the Commencement Date until the Completion Certificate is issued, except and to the extent that any loss of or damage to the same shall arise out of any default or neglect of the Employer.
- 2.9.2 The Agency shall throughout the execution of the Works including the carrying out of any testing, commissioning (including Integrated Testing and Commissioning), or remedying of any defect;
- 2.9.3 Take full responsibility for the adequacy, stability, safety and security of the Works, Plant, Goods, Agency's Equipment, Temporary Works, operations on Site and methods of manufacture, installation, construction and transportation;
- 2.9.4 Have full regard for the safety of all persons on or in the vicinity of the Site (including without limitation persons to whom access to the Site has been allowed by the Agency), comply with all relevant safety regulations, including provision of safety gear, and insofar as the Agency is in occupation or otherwise is using areas of the Site, keep the Site and the Works (so far as the same are not completed and occupied by the Employer) in an orderly state appropriate to the avoidance of injury to all persons and shall keep the Employer indemnified against all injuries to such persons.
- 2.9.5 Provide and maintain all lights, guards, fences and warning signs and watchmen when and where necessary or required by the Engineer-in-Charge or by laws for the protection of the Works and for the safety and convenience of the public and all persons on or in the vicinity of the Site.

- 2.9.6 Where any work would otherwise be carried out in darkness, ensure that all parts of the Site where work is being carried out are so lighted as to ensure the safety of all persons on or in the vicinity of the Site and of such work.
- 2.9.7 Agency is required to take note of all the necessary provisions in Employer's Safety, Health and Environment Manual (SHE Manual) and the Agency's price shall be inclusive of all the necessary costs to meet the prescribed safety standards. In the case, the Agency fails in the above, the Employer may provide the necessary arrangements and recover the costs from the Agency.
- 2.9.8 All stairways, passageways and gangways shall be maintained without any blockages or obstructions.
- 2.9.9 All emergency exits passageways, exits fire doors, break-glass alarm points, fire-fighting equipment, first aid stations, and other emergency stations shall be kept clean, un-obstructed and in good working order.
- 2.9.10 All surplus earth and debris shall be removed/ disposed-off from the working areas immediately. Trucks carrying sand, earth and any pulverized materials etc. shall be covered while moving in order to avoid dust or odour impact. The tyres of the trucks leaving the site shall be cleaned with water, wherever the possibility of spillage on carriageways meant for regular road traffic exists.
- 2.9.11 No parking of trucks/trolleys, cranes and trailers etc. shall be allowed on roads, which may obstruct the traffic movement.
- 2.9.12 Roads shall be kept clear and materials like: pipes, steel, sand boulders, concrete, chips and brick etc., shall not be allowed on the roads to obstruct free movement of road traffic.
- 2.9.13 Water logging or bentonite spillage on roads shall not be allowed.
- 2.9.14 Proper and safe stacking of material are of paramount importance at fabrication stores, stores and such locations where material would be unloaded for future use. The storage area shall be well laid out with easy access and material stored / stacked in an orderly and safe manner.
- 2.9.15 Flammable chemicals, compressed gas cylinders etc. shall be safely stored. Unused/surplus cables, steel items and steel scrap lying scattered at different places within the working areas shall be removed to marked locations(s). All wooden scrap, empty wooden cable drums and other combustible packing materials, shall be removed from the site. Lumber with protruding nails shall be either bent/ removed and properly stacked.

- 2.9.16 The compliance of above provisions is deemed to be included in the quoted amount of the Agency and no claim / payment whatsoever shall be entertained on this account.

2.10 Safety

- 2.10.1 Minimum one Safety Officer/ Manager is required to be at site at all times.
- 2.10.2 Qualifications of Safety Coordinator/ Manager should not be less than those prescribed in local regulation in building and other construction workers (regulation of employment & conditions of service) central Rules,1998.
- 2.10.3 Agency shall arrange for initial Site orientation / induction of all Workmen / Supervising personnel on 'Safety practices' before beginning of work at site. This shall include a briefing about project, safety policy, site safety rules and site facilities.
- 2.10.4 Agency shall conduct a daily toolbox talk for all workers previous to starting to work.
- 2.10.5 These tool box talks should include topics related to ongoing work activities and precautions to be taken on daily activities.
- 2.10.6 Agency shall ensure participation of his site in-charge and the safety coordinator in the safety meetings arranged at intervals decided by the Engineer-in-Charge.
- 2.10.7 Agency shall also submit a Health & Safety report on monthly basis or as directed to Engineer-in-Charge.
- 2.10.8 Agency's Safety Engineer / Safety Officers shall:
- a. Assist the Agency's Construction Manager and coordinate with consultant's Safety Supervisor for the implementation of the HSE program within corresponding work groups.
 - b. Get familiarized with all government, and Owner's safety and health regulations, including reports and work permits procedures.
 - c. Inspect the construction area on a regular basis in order to verify appropriate corrective actions and prepare reports to their Construction Manager.
 - d. Review the SAP (Safety Action Plan) prepared by line supervisor.
 - e. Co-ordinate with supervisors and foremen periodical safety meetings and lead daily safety meetings.
 - f. Conduct safety training classes for all workers.
 - g. Participate in Tool Box Talks.
 - h. Suggest safety promotional activities.
- 2.10.9 Information to Be Provided by Agency
- a. Health, Safety and Environment policy
 - b. A detailed Health, Safety and Environment plan.

- c. Names of the Safety personnel.
 - d. Employers' liability insurance policy.
 - e. Work method statements for critical operations such as lifting etc.
 - f. Test Certificates for lifting gear, lifting equipment and accessories.
 - g. Information related to hazardous materials used and corresponding MSDS (Materials Safety Data Sheets).
 - h. Daily labour returns
 - i. Copies of all Statutory Records.
 - j. Copies of the Agency Safety's reports
 - k. Supervisor's reports of his findings on site inspections.
 - l. Initial site orientation / induction
- m. The number of orientation sessions presented each week will vary to the greatest extent possible in order to accommodate the Agency's needs to bring labour on site.
- 2.11** The following topics shall be included during such presentations, which will change during the course of the project to meet changing site requirements:
- a. Introduction to the site and project, with a brief overview of the project under constructions.
 - b. Owner and consultant's HSE policy and safety philosophy.
 - c. Personal Protective Equipment (hard hats, safety glasses, safety steel-toed boots)
 - d. Working in and around excavations
 - e. Working at height (ladders, scaffolds, free edges and openings)
 - f. The Safety Action Plan (SPA)
 - g. First aid facilities, Accident reporting system
 - h. Emergency procedure
 - i. Smoking restrictions, prohibition of alcohol and drugs.
 - j. The Agency will conduct a site visit for his new employees in groups of less than 25 so that they get acquainted with essential services, their work place, and general site layout.
 - k. Gate pass will be issued only after completion of the site orientation / induction.

2.12 Personal Protective Equipments (PPE)

2.12.1 The Agency shall provide required PPEs to workmen to protect against safety and/or health hazards. Primarily PPEs are required for the following protection.

- (a) Head Protection (Safety helmets)
- (b) Foot Protection (Safety footwear, Gumboot, etc.)
- (c) Body Protection (High visibility clothing (waistcoat/jacket, Apron, etc.)
- (d) Personal fall protection (Full body harness, Rope-grape fall arrester, etc.)
- (e) Eye protection (Goggles, Welders glasses, etc.)
- (f) Hand protection (Gloves, finger coats, etc.)
- (g) Respiratory Protection (Nose mask, SCBAs, etc.)
- (h) Hearing protection (Ear plugs, Ear muffs, etc.)

- (i) The PPEs and safety appliances provided by the Agency shall be of the standard as prescribed by Bureau of Indian Standards (BIS). If materials conforming to BIS standards are not available, the Agency shall procure PPE and safety appliances, as approved by the Engineer-in-charge.

Safety Helmet Colour Code	Person to use
White	CPWD/CPWD staff
Grey	All designers, Architect, Consultants etc.
Violet	Main Agencies (Engineers/Supervisors)
Blue	All Sub-Agencies (Engineers/Supervisors)
Red	Electricians (both Agency and sub-Agency)
Green	Safety Professionals (Both Agency and sub-Agencies)
Orange	Security Guards/Traffic Marshals
Yellow	All workmen
White (with “Visitor” sticker)	Visitors

*(Every Helmet should have the LOGO affixed/painted).

- (ii) All construction workers should be provided with high visibility jackets with reflective tapes confirming to the requirement specified under BS EN 471: 1994. The conspicuous of workmen at all times shall be increased so as to protect them from speeding vehicular traffic.
- (iii) In addition to the above, any other PPE required for any specific jobs like, welding and cutting, working at height, tunnelling etc. shall also be provided to all workmen and also ensure that all workmen use the PPEs properly while on the job. The Agency shall not pay any cash amount in lieu to PPE to the workers/sub-Agencies and expect them to buy and use during work.
- (iv) The Agency shall at all-time maintain a minimum of 10% spare PPEs and safety appliances and properly record and show to the Engineer-in-charge during the inspections. It is always the duty of the Agency to provide required PPEs for all visitors & CPWD staff. Towards this required quantity of PPEs shall be kept always at the security post.
- (v) Notwithstanding the above, the Agency shall at their expense arrange for the safety provision as per all relevant Indian Standard Safety Codes & local bye-laws. The Agency shall provide all facilities in connection therewith and shall also issue the identity card to his labourers.

2.13 Sanitation and Hygiene Measures

2.13.1 In order to provide adequate sanitary conditions for all personnel at site, the following provisions as a part of the temporary facilities to be provided by the Agency:

- ii) Provision for an adequate supply of potable water.
- iii) Provision for toilets and hand wash basins.
- iv) Garbage disposal and regular collection.
- v) Proper drainage and sewer disposal.
- vi) Other special hygienic operations viz. Fumigation, pest controls etc.
- vii) Worker's Rest Space:
- viii) Smoking hut
- ix) Sunshade and/or site canteen
- x) Smoking on site is not allowed, « No smoking » signs shall be displayed at prominent location including stores/ storage places.

2.14 Work at Heights

- 2.14.1 During construction of buildings/towers safety net (horizontal and vertical) shall be used by Agency to check/control falling of any object. The Agency/vendor shall also take the other safety measures used during construction, for e.g. Personal Protective Equipment's (PPEs), safety during working at heights etc.
- 2.14.2 The Agency shall provide proper scaffolding and working platforms with handrails to work at higher elevations and Tools and loose material should not be left on the scaffolding from where they are likely to fall. Persons should use safety belts while working near open edge where it is not possible to provide hand rails.
- 2.14.3 Things should not be thrown from heights and should be brought down or taken up with the help of ropes. While work is being carried on at higher elevations, warning notices should be posted below or barricade the area so as to draw the attention of persons and prevent them from coming under the falling objects.
- 2.14.4 Defective scaffoldings, damaged ladders, insufficient working platforms etc. shall not be permitted. Wherever necessary, light weight mobile tower scaffolds or hydraulic platforms should be used.
- 2.14.5 Proper access should be available to the work spot. Nobody should jump over open area between equipment, pipes and rails etc. from where they may slip. Walking over beams, narrow pipes etc. should be prohibited.
- 2.14.6 The area from where the materials is pulled up with ropes etc. should have hand railings and the person should keep firm footing. They should not lean over the handrails and should use safety belts to protect themselves from fall due to body imbalance.
- 2.14.7 The Agency should reduce the hazards associated with falls first through engineering controls and have a formal fall protection program in accordance with Factories Act

requirements. Agency should Institute personal fall arrest systems, administrative controls and training when engineering controls are not feasible.

- 2.14.8 The Agency shall have the necessary fall protection equipment to safely perform the job and properly train workers in the use of fall protection equipment and supervisors (or competent personnel) shall ensure the use of fall protection equipment as required. Agency shall obtain work permit from the Consultant prior to starting of activities requiring fall protection.
- 2.14.9 Should Use powered access safely and Protect holes and leading edges, e.g. with hand rails and toe boards
- 2.14.10 The construction waste from the height should be transferred through closed chutes.
- 2.14.11 All other measures to be taken for the safety at project shall be ensured by the Agency.
- 2.14.12 It shall be deemed that rates quoted by the Agency are inclusive of all the expenditures incurred in the safety procedures. No extra payment on this account shall be payable to Agency.

2.15 Unforeseeable Difficulties

2.15.1 Except as otherwise specifically stated elsewhere in the Contract:

- (a) The Agency shall be deemed to have obtained all necessary information as to risks, contingencies and other circumstances which may influence or affect the Works;
- (b) By signing the Contract, the Agency accepts total responsibility for having foreseen all difficulties and costs of successfully completing the Works; and
- (c) The Contract Price shall not be adjusted to take account of any unforeseen difficulties or costs.
- (d) CPWD shall not provide any material either on chargeable or on free issue basis to the Agency for execution of the project.

SPECIFICATIONS FOR CIVIL WORKS

1. Cement

- (i) The agency shall procure PPC/OPC with fly ash conforming to IS: 1489(Part-I) as required in the work. Cement required for the work shall be procured by the agency from the list of “Acceptable make for Civil Works”
- (ii) The supply of cement shall be taken in 50 kg. bags/ bulkers imprinted with manufacturer's name, ISI marking, brand, quality and quantity of the product. Samples of cement arranged by the agency shall be taken by the Engineer-in-charge and got tested in accordance with provisions of relevant BIS codes.
- (iii) The cement godown/ silos shall always be accessible for the Engineer-in-Charge or his representative.
- (iv) The cement shall be got tested by the Engineer-in-charge and shall be used on the work only after satisfactory test results have been received. The agency shall supply free of charge the cement required for testing including its transportation cost to testing laboratories. The cost of tests shall be borne by the agency. In case the test results indicate that the cement arranged by the agency does not conform to the relevant BIS codes, the same shall stand rejected, and it shall be removed from the site by the agency at his own cost within a week's time of written order from the Engineer- in-charge to do so.
- (v) The actual issue and consumption of cement on work shall be regulated and proper accounts maintained as provided in clause 10 of the GCC. The theoretical consumption of cement shall be worked out as per procedure prescribed in clause 38 of the GCC and shall be governed by conditions laid therein. In case the cement consumption is less than theoretical consumption including permissible variation, the work shall be rejected. However, if in view of engineer-in-charge and third-party quality assurance agency, the matter has merit for review, the same shall be sent to competent authority for further decision in this regard as per GCC clauses.
- (vi) The cement brought to the site and the cement remaining unused after completion of the work shall not be removed from site without the written permission of the Engineer-in-charge.
- (vii) Any damaged/rejected cement shall be removed from the site immediately by the agency on receipt of a notice in writing from the Engineer-in-charge. If he does not do so within 3 days of receipt of such notice, the Engineer-in-charge shall get it removed at the cost of the agency.
- (viii) Durability of concrete structure can be achieved by using proper ingredient, Grade of concrete & mix design as per IS 456:2000 & IS 10262:2008.

2. Steel Reinforcement

Conditions for Steel Reinforcement

- (i) The contractor shall procure ISI marked low alloy TMT Bars (corrosion resistance steel) of appropriate grade from the steel manufacturer such as List of Preferred Makes for Civil Works. Or their authorized dealer having valid BIS License for IS 1786-2008 (latest AMENDMENT). If low alloy TMT bars of any dia of above-mentioned make is not available in market at any time then the contractor on producing non availability certificate from the manufacturers may procure TMT bars of that dia from Steel manufacture as decided by the Engineer-in-Charge.
- (ii) As per CSQ CPWD OM issued by file no. CSQ/SE(TAS)/Steel/2024/262(H) dt. 14.08.2024 Steel bars classified as “Bar Set-I” shall be used in the works. As per Annexure-I(C) of the said OM.
- (iii) **Testing requirement for individual reinforcement bar diameter of Particular Grade of steel:**
Tests required for Fe 415D, Fe500D, Fe550D grade of steel and Low alloy steel reinforcement bars:

NOTE: As a matter of policy only corrosion resistant steel bars are to be used for the work. If, low alloy/CRS bars are not available/ or have delayed delivery in few instances, considering the practical situation and to take care of such instances, the Engineer-in-Charge may allow use of TMT bars of various grades as specified in the NIT from the list of approved makes, given elsewhere in the NIT.

Necessary cost adjustment as per recovery schedule page 82 for not using corrosion resistant steel bars shall be made, based on the actual invoices given by the contractor/ prevailing market rates. The decision of Engineer-in-Charge with respect to any such recovery shall be final and binding on the contractor

A. FOR BAR SET – I

- 1) Tests as per IS 1786 (latest version) and specified therein.

1.1 Chemical Properties

Ladle analysis of steel for above grades for maximum percentage of constituents.

- (i) Carbon (C) (ii) Sulphur (S) (iii) Phosphorous (P) and (iv) Nitrogen and Carbon Equivalent.

1.2 Physical Properties

- (i) 0.2 percent proof stress/yield stress, minimum, N/mm².
- (ii) Ratio of Tensile Strength (Ts) to Actual Yield Strength (or 0.2% of yield stress (Ys)) of the test piece N/mm².
- (iii) Elongation, percent, Minimum, on gauge length $5.65\sqrt{A}$, where A is the cross-sectional area of the test piece.

- (iv) Total elongation at maximum force, percentage, minimum on gauge length $5.65\sqrt{A}$, where A is the cross-sectional area of the test piece.
- (v) Bend test and re-bend test.
- (vi) The mean area of ribs (in mm²) per unit length (in mm) above the core of the bar, projected on a plane normal to the axis of the bar.
- (vii) Pull-out testing in accordance with IS 2770 (Part 1).

2) Additional requirement

2.1 Permissible limit for Manganese and Copper as follows:

Constituent	Permissible Limit (% of cast metal quantity)		
	Fe 415 D	Fe 500 D	Fe 550 D
Manganese (Mn)			
Maximum	1.60	1.60	1.60
Copper (Cu)			
Maximum	0.80	0.80	0.80
Minimum	0.20	0.20	0.20
Notes: The above composition shall be obtained as per latest version of IS 228. 1. Manganese using Periodate Spectrophotometric Method (Part 12), and 2. Copper using Thiosulphate Iodide Method (Part 15) or Spectrophotometric (Diethyl Dithiocarbonate) Method (Part 21)			

2.2 Tempered Martensite Ring Test as per Annexure-1 (d) of OM no. CSQ/SE(TAS)/Steel/2024/262(H) dt. 14.08.2024.

2.3 The process of manufacturing steel complies with the provisions of ISO9001:2015 and ISO14001:2004.

- (iv) The agency shall procure steel reinforcement as per approved list of makes given in this document and directions given by DG, CPWD from time to time.
- (v) The contractor shall have to obtain and furnish test certificates to the Engineer-in-charge in respect of all supplies of steel brought by him to the site of work.
- (vi) Sample shall also be taken and got tested by the Engineer-in-charge as per the provisions in this regard in relevant BIS codes. In case the test results indicate that the steel arranged by the agency does not conform to the specifications, the same shall stand rejected, and it shall be removed from the site of work by the contractor at his cost within a week time or written orders from the Engineer-in-charge to do so.

- (vii) The steel reinforcement bars shall be brought to the site in bulk supply of generally 100 tons or more, or as decided by the Engineer-in-charge.
- (viii) The steel reinforcement bars shall be stored by the agency at site of work in such a way as to prevent their distortion and corrosion, and nothing extra shall be paid on this account. Bars of different size and lengths shall be stored separately to facilitate easy counting and checking.
- (ix) For checking nominal mass, tensile strength, bend test, re-bend test, elongation etc. specimens of sufficient length shall be cut from each size of the bar at random, and at frequency not less than that specified below:

Size of Bar	For consignment below 100 tonnes	For consignment above 100 tonnes
Under 10 mm dia bars	One sample for each 25 tonnes or part there of	One sample for each 40 tonnes or part there of
10 mm to 16 mm dia bars	One sample for each 35 tonnes or part there of	One sample for each 45 tonnes or part there of
Over 16 mm dia bars	One sample for each 45 tonnes or part there of	One sample for each 60 tonnes or part there of

- (x) The agency shall supply free of charge the steel required for testing including its transportation to testing laboratories. The cost of tests shall be borne by the agency.
- (xi) The actual issue and consumption of steel on work shall be regulated and proper accounts maintained as provided in clause 10 of the GCC. The theoretical consumption of steel shall be worked out as per procedure prescribed in clause 38 of the agency and shall be governed by conditions laid therein. In case the consumption is less than theoretical consumption including permissible variations, the work shall be rejected. However, if in view of engineer-in-charge and third-party quality assurance agency, the matter has merit for review, the same shall be sent to competent authority for further decision in this regard as per GCC clauses.
- (xii) The steel brought to site and the steel remaining unused shall not be removed from site without the written permission of the Engineer-in-charge.

3. R.C.C./C.C work (Condition for Ready Mix Concrete)

- (i) The contractor shall procure Ready Mix Concrete (RMC) from the RMC producing plants. (As per approved list attached)
- (ii) Engineer-in-Charge in aforesaid manner or provisions in CPWD Specification 2019, the contractor shall be fully responsible for quality of concrete including input control, transportation and placement etc.
- (iii) For all purpose the contractor shall carry out fully, the responsibilities of the “placement concrete” and the “manufacturer of concrete”.

- (iv) The Engineer-in-Charge reserves the right to inspect at any stage and reject the concrete if he is not satisfied about quality of product at the user's end.
- (v) The Engineer-in-Charge reserves the right to exercise control over the:
 - (a) Ingredients water and admixtures purchased, stored and to be used in the concrete including conducting of test for checking of materials, recording of test results and declaring the materials fit or unit for use in production of mix.
 - (b) Calibration check of the RMC Plant.
 - (c) Weight and quantity check on the ingredients, water and admixtures added for batch mixing.
 - (d) Time of mixing of concrete.
 - (e) Testing of fresh concrete, recording of result and declaring the mix fit or unfit for use. This will be including continues control on the workability during production and taking corrective action, if required.
 - (f) For exercising such control, the Engineer-in-Charge shall periodically depute his authorized representative at the RMC plant. It shall be responsibility of the contractor to ensure that all necessary equipment, manpower & facilities are made available to Engineer-in-Charge and / or his authorized representative at RMC plant.
- (vi) The contractor should therefore draw MOU/Agreement with RMC producer very carefully keeping view all terms and conditions / specifications forming part of this tender document.
- (vii) All required relevant records of RMC shall be made available to the Engineer-in-Charge or his authorized representative. Engineer-in-Charge shall, as required, specify guidelines and additional procedures for quality control and other parameters in respect of materials, production and transportation of concrete mix which shall be binding on the contractor and the RMC plant. Only concrete as approved in design mix by Engineer-in-Charge shall be produced in RMC plant and transport to the site.
- (viii) OPC (Conforming to IS: 8112) of brand / make / source as approved by Engineer-in-Charge shall only be used for production of concrete.
- (ix) Quality control of Ready-Mixed Concrete.
It shall be the responsible of the contractor to ensure that RMC producer provides all necessary testing equipment and take all necessary measures to ensure quality control of ready mixed concrete. In general, the required measures shall be: -
 - (a) Control of purchased materials quality.

RMC producer shall ensure that the materials purchased and used in the production of concrete conform to the stipulation of the relevant agreed standard and the requirements of the concrete mix design and quality control procedure. This shall be accomplished by visual checks, sampling and testing, certification from

materials supplier and information / data from materials supplier. Necessary equipment for the testing of all material shall be provided and maintained in calibration condition at the plant by the RMC producer.

(b) Control of material storage.

Adequate and effective storage arrangement shall be provided by RMC producer at RMC plant for reliable transfer and feed system, drainage of aggregates, prevention of freezing or excessive solar heating of aggregate, prevention of contamination etc.

(c) Record of Mix design and mix design modification.

RMC producer shall ensure that record of mix design and modifications is readily available in his computer at RMC plant for inspection of Engineer-in-Charge or his authorized representative at any time. Any modifications in mix design shall be done only after the approval of Engineer-in-Charge.

(d) Transfer and weighing equipment.

RMC producer shall ensure that a documented calibration procedure is in place. Proper calibration records shall be made available indicating date of next calibration due and corrective action taken. RMC producer shall ensure additional calibration checks whenever required by Engineer-in-Charge in writing to contractor. RMC producer shall also maintain a daily production record including details of customers to whom RMC was supplied including details of mixes supplied. Record shall also be maintained of what materials were used for each day's production including water and admixtures.

The accuracy of measuring equipment shall be within $\pm 2\%$ of quantity of cement and $\pm 3\%$ of quantity of aggregate, admixture and water being measured.

(e) Maintenance of Plant, Truck Mixture and Pumps: -

Plant, Truck Mixtures and Pumps should be well maintained so as to not hamper any operation of production, transportation and placement of concrete.

(f) Production of concrete at RMC producing plant.

(g) Weighing (correct reading of batch accurate weighing): - For each load, written, printed or graphical records shall be made of the weights of the materials batched, the estimate slumps, the total amount of water added to the load, the delivery tickets number for that load and the time of loading the concrete into the truck.

(h) Visual observation of concrete production and delivery or during sampling and testing of fresh concrete (assessment of uniformity cohesion, workability, adjustments to water content) :- The workability of the concrete shall be controlled on a continuous basis during production. The batch mix found unfit shall not be loaded into the truck for transportation. Necessary corrective action shall be taken in the production of mix as required for further batches.

- (i) Adequate testing equipment at the plant including equipment for measuring surface moisture content of aggregates shall be provided by the RMC producer.
- (j) Making corresponding adjustment at the plant automatically or manually to batched quantities to allow for observed, measured or reported changes in materials or concrete qualities.
- (k) Sampling of concrete, testing, monitoring of results.
- (l) Diagnosis and correction of faults identified from observations/complaints.
- (m) Control of designed and prescribed mixes: - A quality control system shall be operated to control the strength of designed mixes the required levels. The system shall include continuous analysis of results from cube tests.

4. Design Mix Concrete

Following parameters shall be adopted for mix design as per IS-456-2000 (Latest Edition).

- (i) Approved admixtures conforming to IS 9103 shall be permitted to be used. The chloride content in the admixture shall be satisfying the requirement of BS 5075. The total amount of chloride content in the admixture mixed concrete shall satisfy the requirement of IS 456-2000.
- (ii) The Concrete mix design with and without admixture will be carried out by the Contractor, at his own cost, through one of the following laboratories/ Test House to be approved by Engineer-in-Charge: -
 - (a) Any IIT.
 - (b) National Council for Cement & Building Materials, Ballabhgarh.
 - (c) CRRI, Delhi.
 - (d) Delhi Technological University, Shahabad Daulatpur, New Delhi.
- (iii) In the event of all the four laboratories being unable to carry out the requisite design/ testing, the contractor shall have to get the same done from any other reputed laboratory with prior approval of the Engineer- in-Charge.
- (iv) The various ingredients for mix design/ laboratory tests shall be sent to the approved lab/ test houses through the Engineer – in – Charge and the samples of such ingredients sent shall be preserved through at site by the contractor till completion of work or change in Design Mix whichever is earlier. The sample taken from the approved materials which are proposed to be used in the work.
- (v) The Contractor shall submit the mix design report from approved laboratory for approval of Engineer-in-Charge within 30 days from the date of issue of letter of acceptance of the tender. No concreting shall be done until the mix design is approved by Engineer-in-Charge.
- (vi) The contractor shall make cubes of trial as per approved laboratory for all grades of concrete in presence of the Engineer-in-charge using same ingredients as adopted for

design mix, prior to commencement of concreting and get them tested in presence of Engineer-in-charge. The testing and the acceptance of the trial mixes shall be as CPWD specifications. The conformity of mix design should be established by conducting three repeat trial mix tests. In each repeat trial mix cubes of standard size 15cm x 15 cm x 15 cm shall be cast, out of which three cubes shall be tested after 7 days & 3 cubes shall be tested after 28 days. The provision shall be as per relevant paras of CPWD specifications 2019.

- (vii) 90% of the total trial mix tests shall be done in the laboratory established at site by the contractor and remaining 10% in the laboratory of Central Design Organization, CPWD or in any other laboratory as directed by Engineer –in-Charge. The testing charges would be governed by para 5.0 of special conditions.
- (viii) For each change of source or quality/ characteristic properties of the ingredients from that approved & used in the concrete mix during the work, a fresh mix design shall be got done by the contractor. However, maximum two such changes shall be permitted in the whole work. For any change, the Contractor shall bear the cost of fresh Mix Design. Revised trial mix tests shall be conducted at laboratory established at site or Engineer-in-charge may order for testing of these cubes from any approved laboratory.
- (ix) The cost of packaging, sealing, transportation, loading, cost of samples and the testing charges for mix design in all cases shall be borne by the Contractor.
- (x) The mix design shall be done considering the degree of quality control as “GOOD” in all cases.

5. Requirements of Design Mix

- (i) The mix design for a specified grade of concrete shall be done for target mean compressive strength

$$T_{ck} = f_{ck} + 1.65 S$$
 Where : f_{ck} = characteristic compressive strength at 28 days.
 S = Standard deviation which depends on degree of quality control.
- (ii) The degree of quality control for this work shall be “GOOD” for which the standard deviation (s) for different grades of concrete as per IS 456-2000 shall be followed. Standard deviation calculation of test results shall also be done as per clause 9.2.4 of IS 456-2000 for maintaining the quality control.
- (iii) The mix design shall be carried out generally in accordance with the provisions made in CPWD specification and IS456-2000 read along with the provisions mentioned in these documents.
- (iv) Acceptance criteria for trial Mix: -
 Average of all the cubes tested at 28 days shall be more than target mean strength (i.e. $f_{ck} + 1.65 S$). No. individual cube shall be less than 0.85 times target mean strength.

(v) Work strength Test and Acceptance criteria: -

Work strength Test for strength of concrete shall be carried out as per para 5.8.12.2 of CPWD specifications 2002, relevant paras of CPWD specifications-2019 will supersede. 90% of the total work strength tests shall be done at the laboratory established at site by the contractor and remaining 10% in the laboratory of Central Design Organization, CPWD or in any other laboratory as directed by Engineer-in-charge. The testing charges would be governed by para 5.0 of special conditions. The acceptability criterion given in para 5.8.4.1 of CPWD specifications 2002, relevant paras of CPWD specifications-2019 will supersede shall be read along with followings: -

- (a) In case four consecutive tests results (as per 5.8.4.1 of CPWD specifications) are not available in one day's concreting the standard deviation for purpose of acceptance of concrete shall be calculated on the basis of all the cube test results of the particular day of concreting.
- (b) If the cube results of individual cube do not comply with the conditions mentioned in column 3 of Table 6 of para 5.8.4.1 of CPWD specifications 2002, relevant paras of CPWD specification 2019 will superseded but the test results satisfy the requirement of mean compressive strength as mentioned in column 2 of above table the concrete represented by the cube not meeting the requirement shall be at risk. The Engineer-in-Charge reserves the right to reject the said concrete or to accept it at reduced rate subject to establishing the structure adequacy by mean of additional tests and suitable remedial measures as directed by Engineer-in-Charge.

6. All RCC works shall be of minimum M30 grade as per approved structural drawings, using fly ash and cement content as per approved design mix. Admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer - in - charge. Fly ash can be omitted but no extra payment will be made for that.

7. Minimum cement content in each concrete grade shall be:

- a. M10: 220 kg/cum
- b. M15: 240 kg/cum
- c. M25: 330kg/cum
- d. M30: 350kg/cum
- e. M35: 370 kg/cum
- f. M40: 390 kg/cum.

No extra payment shall be made for extra cement if provided as per approved mix design. Mix design with cement content less than above shall not be approved.

**Production of Design Mix Concrete from Fully Automatic Computerised
Concrete Batching and Mixing Plant**

1. All concrete shall be produced at site through fully computerised weigh-batching plant of suitable capacity conforming to IS:4925 (2004) with the arrangements for automatic dispensing of admixture and having facility of giving print out indicating weight / details of all ingredient of concrete in each lot/ batch and variations from the approved design mix if any. Minimum 1 fully automatic batching and mixing plant having capacity not less than 30 cum/ hour shall be installed at site by the contractor. The batching and mixing plants shall be dedicated plant for this project. Contractor shall make his own arrangements for the necessary infrastructure for installation of batching plant and other machineries. However, if due to any reason, contractor wishes to supplement the concrete from Ready Mix Concrete (RMC) supplier, he is permitted to procure the same from the source approved in tender document or by the Engineer-in-charge. In such a situation, all technical requirements such as cement type and minimum cement quantity, w/c ratio, slump, admixture etc shall be conveyed to RMC supplier by the contractor and contractor shall be wholly responsible for ensuring the property of concrete as required at site.

The batching and mixing plant shall be fully automatic of suitable capacity not less than 30 cum./hour. Automatic batcher shall be charged by devices which when actuated by a single starter switch will automatically start the weighing operation of each material and stop automatically when the designated weight of each material is fed in the mixer. The batching plant shall have automatic arrangement for dispensing the admixture and shall be capable of discharging water in more than one stage. A batching plant essentially shall consist of the following components:

- a. Separate storage bins for different sizes of aggregates, silo for cement and fly ash;
- b. water storage tank.
- c. Batching equipment
- d. Mixers
- e. Control Panels
- f. Mechanical material feeding and elevating arrangements
- g. RO Plant of adequate capacity to feed Batch mix plant.

The compartments of storage bins for aggregates shall be approximately of equal size. The cement compartment shall be centrally located in the batching plant. It shall be water tight and provided with necessary air vent, aeration fittings for proper flow of cement & emergency cut off gate. The aggregate and sand shall be charged by power operated centrally revolving chute. The entire plant from mixer floor upward shall be enclosed and insulated. The batch bins shall be constructed so as to be self-cleansing during draw-down. The batch bins shall in general conform to the requirements of IS:4925 (2004).

The batching equipment shall be capable of determining and controlling the prescribed amounts of various constituent materials for concrete accurately i.e. water, cement, sand, individual size of coarse aggregates etc. The accuracy of measuring devices shall fall within the following limits.

Measurement of Cement:	$\pm 2\%$ of the quantity of cement in each batch
Measurement of Water:	$\pm 3\%$ of the quantity of water in each batch
Measurement of Aggregate:	$\pm 3\%$ of the quantity of aggregate in each batch
Measurement of Admixture:	$\pm 3\%$ of the quantity of admixture in each batch

The batching and mixing plant shall have the provision of adjusting the plus / minus quantity of the various ingredients in the next batch so that there is no variation in quantity of ingredients from design mix in a lot consisting of 5 to 6 batches.

The mixer in the batching plant shall be so arranged that mixing action in the mixer can be observed from the operator's station. The mixer shall be equipped with a mechanically or electrically operated timing, signalling and metering device which will indicate and assure completion of the required mixing period. The mixer shall have all other components as specified in IS: 4925 (2004).

2. Transportation, Placing and Compaction of Concrete

Mixed concrete from the RMC / Batching plant shall be transported to the point of placement by transit mixers and placed in position through concrete pumps. In case the concrete is proposed to be transported by transit mixer, the mixing speed shall not be less than 4 rev/min. of the drum nor greater than a speed resulting in a peripheral velocity of the drum 70 m/minutes at its largest diameter. The agitating speed of the agitator shall be not less than 2 rev/min nor more than 6 rev/min of the drum. The number of revolutions of the mixing drum or blades at mixing speed shall be between 70 to 100 revolutions for a uniform mix, after all ingredients, have been charged into the drum. Unless tempering water is added, all rotation after 100 revolutions shall be at agitating speed of 2 to 6 rev/min and the number of such rotations shall not exceed 250. The general construction of transit mixer and other requirement shall conform to IS:5892 (2004).

In case concrete is to be transported by pumping, the conduit shall be primed by pumping a batch of mortar through the line to lubricate it. Once the pumping is started, it shall not be interrupted (if at all possible) as concrete standing idle in the line is liable to cause a plug. The operator shall ensure that some concrete is always there in the pump receiving hopper during operation. The lines shall always be maintained clean and shall be free of dents at all stages.

3. Waterproofing

The work shall be got executed from the specialized agency as approved by the Engineer-in-charge.

Agency shall submit the names of "water proofing specialist" along with information about their technical capabilities and list of similar works executed by the specialized agency in the past seven years for the approval of Engineer-in-charge at least 100 days in advance from the start of waterproofing work.

Total quantity of the water proofing compound required shall be arranged only after obtaining the prior approval of the make by Engineer-in-charge in writing. Materials shall be kept under double lock and key and proper account of the water proofing compound used in the work shall be maintained. It shall be ensured that the consumption of the compound is as per specified requirements.

The finished surface after water proofing treatment shall have adequate smooth slope as per the direction of the Engineer-in-charge.

Before commencement of treatment on any surface, it shall be ensured that the outlet drain pipes / spouts have been fixed and the spout openings have been eased and rounded off properly for easy flow of water.

The approved specialized agency for the work of water proofing will have to execute a guarantee bond in prescribed Performa enclosed at ANNEXURE-II for removing any defects for at least 10 years. Guarantee bond shall be signed by both the specialized agencies as approved by the Engineer-in-Charge and the agency to meet their liability under the guarantee bond. However, the sole responsibility about the efficiency of water proofing treatment shall rest with the main agency. Any leakage /defects in waterproofing arising during the defect liability period shall have to be got attended immediately within a reasonable time and rectified by the main agency at their cost to the satisfaction of the Engineer-in-Charge. This would include any incidental cost i.e. flooring, filling, tilling, piping and plaster etc. complete and nothing shall be payable to the contractor on this account.

10% of the cost of water proofing work shall be retained as additional security deposit and the amount so withheld would be released after ten years from the date of completion of the entire work under the agreement. If the performance of the work done is found unsatisfactory and any defects noticed during the guarantee period, they shall be rectified by the agency within seven days of receipt of intimation of defects in the work. If the defects pointed out are not attended to within the specified period, the same will be got done from another agency at the risk and cost of the agency.

In all waterproofing works, due care shall be taken on the openings, around pipers or any other service ducts / pipes etc. by using epoxy painting around it and providing bond with GP2.

The specification and method statement shall be submitted by the agency well in advance before the start of execution. The execution shall be allowed only after due approval of engineer-in-charge.

4. Vacuum Dewatering

C.C. pavement of minimum mix M-25 with ready mixed concrete from batching plant. The ready mixed concrete shall be laid and finished with screed board vibrator, vacuum dewatering process and finally finished by floating, brooming with wire brush etc. complete as per specifications and directions of Engineer-in-charge.

5. Material

All materials of construction like cement, aggregate, sand, water etc.

Cement (PPC) is particularly suitable as binding agent. Cement content shall be at the lowest limit. The total filler content consisting of cement and fine particle, shall be limited to a minimum. This factor is of foremost importance both for the vacuum and for the reduction of shrinkage.

6. Grade of Concrete

Minimum grade of concrete used shall be M-30 conforming to IS-456. Only Design Mix Concrete shall be used.

7. Special Requirement

All works covered by this specification shall be carried out by an experienced agency having expertise in vacuum dewatering concrete system after getting the same approved. Only skilled and experienced operators shall be employed for the purpose. Prior approval of the agency shall be obtained from the Engineer-in-Charge before starting the work. All the equipment shall be of approved and proven types and suitable for the work involved.

Concrete laying pattern shall be decided in consultation with the Engineer-in-Charge and with his approval. The maximum width of a slab strip shall not generally exceed 4 meters and minimum number of construction joints shall be used. Alternate slab strips shall be sequentially laid. Any damage to the already finished top surface shall be avoided. At construction joints no overflow of mortar or slurry on the already hardened surface shall be allowed while concreting the intermediate slab strip. Such construction joints shall be marked with a thread in a straight line while the concrete is still green. Continuity of reinforcement shall be maintained while laying concrete in slab strips. Edges at expansion joints shall be protected and proper arrangement of shear-transfer shall be provided standards.

For Concrete compaction after placing concrete in position, it shall be vibrated thoroughly using poker/ needle vibrators and thereafter levelled with surface vibrators to produce a homogeneous and smooth concrete surface. In order to achieve a smooth surface to the satisfaction of the Engineering-in-Charge, surface vibrators shall be very carefully used by skilled operators. Over vibration resulting in excess mortar near the surface shall be avoided.

8. Dewatering

Suction mats shall be spread over the levelled fresh concrete surface and shall be connected by suction hose to the vacuum pumps for De-watering of surplus water in the concrete. During De-watering it shall be ensured that no cement/ cement slurry is pumped out.

9. Floating and Trowelling

This shall be done after De-watering by using skim floater (power floater. After this, surface shall be to welded with minimum two passes of power trowel to achieve a wear resistant surface to the satisfaction of the Engineer-in-Charge.

10. Curing

However, all care shall be taken to avoid any stain any permanent stain on the surface. Any stain or permanent marking on the top surface shall be removed by approved means.

Approach Working Platform & Formwork

The Agency shall arrange all approaches, scaffolding, working platforms etc. for carrying out the entire operation safely and in a work-man-like manner. The working area shall be nearly maintained and all the facilities required by the Engineer-in-Charge for proper supervision of the work shall be provided.

The specification and method statement shall be submitted by the agency well in advance before the start of execution. The execution shall be allowed only after due approval of engineer-in-charge.

11. Hardware for Door & Windows

The stainless-steel fittings and fixtures shall be as per specification, machine made and free of fabrication marks, residual effects of welding /riveting etc.

The fitting shall be finished in a Satin fish (brushed finish-satin's commercial purpose) except wherever specified otherwise. The brush effect shall be uniform and without any variations.

Irrespective of the stipulations contained above, the agency shall produce samples for all the fitting in advance and a written approval for the chosen sample shall be obtained from the CWPD. The decision of the CWPD in respect of the specification, quality and make of fitting to be used at site shall be final and binding on the agency. Nothing extra shall be payable on this account.

All the fittings shall provide with all such accessories as are required to complete the item in working condition whether specifically mentioned or not in the Bill of Quantities, specification & elsewhere in this tender document. The quoted rates shall be deemed to be all inclusive for a complete item fit for use including all material. Labour, T & P, Specials, fixing arrangements, nuts, bolts, screws, bushes, all required connection pieces etc. as well as making good the surface wherever required.

All the accessories including brackets, nuts, bolts, screws, bushes etc. shall be of the quality and make specified by the manufacture of the fitting.

All the fitting shall be got fixed through the authorized "Fixing Agency" on the approved list of manufacturers of fitting. The said Fixing Agency shall be got approved from the PMC before start of fixing at site.

All the fitting including accessories shall be accompanied with certificate of origin and representative test certificate of conformance with relevant code form the manufacturer with each lot supply. The test certificate shall clearly indicate the lot numbers of the supplied fittings.

The specification and method statement shall be submitted by the agency well in advance before the start of execution. The execution shall be allowed only after due approval of engineer-in-charge.

12. The following information shall be submitted by the agency for obtaining approval of the Engineer-in-charge before start of work.

12.1 Product Data : Manufacturer's data sheets on each product to be used, including preparation instructions and recommendations. Storage and handling requirements and recommendations. Details of construction and fabrication. Installation methods.

12.2 Shop Drawings: Detailed plans and elevations, details of framing members, anchoring methods, clearances, hardware, and accessories clearly shown.

12.3 Manufacturer's Certificates: Certifying that products meet or exceed specified requirements.

12.4 Operation and Maintenance Data: Submit lubrication requirements and frequency, and periodic adjustments required.

12.5 Name of installer: Approved by the manufacturer, specializing in performing work of this section with minimum three years' experience.

Delivery, Storage and Handling Fire rated door set shall be delivered and stored in manufacturer's unopened packaging until ready for installation. It shall be protected from exposure to moisture and shall be stored in a dry, warm, ventilated weather tight location

The Agency shall furnish all materials, labour, operations, equipment, tools & plant, scaffolding and incidentals necessary and required for the completion of all metal work in connection with steel doors, as called for in the drawings, specifications and bill of quantities which cover the major requirements only. Anything called for in the tender documents shall be considered as applicable to the items of work concerned. The supply and installation of additional fastenings, accessory features and other items not specifically mentioned, but which are necessary to make a complete functioning installation shall form a part of this contract.

The Agency shall submit the details of manufacturers from the list of approved makes from which he intends to procure the doors. The agency shall procure the doors only after the approval of the manufacturer from the Engineer-in-charge.

All metal work shall be free from defects, impairing strength, durability and appearance and shall be of the best quality for purposes specified made with structural proprieties to withstand safety strains, stresses to which they shall normally be subjected to. All fittings shall be of high quality and as specified and as per approval. The Agency shall strictly follow, at all stages of work, the stipulations contained in the Indian Standard Safety Code or its Equivalent British Standard and the provisions of the safety code and the provision of the safety rules as specified in the General Conditions of the Contract for ensuring safety of men and materials. Any approval, instructions, permission, checking, review, etc. by Engineer-in-Charge, shall not relieve the Agency of his responsibility and obligation regarding adequacy, correctness, completeness, safety, strength, quality, workmanship.

Testing: The fire doors shall be tested by CBRI or any Test Lab approved by the competent authority. Galvanized steel to be used conforming to IS:277.

Mock-up: Before proceeding for mass production of all units, the agency shall fix typical mock-up units of each type to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution. The agency shall proceed for mass production only after approval of Mock-ups by Engineer-in-Charge or his authorized representative.

The specification and method statement shall be submitted by the agency well in advance before the start of execution. The execution shall be allowed only after due approval of engineer-in-charge.

Generalized Guidelines/Specifications for Civil Work

Item No.	Description	Brief Specification Guidelines
1.0	General Guidelines /Specifications	1. All the items of Delhi Schedule of Rates are in the scope of work against the tender, as may be applicable, according to the design developed by the contractor and discharged by the Engineer-in-Charge by way of Good for Construction drawings. 2. CPWD Specifications 2019 Vol-I and Vol-II as amended from time to time shall be applicable for all the items to be executed as per Good for construction drawings. 3. Provisions contained in Harmonized Guidelines & Standards for Universal Accessibility in India 2021 (available on CPWD Website) of Ministry of Housing and Urban Affairs; Government of India shall be complied with while preparing drawings. 4. Contractor shall submit detailed Architectural working drawings to Engineer- in-Charge. The Engineer-in-Charge shall get it examined from the designated Architect of the project and issue NOC for taking up work. 5. Contractor shall submit Good for construction drawings (structural, services, MEP etc.) to the Engineer-in-Charge. Work shall be executed only as per NOC issued for Good for construction drawings (structural, services, MEP etc.) by the Engineer- in-Charge, for which he shall take prior internal approval from the authority competent to accord technical sanction. 6. Contractor shall carry out his own soil investigation from a soil investigating agency approved by the Engineer-in-Charge for the purpose of design of foundation and superstructure. In case of any contradiction between Geo technical report appended with tender documents and that undertaken by contractor, the report suggesting of weaker technical conditions shall prevail. 7. Type of cement to be used in the work shall be as per provisions of IS: 456 with regard to exposure conditions including Sulphate attack. 8. C&D waste products and recycled aggregates to the extent provided in IS codes shall be used as per extant provisions of green building measures. 9. Only potable water shall be used in the work.

2.0	Earthwork foundation and plinth	1. Scope of work includes all items of DSR as contemplated in the Sub Head Earthwork of DSR (including bailing and pumping out water, strutting etc.) as may be applicable to the work as per design and drawings submitted by the contractor and as confirmed by the Engineer-in-Charge and are to be executed as per CPWD specifications. 2. Surplus excavated earth shall be disposed of by the contractor after remittance of due royalty to concerned authority, as applicable, by the contractor. 3. Filling available earth or earth brought from outside shall be done as per requirement to level the ground as per approved drawings. 4. Plinth filling shall be done as per the recommendation of the soil investigation report or with earth suitable for plinth filling including filling of sand of grading zone IV or V as per CPWD specifications and thickness as per drawing. 5. Appropriate ground improvement or soil stabilization measures as per the soil investigation report and structural design, if any recommended shall be carried out. 6. Appropriate foundation system Including isolated footing/combined footing/ Raft/ pile and possible combination of the seas per there commendations of the soil investigation report containing borehole data, seasonal variation of subsoil water table, and as per structural design conforming to relevant Indian Standard Codes shall be provided. 7. Anti-termite treatment as per the necessity of ground shall be carried out as per relevant Indian standard codes/CPWD specifications. 8. Structural Grade slab as per the functional requirement of supported flooring shall be designed & provided accordingly. 9. Damp proof course shall be provided as per CPWD specification. 10. Drainage and Plinth protection along the perimeter of the buildings shall be provided as per CPWD specifications or as per specific functional requirement.

3.0	Superstructure	1. Structural system for the superstructure shall be adopted as per the technology mentioned in the tender document and in line with the list of structural system technologies circulated vide OM No. 17/SE(TAS)/BMTPC/2022/105-H dated 24.03.2022 as amended from time to time. Sl. No. 11 of Table IA is deleted. 2. Structural design shall be carried out conforming to relevant Indian Standard codes. Building shall be designed based on latest IS codes and should have seismic resistant provisions as per IS codes. The materials like concrete, steel, centring and shuttering shall be as per the approved technology and as per CPWD specifications/ IS codes. Minimum M-30grade design mix concrete shall be used for RCC work. Minimum Fe-500 D grade low alloy steel (CRS Bar set-1) as per provisions contained in Note-3 of Para 4.2 of amendment number 3 to IS 1786 shall be used in the work. 3. All the horizontal, vertical, inclined projections of the structure like porticos, slab projections, staircases, mumty, machine rooms, water tanks, any other architectural features shall be designed as integral part of the structure and provided. 4. Expansion joints/seismic separation joints shall be provided as per the approved structural drawing and treated and covered as per CPWD specifications / manufacturer specifications. 5. The Structural Steel shall be made at least 2 hrs fire resistant by using Intumescent Fire Paint / Vermiculite coating as per manufacturer's specifications and by applicators approved by the min case measures stipulated in NBC 2025 are not possible to adopt. 6. External walls and internal partitions/walls if not designed as integral part of the super structure shall be provided as per Schedule (Civil) No, 1

4.0	Reinforced Cement Concrete Works	1. All RCC works shall be of minimum M30 grade as per approved structural drawings, using fly ash and cement content as per approved design mix. Admixtures in recommended proportions as per IS: 9103 to accelerate/retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer - in - charge. 2. Fly ash can be omitted but no extra payment will be made for that. 3. Minimum cement content in each concrete grade shall be: a. M10: 220 kg/cum b. M15: 240 kg/cum c. M25: 330kg/cum d. M30: 350kg/cum e. M35: 370 kg/cum f. M40: 390 kg/cum. 4. No extra payment shall be made for extra cement if provided as per approved mix design. 5. Mix design with cement content less than above shall not be approved. GI coated metal sleeves of required dia. shall be provided in RCC shear walls/beams in all floors as shown in Drawings for taking service lines.
6.0	Steel reinforcement	1. Steel reinforcement shall be Thermo- Mechanically Treated Bars Grade Fe- 500 D (CRS /low alloy steel Bar set-1) or more for R.C.C. work including supplying, straightening, and cutting, bending, placing in position and binding including Reinforcement Coupler/ Mechanical Splice after testing and all complete. 2. Reinforcement coupler shall be approved (if used) before Execution of work.
7.0	Flooring	1. Flooring shall be provided as per Schedule (Civil)No.2. 2. Skirting Flushed with the wall minimum 100 mm high and of flooring materials to be provided as per functional and architectural requirement. 3. Levelling course to be provided on the top of RCC slab before laying flooring as per site requirement, if required.
8.0	Door, Windows, Ventilators, Fittings & Fixtures	1. Doors, windows, ventilators including fittings fixtures and glazing shall be provided as per Schedule (Civil) No 3. 2. Provision for SS 304 mosquito proof shutters shall be made as per requirement for external doors/windows. 3. Windows along with glazing shall be designed for wind

		loads applicable to the area/location as per relevant IS codes. - Wherever required for security concerns, MS/aluminium/SS 304 grills in windows as per approved design shall be provided as per Schedule (Civil) No. 9 - Curtain rods of Stainless steel shall be provided as per Requirement as per Schedule (Civil)No3. - Blinds vertical/horizontal/roller of approved make and opacity shall be provided at windows at as per Schedule (Civil) No. 3
9.0	Internal Finishing painting, dado, false ceiling	Internal Finishing painting, dado, false ceiling shall be provided as per Schedule (Civil) No. 4
10.0	Cupboards wardrobe & Kitchen cabinets/ Modular kitchen	Cupboards, wardrobe & kitchen cabinets/modular kitchen in kitchen shall be provided as per Schedule (Civil) No. 5
11.0	External finishing.	- External finishing shall be provided as per Schedule (Civil) No. 6 - Structural glazing/cladding system shall be designed for applicable wind loads, thermal expansions and seismic movements.
12.0	Internal Water Supply, Sanitary lines and fittings fixtures	- Dual piping system shall be provided as per Schedule (Civil) No.7 wherever recycled water is used for flushing. Separate pipe lines for hot and cold-water supply shall be provided Pipe lines and their accessories shall be of approved make. - Plumbing shall have provision for Geysers, water purifier, washing machines, Dish washers, cage washers, RO filter (in kitchen) or any other equipment as per functional Requirement as per Schedule (Civil)No.7. - Piping has to be done such that every house shall be provided with Individual water meter at a designated location. - In toilets and other waste water disposal areas sanitary pipe lines shall be suspended from the floor slabs i.e. the floor slabs should not be depressed on account of accommodating sanitary lines. These overhanging sanitary lines shall be camouflaged by moisture resistant metallic false ceiling. - Plumbing system shall be designed and provided as per the functional requirements of the buildings.

		6. Double stack system shall be followed. All sewerage to be connected one stack and all drainage to be connected to other stack. 7. Water supply and sanitary fittings shall be provided as per the functional and architectural requirements. 8. Exposed pipes shall be placed over saddle duly fixed to the wall by bracket. 9. All drainage in balconies shall have their inlets in plan. All drainage through balconies shall be connected to Rainwater Harvesting. 10. For high rise buildings the stacks shall be provided in shafts and the shafts shall be opening in balconies, shafts shall be covered with weather proof doors and accessible platform at each floor level from balconies for maintenance. 11. For high rise buildings (Buildings whose height is more than 15m) the stacks shall be provided in shafts and the shafts shall be opening in balconies, shafts shall be covered with weather proof doors and accessible from balconies for maintenance.
13.0	External Water Supply pipelines & Sewage lines Fittings & fixtures/ chambers Sewage pipeline Fittings & fixtures/chambers	1. External water supply & sanitary installation fittings and fixture shall be provided as per Schedule (Civil) No. 8 2. Dual piping system shall be proved, as required, where recycled water is used for flushing, Horticulture, firefighting purposes and for cooling towers for chiller units. 3. Inspection chambers/manholes/ gullies chambers/ valves and other accessories of approved specifications and make shall be provided considering all the site conditions and reduced level as per design parameters.
14.0	Storage tanks	1. Bulk storage tanks including fire tank of required capacity underground and overhead shall be provided. If required hydro pneumatic system of pumping shall be designed and adopted.
15.0	Service Buildings	2. Transformer yard, DG set yard, Substation building, pump house, fire pump room shall be provided as per drawings and design approved by Engineer-in-Charge.

16.0	Roads/ Footpaths/ Kerbstones/ Parking Shed and signage's Compound wall & Gate, Parapet	1. Cement concrete/Bituminous concrete-wearing course, Minimum 200 mm thick Wet mix macadam/150mm thick dry lean concrete-base course. 2. Minimum 250 mm thick Granular sub base More thickness to be provided as per design considering actual ground conditions and traffic load. 3. Footpaths shall be provided as per requirement and design with 60mm thick factory-made interlocking paver blocks of M-35 grade/16 mm thick factory-made chequered cc tiles/vitrified tiles. Factory made Kerb stones of required sizes along the sides of roads and footpaths shall be provided. 4. Covered/open parking areas shall be provided as per requirement with CC/BT/80 mm thick Paver blocks of grade M-40. Roofing if required shall be RCC/Galvalume/CGI/Bamboo sheets supported on RCC /Steel structure. 5. Retro-reflective sign boards shall be made of aluminium /Stainless steel sheet supported on SS 304 frame work Road markings shall be with thermoplastic reflective paint. 6. Rain water harvesting structure complete with excavation, RCC silting chamber, RCC bore well, boring, filling with aggregates, piping, covering with RCC slab, providing manholes etc. complete as direction of Engineer-in-Charge. 7. Roof Top rain water has to be harvested. 8. Storm water drains shall be provided wherever required with Brick masonry / RCC / Precast RCC/ non-pressure RCC pipes/HDPE pipes with road gully chambers as per approved development plan and site conditions. Drain shall be covered using factory made pre cast RCC perforated drain covers. (i) NP3/HDPE pipe of required diameter including testing of joints as per specification shall be provided at road crossings. (ii) Manholes of required dia. and depth shall be provided with brick wall (with Sewer Bricks/CD-100 bricks) as per CPWD specifications or IS codes. In ad-verse sub soil conditions, manholes and sewer lines pipes shall be appropriately designed and provided. 9. The height of parapet wall shall be minimum 1100 mm from finished roof level and all external RCC columns shall be taken up to parapet top level. The parapet height includes the RCC coping of minimum 75mm thickness as per design.

17.0	Waterproofing treatment	1. Waterproofing treatment shall be done as applicable and as required on terraces, toilet slabs, lift pits, water tanks, UG sumps, OHTS and any other liquid retaining structures as per Schedule (Civil) No. 9 Water stops shall be provided in construction joints of liquid retaining structures.
18.0	Railing & Grills	1. Stainless steel of grade SS 304L railing railings shall be provided as per architectural design in Balconies, staircases, steps, Ramps corridors and in other common circulation areas as indicated in drawings and in accordance with provisions of NBC 2025 as per Schedule (Civil)No.10
19.0	Façade/Jalis of shafts	1. Aluminium louvers, GFRC (Glass fibre reinforced concrete)/WPC (Wood Polymer Composite) CNC curtain Jalis to cover exposed Rain water pipe shafts, Toilet shafts and other areas shall be provided as per requirement. The sections for fixing of such Jalis shall be designed as per Codal provisions to with stand wind loads, seismic movements etc.as per Schedule (Civil)No.10.
20.0	Miscellaneous	1. All shafts (Civil and E&M) shall be appropriately closed horizontally and covered with appropriate door system vertically. This arrangement may be augmented as per fire requirements. 2. Kitchen should be so designed so as to ensure that various gadgets ducts are conveyed to service ducts for example ducting for electric chimney. 2. Accessible roofs shall have parapets. 3. One toilet on each floor shall be made as per harmonized disability. guidelines and space standards for barrier free built environment for persons with disability and elderly persons as per finishing specification, Plumbing and Architectural drawings attached and as per CPWD specification.
21.0	Fire rated doors at Lift/ Staircase Lobby	1. Fire Rated Doors: - a. Fire rated doors shall be provided as per Architectural drawings, NBC norms and the Requirements of fire department. Wherever required Insulated fire rated doors having 120minute rating shall be provided. 2. Fire Rated Doors: Location: Staircase on all floors (except on terrace) as per requirement of NBC-2025:- a. ISI marked minimum 60 mm thick Fully Flush step

		design, double skin insulated shutters with or without vision lite as per IS 3614:2021 and tested as per IS/ISO 3008. The door frame and shutter hardware shall be tested as a complete assembly for maximum rating of 120minutes Fire integrity and 30minutes insulation. Door frame must be stepping rebate grooved profile of size 125x 75mm made out of 1.20mm (18gauge) minimum thick galvanized steel sheet. Frames shall be mitred only. Frames shall be field assembled with self-tabs. Bolted & butted joints are not acceptable. Frames to have in build grooved sealing system and shall be site fitted with fire rated EPDM C421 gasket as standard. All provision should be mortised, drilled and tapped for receiving appropriate hardware. Frames should be provided with back plate bracket and anchor fasteners for installation on a finished plastered masonry wall opening. Once frame installed should be filled with PUF as recommended by the manufacturer or Engineer-in-charge. The infill material shall be mineral wool minimum density of 120kg. Door leaf shall be 60 mm thick fully flush double skin step design door, insulated with or without vision lite. Door leaf shall be manufactured from 1.2 mm (18 gauge) minimum thick galvanised steel sheet. The internal construction of the door should be rigid reinforcement pads for receiving appropriate hardware. The infill material shall be 120 kg high density mineral wool insulation material. Intumescent seals 15 x 1.5 mm to be provided. All doors shall be factory prepared for receiving appropriate hardware and provided with necessary reinforcement for hinges, locks and door closers. The door stiles should be interlocked, for pairs of door integral astragals have to be provided on the meeting stile for both active and inactive leaf. Wherever vision panel is required, it should be with clip-on arrangement. All frames and door shutters shall be finished pure polyester powder coated to approved colour and shall have passed minimum 500 hours of salt spray test as per the directions of the Engineer-in-charge. The door set shall include following hardware and accessories as a complete assembly for door of any and minimum 3No. SS ball bearing hinges of SS304 grade of size 100x89x3mm per shutter, 1no Fire rated mortice dead lock including 55 mm BS, 20mm sq. For end, as per EN 12209 with both side key cylinder on active leaf, 1 pair Pull handle D type, 22dia, CTC 300mm, back-to-back, with spindle, SS 304, SS finish. Per shutter, 1No. of Door closer with spring size of EN

		2-4, as per EN1154 and CE marked per shutter, 2 No. flush bolt on the inactive leaf, 1 No. dust proof socket. Suitable anchor fasteners for fixing on different type of wall construction as per manufacturer recommendation. Proper label conforming the type of door and the hourly rating is mandatory for both frame, shutter and glass manufacturer test certificates shall cover doors both single and double leaf as a complete door set assembly within the tested specimen. Vision lite wherever applicable shall be maximum 200 x 300 mm (or max 0.06 sq.mt) with clear borosilicate fire rated glass of 6 mm. Glass shall be fixed with suitable gasket and with clip-on arrangement. 3. Lift Lobby on all floors (except on terrace), and any other areas as per requirement of NBC-2025. a. All the fire Frame and door will be as per item no. 9.161, 9.162 and 9.164 of DSR-2023. The cost of S.S. Ball, Bearing, Hinges etc. is included in the item. Nothing shall be paid on this account extra and any other areas. The Glazing door should be made of SAINT GOBAIN or any other equivalent including fittings with panic bar/latch lock and door closer of. The inactive leaf should be fixed to the frame using tower bolt at meeting edge at top or as per the tested evidence. The system profiles shall offer C4 level of wind resistance when tested as per EN 12210, Class 4 level of air permeability when tested as per EN 12207, Class 5 Impact Resistance when tested as per EN 13049 and shall have 8A class of water tightness when tested as per EN 12208. All hardware and fittings such as, door closer, hinges as per fire norms is included in scope of work.
22.0	Fire Shaft Doors	Providing and fixing 50 mm thick, glazed powder coated Mild sheet door shutters made of 1.2mm thick sheet, fixed with SS ball bearing hinges to door frame of powder coated mild steel of size section 50 x 60 mm on horizontal side & 35 x 60 mm on vertical sides having built in rebate made out of 1.2 mm thick powder coated MS sheet. Glazing shall be 6mm thick float glass of approved make. Powder coating on door frame and shutter shall be post officered or as approved by the Engineer-in-Charge.

23.0	Barricading	Temporary barricading: Contractor shall provide and erect 6 meter high or as required by NGT or by local authority whichever is higher temporary barricading all-round the buildings at site. He shall use pre-coated galvanized iron profile sheets with adequate frame work. The work shall be executed as per approved drawing and direction of Engineer-in-Charge which includes writing and painting, arrangement for traffic diversion such as traffic signals during construction at site for day and night, glow lamps, reflective signs, marking, flags, and caution tape. The barricading shall be retained in position at site continuously till its completion. The barricading shall not be removed without prior approval of Engineer-in-Charge. Nothing extra shall be paid in this regard. The agency to quote the rates accordingly.

Technical Specification for Laboratory

A. Laboratory Fume Hoods Specification

1.1 Description of Work

a) Section Includes:

Furnishing and installing all fume hoods, work tops, understructures, filler panels, knee space panels and scribes as shown on drawings.

b) Accessorizing:

Furnishing and delivering all service outlets, accessory fittings, electrical receptacles and switches, as listed in these specifications, equipment schedules or as shown on drawings. Fittings attached to the fume hood superstructure shall be mounted at the factory.

1.2 Standard fume hood performance requirements

Fume hoods shall be belted counterweight sash design and adjustable LED lighting. Sash and air entry framework of the hood shall minimize eddying of air currents at the hood face, and vertical rear baffle system shall minimize turbulence and vortexes in all portions of the hood interior.

a) Standard Fume Hood Types

b) Constant Volume Fume Hood

- (i) Constant Volume Fume Hood designed to yield 80 FPM face velocity at 18" sash opening
- (ii) Maximum sash opening to be 28", yielding 55 FPM face velocity
- (iii) Notched belt and sprocket sash system
- (iv) LED lighting, with variable intensity and color range

c) Containment:

- (i) The purpose of this specification is to pre-qualify the performance of the bidder's laboratory fume hood before award of contract. At their option, owners or their representatives may require the same tests to be performed and the same performance be achieved before acceptance of the hood after award of contract. The owner or their representative shall witness the tests. Failure to meet the performance specified shall be cause for rejection of the bidder.
- (ii) Test Method:
The hood shall be tested per the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Standard 110-2016.
- (iii) Location of Tests and Test Facility:

All tests referenced herein shall be performed in the bidder's fume hood test facility. Field-testing is described in Section 3.01.F. The test facility shall meet the following requirements:

The test facility shall have sufficient area so that a minimum of 5 feet of clear space is available in front of and on both sides of the hood for viewing tests.

The facility's ventilation system shall have adequate heating and air conditioning so that room air temperatures can be maintained within the desired ranges.

Standard room air currents in the test area shall be less than 30 FPM.

The hood exhaust system shall be properly calibrated so that the desired exhaust air volumes can be easily attained.

Make-up air to the test room shall be ceiling-supplied as in a standard chemical laboratory.

(iv) Instrumentation, Equipment and Test Personnel:

Qualified personnel to perform the tests shall be supplied by the bidder. Instrumentation and equipment required shall be supplied by the bidder at their expense. Required instrumentation shall include but not be limited to the following items:

- a) Thermal anemometer capable of measuring air velocities from 10 to 600 ft./minute
- b) One-half minute smoke candles or other source of high volume smoke
- c) Smoke tubes or other source of localized smoke
- d) Miran 103 analyzer calibrated to indicate concentration of sulfur hexafluoride or equivalent.
- e) Flowmeter - 15 L/minute capacity
- f) Tank of sulfur hexafluoride with a two-stage regulator or other tracer gas suitable for detector to be used
- g) Adjustable mannequin, 5' 0" to 5'8" in height, with reasonable human proportions and arms hanging at its side
- h) ASHRAE 110-1995 tracer gas ejector

(v) ASHRAE Test:

Standard 110-2016 Test Hood shall be tested with a face velocity of 50 FPM (bench hoods only) with the sash at the maximum opening, 28". The hood shall have a performance rating in the static portion of ASHRAE 110-2016 (Section 7.1-7.10) of AM 0.05 or better wherein:

4.0 = tracer gas release in liters/minute

AM = as manufactured

0.05 = 5 minute time average level of control of tracer gas in parts per million (PPM)

(vi) Twisting Manikin Test

A manikin mounted to a twisting base will be placed in standard ASHRAE 110 position. Arms will be altered to hold objects similar in dimension to two 600 ml beakers inside the hood. Manikin twist angle will be such that at the extreme right and left rotational positions, one "beaker" is outside the sash plane. At a rotation rate of 4 cycles per minute, a four-minute run will be undertaken with a sensor in the manikin breathing zone. Average breathing zone concentration shall remain less than 0.05 PPM.

1.3 Quality Assurance

- a) The laboratory fume hood manufacturer shall provide fume hood work tops and casework all manufactured or shipped from the same geographic location to assure proper staging, shipment and single source responsibility.
- b) General Performance: Provide certification that fume hoods meet the performance requirements described in section 1.02.C.

1.4 Materials And Construction

a) Fume Hood Superstructure Frame:

A structure of steel support members shall be provided to support exterior panels and interior liner and baffle panels. To allow for maintenance and replacements, the baffle panels shall be removable without disassembly of the frame structure and outer steel panels. Likewise, the exterior steel panels shall be removable without disassembly of the frame structure and inner liner panels.

b) Fume Hood Side Walls:

Double wall ends, not more than 4.5" wide, with sash track flush with front vertical fascia, shall be provided to maximize interior working area. This fascia shall contain space for the required service controls and electrical devices. The front vertical fascia shall be in a plane 45° from the hood face and incorporate a port to provide accelerating air through the lower corners of the face opening.

c) Fume Hood Dimensions:

Double wall end panel thickness shall not exceed 4.5". Interior clear working height shall be not less than 48" at any location in the interior of the hood on bench hoods. Interior depth from the back of the sash to the front of the rear baffle shall not be less than 24". The sash opening shall be not less than 28" in height above the worksurface on bench hoods.

d) Sash Support System:

Fume hood sash support to employ notched belt and shaft interlocked gears. Belt to be Polyurethane with green polyamide fabric on notch side, 10mm wide x 5.6mm thick rated at 3600N tensile strength. Support system to be rated to 300,000 cycles (one cycle = one full up and one full down sash motion) without a failure. Sash support system to employ retainers to ensure sash remains level and square throughout use.

e) Fume Hood Airfoil:

An 18 gauge painted steel, convergence z-cross section airfoil shall be mounted flush to the worksurface immediately in front of the sash plane. It shall nest into the port on each side, and provide no open space between it and the top front edge of the worksurface. Raised airfoils, or flush designs that create openings within the hood chamber, are not acceptable.

- f) Fume hood top panel shall incorporate a dynamic barrier bypass providing a clean air stream behind the sash plane.

- g) Fume Hood Baffles:

The fume hood baffles shall be fixed, and constructed of the same material as the hood lining. They shall consist of multiple sections with vertical slots and a continuous horizontal slot at the worksurface. Each baffle panel shall be easily removable from the interior, without the use of tools, or requiring liner disassembly. Mechanical or manually adjustable baffles are not acceptable.

- h) Fume Hood Duct Collar:

Each fume hood up to six feet in length shall contain one (1) 12" diameter FRP duct collar in the hood roof for exhausting the hood. Fume hoods over six feet in length shall contain two (2).

- i) Fume Hood Lighting:

An LED light fixture shall be provided in the hood roof. The light shall provide (15) intensity adjustment levels, and (3) color options. Illumination at the worksurface shall be at 100 foot-candles at the full intensity setting. The light fixture shall be isolated from the hood interior by a 1/4" thick tempered glass panel sealed from the hood cavity. Fixture shall be UL listed.

- j) Sash Glass:

Fume hood sash to be laminated safety glass.

- k) Fume Hood Combination Sash:

A combination sash shall be provided. The sash shall have horizontal sliding glass panels in a vertical rising steel frame. The bottom of the sash frame shall have a full length metal handle. The sash shall be counterbalanced with a single weight to prevent tilting and binding during operation. The sash shall be connected to the counterweight system with two, 1/2" wide steel-reinforced polyurethane notched belts that engage two sprocket shaft drives. The glass panels shall be top hung 1/4" laminated safety float glass mounted with metal rollers in an aluminum track. Sash Heights.

- l) Fume Hood Services:

Rod Type Remote Control Fittings: Service fitting valves shall be needle valve design and be mounted to the hood interior sidewall liner with extension rods to the front vertical fascia. Valves shall be furnished with molded nylon handles with color-coded index buttons and color-coded service outlet.

- m) Fume Hood Electrical Fixtures:

The hood superstructure shall be pre-wired and contain a UL label certifying acceptable wire gauge, connections, fixtures and wire color-coding. Electrical fixtures shall be

specification grade and consist of Electrical sockets with light switch. The Sockets will be 3-wire polarized grounded. Each fascia shall be prewired to a single circuit and have a minimum of (1) ground fault interruption device. The light & light switches shall be low voltage. Final wiring and circuit dedication shall be by others.

n) Hood Worksurface:

Black Granite:

Hood worksurface shall be 1-1/4" thick jet-black granite made in the form of a watertight pan, not less than 3/8" deep to contain spillage with a 6" wide safety ledge across the front edge. A cup sink flush with the recessed worksurface shall be provided. The worksurface and cup sink shall be available in black.

o) Interior Service Access:

Access to services shall be through a trapezoid shaped gasketed panel constructed of the same material as the liner. The panel shall be easily removable without the use of tools.

p) Fume Hood Liners:

Interior liner panels shall be 1/4" thick made from a compression molded cellulose fiber reinforced phenolic resin core with integrally cured white melamine surfaces. Interior liner panels shall be fastened using stainless steel screws with plastic covered heads.

q) Fume Hood Base Cabinets

Acid Storage Base Cabinets:

Acid storage fume hood cabinets shall utilize the same gauges of steel and construction features as other base cabinets except they shall be completely lined with a one piece Polyethylene corrosion resistant liner. The liner shall be 1/4" thick, molded into a seamless tub, including top, sides and bottom, with a 1" lip at the bottom front to contain spills. Each door shall have a set of louvers at the top and bottom, and have a 1/8" sheet polyethylene liner. Where specified, each cabinet shall be vented into the fume hood with a 2" vent pipe. It should provide a positive airflow directly into the fume hood exhaust system. Where specified or shown on drawings, supply an epoxy coated wire shelf supported by integral brackets built into the Polyethylene liner.

Accessories:

(i) Digital Face Velocity Alarm System:

Fume hoods shall be provided with an alarm system to detect low and high hood face velocities. The alarm system shall indicate the actual face velocity of the hood regardless of sash position. The system shall have an air velocity sensor mounted on the interior side liner of the hood where it is easily accessible for cleaning. The velocity monitor shall digitally display the air velocity through the hood face in feet per minute. The alarm signals shall activate any time the face velocity falls below the low velocity alarm set point. There shall be both visual and audible alarm signals. The audible alarm shall have a mute. Low and high alarm contacts shall be provided for remote monitoring. An hour-long "event timeline" detailing low velocity episodes shall be part of the alarm readout.

(ii) Ceiling Enclosure:

Fume hood to be fitted with a steel enclosure to fill the space between the top of the hood and the ceiling. Enclosure is to be three sided and designed and manufactured to provide a finished appearance. Front panel of enclosure is to be removable.

r) Fume Hood Finish:

After the component parts have been completely welded together and before finishing, they shall be given a pre-paint treatment to provide excellent adhesion of the finish system to the steel and to aid in the prevention of corrosion. Physical and chemical cleaning of the steel shall be accomplished by washing with an alkaline cleaner, followed by a spray treatment with a complex metallic phosphate solution to provide a uniform fine grained crystalline phosphate surface that shall provide both an excellent bond for the finish and enhance the protection provided by the finish against humidity and corrosive chemicals.

After the phosphate treatment, the steel shall be dried and all steel surfaces shall be coated with a chemical and corrosion-resistant, environmentally friendly, electrostatically applied powder coat finish. All components shall be individually painted, insuring that no area be vulnerable to corrosion due to lack of paint coverage. The coating shall then be cured by baking at elevated temperatures to provide maximum properties of corrosion and wear resistance.

The completed finish in standard colors shall meet the performance test requirements specified under Section 2.02 A. Steel Paint Finish Performance Test Results.

1.5 Performance Requirements

Steel Paint Finish Performance Test Results (Chemical Spot Tests):

a) Testing Procedure:

- (i) Chemical spot tests for non-volatile chemicals shall be made by applying 5 drops of each reagent to the surface to be tested and covering with a 1-1/4" dia. watch glass, convex side down to confine the reagent. Spot tests of volatile chemicals shall be tested

by placing a cotton ball saturated with reagent on the surface to be tested and covering with an inverted 2-ounce wide mouth bottle to retard evaporation. All spot tests shall be conducted in such a manner that the test surface is kept wet throughout the entire test period, and at a temperature of $77^{\circ} \pm 3^{\circ}$ F. For both methods, leave the reagents on the panel for a period of one hour. At the end of the test period, the reagents shall be flushed from the surface with water, and the surface scrubbed with a soft bristle brush under running water, rinsed and dried. Volatile solvent test areas shall be cleaned with a cotton swab soaked in the solvent used on the test area. Immediately prior to evaluation, 16 to 24 hours after the reagents are removed, the test surface shall be scrubbed with a damp paper towel and dried with paper towels.

(ii) Test Evaluation:

Evaluation shall be based on the following rating system.

Level 0— No detectable change.

Level 1— Slight change in color or gloss.

Level 2— Slight surface etching or severe staining.

Level 3— Pitting, cratering, swelling, or erosion of coating.

Obvious and significant deterioration.

After testing, panel shall show no more than three (3) Level 3 conditions.

(iii) Test Reagents:

Test No.	Chemical Reagent	Test Method
1.	Acetate, Amyl	Cotton ball & bottle
2.	Acetate, Ethyl	Cotton ball & bottle
3.	Acetic Acid, 98%	Watch glass
4.	Acetone	Cotton ball & bottle
5.	Acid Dichromate, 5%	Watch glass
6.	Alcohol, Butyl	Cotton ball & bottle
7.	Alcohol, Ethyl	Cotton ball & bottle
8.	Alcohol, Methyl	Cotton ball & bottle
9.	Ammonium Hydroxide, 28%	Watch glass
10.	Benzene	Cotton ball & bottle
11.	Carbon Tetrachloride	Cotton ball & bottle
12.	Chloroform	Cotton ball & bottle
13.	Chromic Acid, 60%	Watch glass
14.	Cresol	Cotton ball & bottle
15.	Dichlor Acetic Acid	Cotton ball & bottle
16.	Dimethylformamide	Cotton ball & bottle
17.	Dioxane	Cotton ball & bottle
18.	Ethyl Ether	Cotton ball & bottle
19.	Formaldehyde, 37%	Cotton ball & bottle
20.	Formic Acid, 90%	Watch glass
21.	Furfural	Cotton ball & bottle
22.	Gasoline	Cotton ball & bottle
23.	Hydrochloric Acid, 37%	Watch glass
24.	Hydrofluoric Acid, 48%	Watch glass
25.	Hydrogen Peroxide, 3%	Watch glass

26.	Iodine, Tincture of	Watch glass
27.	Methyl Ethyl Ketone	Cotton ball & bottle
28.	Methylene Chloride	Cotton ball & bottle
29.	Mono Chlorobenzene	Cotton ball & bottle
30.	Naphthalene	Cotton ball & bottle
31.	Nitric Acid, 20%	Watch glass
32.	Nitric Acid, 30%	Watch glass
33.	Nitric Acid, 70%	Watch glass
34.	Phenol, 90%	Cotton ball & bottle
35.	Phosphoric Acid, 85%	Watch glass
36.	Silver Nitrate, Saturated	Watch glass
37.	Sodium Hydroxide, 10%	Watch glass
38.	Sodium Hydroxide, 20%	Watch glass
39.	Sodium Hydroxide, 40%	Watch glass
40.	Sodium Hydroxide, Flake	Watch glass
41.	Sodium Sulfide, Saturated	Watch glass
42.	Sulfuric Acid, 33%	Watch glass
43.	Sulfuric Acid, 77%	Watch glass
44.	Sulfuric Acid, 96%	Watch glass
45.	Sulfuric Acid, 77% and Nitric Acid, 70%, equal parts	Watch glass
46.	Toluene	Cotton ball & bottle
47.	Trichloroethylene	Cotton ball & bottle
48.	Xylene	Cotton ball & bottle
49.	Zinc Chloride, Saturated	Watch glass

* Where concentrations are indicated, percentages are by weight.

(iv) Performance Test Results (Heat Resistance):

Hot water (190° F - 205° F) shall be allowed to trickle (with a steady stream at a rate not less than 6 ounces per minute) on the finished surface, which shall be set at an angle of 45° from horizontal, for a period of five minutes. After cooling and wiping dry, the finish shall show no visible effect from the hot water treatment.

(v) Performance Test Results (Impact Resistance):

A one-pound ball (approximately 2" diameter) shall be dropped from a distance of 12 inches onto the finished surface of steel panel supported underneath by a solid surface. There shall be no evidence of cracks or checks in the finish due to impact upon close eye-ball examination.

(vi) Performance Test Results (Bending Test):

An 18gauge steel strip, finished as specified, when bent 180° over a 1/2" diameter mandrel, shall show no peeling or flaking off of the finish.

(vii) Performance Test Results (Adhesion):

Ninety or more squares of the test sample shall remain coated after the scratch adhesion test. Two sets of eleven parallel lines 1/16" apart shall be cut with a razor blade to

intersect at right angle thus forming a grid of 100 squares. The cuts shall be made just deep enough to go through the coating, but not into the substrate. They shall then be brushed lightly with a soft brush. Examine under 100 foot-candles of illumination. Note: This test is based on ASTM D2197-68, "Standard Method of Test for Adhesion of Organic Coatings".

(viii) Performance Test Results (Hardness):

The test sample shall have a hardness of 4-H using the pencil hardness test. Pencils, regardless of their brand are valued in this way: 8-H is the hardest, and next in order of diminishing hardness are 7-H, 6-H, 5-H, 4-H, 3-H, 2-H, F, HB, B (soft), 2-B, 3-B, 4-B, 5-B (which is the softest).

The pencils shall be sharpened on emery paper to a wide sharp edge. Pencils of increasing hardness shall be pushed across the paint film in a chisel-like manner until one is found that will cut or scratch the film. The pencil used before that one—that is, the hardest pencil that will not rupture the film is then used to express or designate the hardness.

b) Fume Hood Liner Performance:

(i) Chemical Spot Tests - 24 Hours:

Chemical spot test shall be made by applying 10 drops (approximately 1/2 cc) of each reagent to the surface to be tested. Each reagent (except those marked **) shall be covered with a 1-1/2" diameter watch glass, convex side down to confine the reagent. Spot tests of volatile solvents marked ** shall be tested as follows: A 1" or larger ball of cotton shall be saturated with the solvent and placed on the surfaces to be tested. The cotton ball shall then be covered by an inverted 2-ounce, wide mouth bottle to retard evaporation. All spot tests shall be conducted in such a manner that the test surface is kept wet throughout the entire 24-hour test period and at a temperature of 77 degrees F. + 3 degrees F. At the end of the test period, the reagents shall be flushed from the surfaces with water and the surface scrubbed with a soft bristle brush under running water, rinsed, and dried. Volatile solvent test areas shall be cleaned with a cotton swab soaked in the solvent used on the test area. Spots where dyes have dried shall be cleaned with a cotton swab soaked in alcohol to remove the surface dye. The test panel shall then be evaluated immediately after drying.

(ii) Legend / Ratings:

1 - MER (Modified Epoxy Resin)	A = No effect or slight change in gloss
2 - Glass Reinforced Polyester	B = Slight change in gloss or color
3 - Stainless Steel 304	C = Slight etching or severe staining
4 - Stainless Steel 316	D = Swelling, pitting, or severe etching
5 - Reinforced Phenolic Resin	

(iii) Results:

	1	2	3	4	5
1. Acetic Acid 98%	A	C	B	B	A
2. Acetone **	A	A	A	A	A
3. Acid Dichromate	A	B	A	A	A
4. Ammonium Hydroxide ** 28%	A	A	B	B	A
5. Amyl Acetate **	A	A	A	A	A

6. Benzene **	A	A	A	A	A
7. Butyl Alcohol **	A	A	A	A	A
8. Carbon Tetrachloride **	A	B	A	A	A
9. Chloroform **	A	B	A	A	A
10. Chromic Acid 60%	B	C	C	C	A
11. Cresol	A	A	A	A	A
12. Dichloroacetic Acid	A	A	B	A	A
13. Dimethylformamide	A	A	A	A	A
14. Dioxane **	A	A	A	A	A
15. Ethyl Acetate **	A	A	A	A	A
16. Ethyl Ether **	A	A	A	A	A
17. Ethyl Alcohol **	A	A	A	A	A
18. Formaldehyde	A	A	A	A	A
19. Formic Acid 90%	A	B	A	A	A
20. Furfural **	B	C	A	A	C
21. Gasoline **	A	A	A	A	A
22. Hydrochloric Acid 37%	A	A	B	B	A
23. Hydrofluoric Acid 48%	B	A	D	D	A
24. Hydrogen Peroxide 30%	A	A	A	A	A
25. Methyl Ethyl Ketone **	A	A	A	A	A
26. Methyl Alcohol **	A	A	A	A	A
27. Methylene Chloride **	A	B	A	A	A
28. Monochlorobenzene **	A	A	A	A	A
29. Naphthalene **	A	A	A	A	A
30. Nitric Acid 20%	B	A	B	A	A
31. Nitric Acid 30%	B	B	B	A	A
32. Nitric Acid 70%	B	B	B	A	A
33. Phenol ** 85%	A	A	A	A	A
34. Phosphoric Acid 85%	A	A	B	A	A
35. Silver Nitrate	B	C	A	A	C
36. Sodium Hydroxide 40%	A	A	A	A	A
37. Sodium Hydroxide 20%	A	A	A	A	A
38. Sodium Hydroxide 10%	A	A	A	A	A
39. Sodium Hydroxide Flake	A	A	A	A	A
40. Sodium Sulfide	A	A	A	A	A
41. Sulfuric Acid 77%	A	A	C	A	A
42. Sulfuric Acid 96%	C	B	C	A	C
43. Sulfuric Acid 33%	A	A	C	A	A
44. Tincture of Iodine	A	C	B	B	A
45. Toluene **	A	A	A	A	A
46. Trichlorethylene **	A	A	A	A	A
47. Xylene **	A	A	A	A	A
48. Zinc Chloride	A	A	B	A	A
49. Nitric 70%/Sulfuric Acid 77%*	B	B	B	A	A

*Equal parts of Nitric Acid 70% and Sulfuric Acid 77%.

**Indicates these solvents tested with cotton and jar method

1.6 Material of Construction

Fume Hood superstructure : 18 gauge CRC Sheets, Electrode position
Powder coated 60-80 micron

Electrical sockets : PVC

Gas fixtures : Brass Lacquer Coated

Gas piping : SS304

Vacuum Fixtures : Brass Lacquer Coated

Vacuum Piping : Copper/SS/PP

Water fixtures : Brass Lacquer Coated

Water Piping : Brass Lacquer Coated

Electrical cables : Copper wire with PVC Sheath

1.7 Applicable Codes & Standards:

ASHRAE Standard 110.2016: Method of Testing Performance of Laboratory Fume Hoods

NSF STD#49 : Photometric Method of Testing

NIH03-112C : National Institute of Health Specification

UL : Underwriters Laboratories

ASTM D552 : Bending Test

NFPA-45 : National Fire Protection Association

B. Laboratory Furniture Specification

1.0 Summary and Scope

1.1 Section Includes:

- a) Furnish all cabinets and casework, including tops, ledges, supporting structures, and miscellaneous items of equipment as listed in these specifications, equipment schedules, and drawings. Include delivery to the building, set in place, level, and scribe to walls and floors as required. Furnish and install all filler panels, knee space panels and scribes as shown on drawings.
- b) Furnish and deliver all utility service outlet accessory fittings, electrical receptacles and switches as listed in these specifications, equipment schedules, and drawings, as mounted on the laboratory furniture. All plumbing and electrical fittings, not preinstalled in equipment, shall be packaged separately and properly marked for delivery to the appropriate contractor.
- c) Furnish and deliver, for installation by the mechanical contractor, all laboratory sinks, cup sinks or drains, drain troughs, overflows and sink outlets with integral tailpieces, which occur above the floor, and where these items are part of the equipment or listed in these specifications, equipment schedules, and drawings. All tailpieces shall be furnished less the couplings required to connect them to the drain piping system.
- d) Furnish service strip supports where specified, and set in place, service tunnels, service turrets, supporting structures and reagent racks of the type shown on the drawings.
- e) Remove of all debris, dirt and rubbish accumulated as a result of the installation of the laboratory furniture to an onsite container provided by others, leaving the premises broom clean and orderly.

1.2 Basis of Work

Laboratory Furniture as the standard of construction for steel laboratory furniture. The construction standards of this product line shall provide the basis for quality and functional installation.

2.0 Floor Mounted Furniture System:

Cabinet Style:

- a) **Steel:**
Cabinet bodies, drawer bodies, shelves, drawer heads and door assemblies shall be fabricated from Cold Rolled Steel.

2.1 Materials

a) **General Requirements:**

It is the intent of this specification to provide a high quality steel cabinet specifically designed for the laboratory environment.

b) **Steel:**

Cold Rolled Steel Cold rolled sheet steel shall be prime grade 12, 14, 16, 18 and 20 gauge U.S. Standard; roller leveled, and shall be treated at the mill to be free of scale, ragged edges, deep scratches or other injurious effects.

c) **Drawer and Door Pulls:**

Drawer and door pulls shall be mounted on 4" centers, offering a comfortable hand grip, and be securely fastened to doors and drawers. Pull shall be of modern design, offering a comfortable handgrip, and be securely fastened to doors and drawers with screws. All pulls shall be satin finish aluminum, with a clear, lacquer finish. Two pulls shall be required on all drawers over 24" long. Use of plastic pulls (molded or extruded), or a design not compatible for usage by the handicapped will not be acceptable.

d) **Hinges:**

5-Knuckle hinges made of Type 304 stainless steel .089 thick, 2-1/2" high, with brushed satin finish, and shall be the institutional type with a five-knuckle bullet-type barrel. Hinges shall be attached to both door and case with two screws through each leaf. Welding of hinges to door or case will not be accepted. Doors under 36" in height shall be hung on one pair of hinges, and doors over 36" in height shall be hung on three hinges

e) **Drawer Slide:**

Heavy duty, full extension, soft-close, self-closing, zinc plated, ball bearing slides, rated for 100 pound loads

f) **Positive Catch:**

A two-piece heavy-duty cam action positive catch Main body of the catch shall be confined within an integral cabinet top or divider rail, while latching post shall be mounted on the hinge side of door. Polyethylene roller type catches are not acceptable.

g) **Shelf Adjustment Clips:**

Shelf adjustment clips shall be ED coated steel.

h) **Base Molding:**

Base Molding shall be provided on all table legs, unless otherwise specified, to conceal leveling device. Shoes shall be a pliable, black vinyl material. Corner clip should be provided to hold the base molding firmly. Use of a leg shoe, which does not conceal leveling device, will not be acceptable.

i) **Sink Supports:**

Sink supports shall be the hanger type, suspended from end panels of sink cabinet by four 1/4" dia. rods, threaded at bottom end and offset at top to hang from two full-depth

reinforcements, welded to the top of end panels. Two 3/4" x 1-1/2" x 12 gauge channels shall be hung on the threaded rods to provide an adjustable sink cradle for supporting sinks

j) Support Struts:

Support struts shall consist of two 16 gauge channel uprights fastened top and bottom by two adjustable 12 gauge "U" shaped spreaders, each, 1-1/2" x length required, formed from galvanized steel. Struts shall be furnished to support drain troughs, and to support worktop at plumbing space under fume hood superstructures or other heavy loads. Support struts can be furnished with hangers at extra cost when specified, to support mechanical service piping and drain lines

2.2 CONSTRUCTION

2.2.1 Steel Base Cabinet Construction:

a) General:

- (i) The steel furniture shall be of modern design and shall be constructed in accordance with the best practices of the Scientific Laboratory Equipment Industry. First class quality casework shall be insured by the use of proper machinery, tools, dies, fixtures and skilled workmanship to meet the intended quality and quantity for the project.
- (ii) All cabinet bodies shall be flush front construction with intersection of vertical and horizontal case members, such as end panels, top rails, bottoms and vertical posts in same plane without overlap. Exterior corners shall be spot welded with heavy back up reinforcements.
- (iii) Each cabinet shall be complete so that units can be relocated at any subsequent time without requiring field application of finished ends or other such parts.
- (iv) Case openings of Inset style cabinets shall be rabbeted on all four sides for both hinged and sliding doors to provide a dust resistant case.
- (v) All cabinets shall have a cleanable smooth interior. Bottoms shall be formed down on sides and back to create easily cleanable corners with no burrs or sharp edges.
- (vi) Cabinets shall be designed using a standardized grid pattern to allow reconfiguration of doors and drawers.

b) Steel Gauges:

Gauges of steel used in construction of cases shall be 18 gauge, except as follows:

- (i) Levelling bolt reinforcements 12 gauge.
- (ii) Top and intermediate front horizontal rails, apron rails, hinge reinforcements, and reinforcement gussets, 16 gauge.
- (iii) Drawer assemblies, door assemblies, bottom, bottom back rail, toe space rail, and adjustable shelves, 20 gauge.

c) Base Cabinets:

- (i) End uprights shall be formed into not less than an L formation at top, bottom, back and a 1" wide front C formation. A pilaster shall be added to the inside front of the upright for cabinet and hinge reinforcement and shall be perforated for the support of drawer channels, intermediate rails, hinge screws, and shelf adjustment holes.

- (ii) A 7/8" high top horizontal rail shall interlock with the flange at top of end panels for strength, but shall be flush at face of unit. Top rails not flush with face of end uprights are not acceptable.
- (iii) Intermediate rails shall be provided between doors and drawers, but shall not be provided between drawers unless made necessary by locks in drawers. Intermediate rails shall be recessed behind doors and drawer fronts, and designed so that security panels may be added as required.
- (iv) Intermediate vertical uprights shall be furnished to enclose cupboards when used in a unit in combination with a half width bank of drawers.
- (v) Cabinet bottom shall be formed of one piece of steel, except in corner units, and shall be formed down on sides and back to create a square edge transition welded to cabinet end panels. Front edge shall include a C formation to form a 7/8" high bottom front rail and shall be flush with face of end uprights. Cabinet bottom front rails not flush with face of end uprights are not acceptable.
- (vi) Toe space rail shall extend up and forward to engage bottom panel to form a smooth surfaced fully enclosed toe space, 3" deep x 4" high.
- (vii) Back construction shall be one piece with integral channel formed for maximum strength and welded to back of top and bottom flanges of end uprights.
- (viii) Each bottom corner of base cabinets shall have a 3/8"-16 levelling bolt, 2-1/2" long capable of supporting 500 lbs. Access to the levelling bolts shall be through plug buttons in the cabinet bottom. Access to levelling bolts through toe space or levelling bolts requiring special tools to adjust are not acceptable.
- (ix) Adjustable shelves shall be formed down 3/4", returned back 7/8" and up 1/4" into a channel formation front and rear and formed down 3/4" at each end. Shelves over 42" long shall be further reinforced with a channel formation welded to underside of shelf. Shelves shall be adjustable on not more than 1" increments.
- (x) Steel Door assembly (two-piece) for solid panel swinging doors shall consist of an inner and outer door pan. Outer door pan shall be formed at all four sides. The corners on the pull side of the outer door pan shall be welded and ground smooth to prevent exposure of sharp edges of steel at these critical points. Inner door pan shall be flanged at all four sides with hinge reinforcements welded in place. The door assembly shall be 3/4" thick and contains sound deadening material. Door assemblies shall be painted prior to assembly, and shall be punched for attaching pulls. Inner pan formation of door shall be indented for in-field installation of locks when required.
- (xi) Doors shall be readily removable and hinges easily replaceable. Hinges shall be applied to the cabinet and door with screws. Welding of hinges to either cabinet or door will not be acceptable.

(xii) **Drawer Assemblies:**

- a) Drawer bodies shall be made in one-piece construction including the bottom, two sides, back and front. They shall be fully coved at interior bottom on all four sides for easy cleaning. The top front of the inner drawer body shall be offset to interlock with the channel formation in drawer head providing a 3/4" thick drawer head.
- b) Knee space panels, where shown or specified, shall be 20 gauge, finished same as casework cabinets, and easily removable for access to mechanical service areas.

2.3 Performance Requirements**a) Steel Casework Construction Performance:**

- (i) Base cabinets shall be constructed to support at least a uniformly distributed load 200 pounds per square foot of cabinet top area, including working surface without objectionable distortion of interference with door and drawer operation.
- (ii) Base cabinet leveling bolts shall support 500 pounds per corner, at 1-1/2" projection of the leveling bolt below the cabinet bottom.
- (iii) Each adjustable and fixed shelf 4 feet or shorter in length shall support an evenly distributed load of 40 pounds per square foot up to a maximum of 200 pounds, with nominal temporary deflection, but without permanent set.
- (iv) Full extension soft-close, self-closing ball bearing zinc plated drawer slide shall be rated for 100 pound loads.
- (v) Swinging doors on floor-mounted inset style casework shall support 200 pounds suspended at a point 12" from hinged side, with door swung through an arc of 160 degrees. Weight load test shall allow only a temporary deflection, without permanent distortion or twist. Door shall operate freely after test and assume a flat plane in a closed position.

b) Steel Paint System Finish and Performance Specification:**(i) Steel Paint System Finish:**

After Cold Rolled Steel and Textured Steel component parts have been completely welded together and before finishing, they shall be given a pre-paint treatment to provide excellent adhesion of the finish system to the steel and to aid in the prevention of corrosion. Physical and chemical cleaning of the steel shall be accomplished by washing with an alkaline cleaner, followed by a spray treatment with a complex metallic phosphate solution to provide a uniform fine grained crystalline phosphate surface that shall provide both an excellent bond for the finish and enhance the protection provided by the finish against humidity and corrosive chemicals.

After the phosphate treatment, the steel shall be dried and all steel surfaces shall be coated with a chemical and corrosion-resistant, environmentally friendly, electro statically applied powder coat finish. All components shall be individually painted,

insuring that no area be vulnerable to corrosion due to lack of paint coverage. The coating shall then be cured by baking at elevated temperatures to provide maximum properties of corrosion and wear resistance.

The completed finish system in standard colors shall meet the performance test requirements specified under PERFORMANCE TEST RESULTS.

(ii) Performance Test Results (Chemical Spot Tests):

a) Testing Procedure:

Chemical spot tests for non-volatile chemicals shall be made by applying 5 drops of each reagent to the surface to be tested and covering with a 1-1/4" dia. watch glass, convex side down to confine the reagent. Spot tests of volatile chemicals shall be tested by placing a cotton ball saturated with reagent on the surface to be tested and covering with an inverted 2-ounce wide mouth bottle to retard evaporation. All spot tests shall be conducted in such a manner that the test surface is kept wet throughout the entire test period, and at a temperature of $77^{\circ} \pm 3^{\circ}$ F. For both methods, leave the reagents on the panel for a period of one hour. At the end of the test period, the reagents shall be flushed from the surface with water, and the surface scrubbed with a soft bristle brush under running water, rinsed and dried. Volatile solvent test areas shall be cleaned with a cotton swab soaked in the solvent used on the test area. Immediately prior to evaluation, 16 to 24 hours after the reagents are removed, the test surface shall be scrubbed with a damp paper towel and dried with paper towels.

b) Test Evaluation:

Evaluation shall be based on the following rating system.

Level 0 – No detectable change.

Level 1 – Slight change in color or gloss.

Level 2 – Slight surface etching or severe staining.

Level 3 – Pitting, cratering, swelling, or erosion of coating. Obvious and significant deterioration.

After testing, panel shall show no more than three (3) Level 3 conditions.

c) Test Reagents

Test No.	Chemical Reagent	Test Method
1.	Acetate, Amyl	Cotton ball & bottle
2.	Acetate, Ethyl	Cotton ball & bottle
3.	Acetic Acid, 98%	Watch glass
4.	Acetone	Cotton ball & bottle
5.	Acid Dichromate, 5%	Watch glass
6.	Alcohol, Butyl	Cotton ball & bottle
7.	Alcohol, Ethyl	Cotton ball & bottle
8.	Alcohol, Methyl	Cotton ball & bottle
9.	Ammonium Hydroxide, 28%	Watch glass
10.	Benzene	Cotton ball & bottle

11.	Carbon Tetrachloride	Cotton ball & bottle
12.	Chloroform	Cotton ball & bottle
13.	Chromic Acid, 60%	Watch glass
14.	Cresol	Cotton ball & bottle
15.	Dichlor Acetic Acid	Cotton ball & bottle
16.	Dimethylformamide	Cotton ball & bottle
17.	Dioxane	Cotton ball & bottle
18.	Ethyl Ether	Cotton ball & bottle
19.	Formaldehyde, 37%	Cotton ball & bottle
20.	Formic Acid, 90%	Watch glass
21.	Furfural	Cotton ball & bottle
22.	Gasoline	Cotton ball & bottle
23.	Hydrochloric Acid, 37%	Watch glass
24.	Hydrofluoric Acid, 48%	Watch glass
25.	Hydrogen Peroxide, 3%	Watch glass
26.	Iodine, Tincture of	Watch glass
27.	Methyl Ethyl Ketone	Cotton ball & bottle
28.	Methylene Chloride	Cotton ball & bottle
29.	Mono Chlorobenzene	Cotton ball & bottle
30.	Naphthalene	Cotton ball & bottle
31.	Nitric Acid, 20%	Watch glass
32.	Nitric Acid, 30%	Watch glass
33.	Nitric Acid, 70%	Watch glass
34.	Phenol, 90%	Cotton ball & bottle
35.	Phosphoric Acid, 85%	Watch glass
36.	Silver Nitrate, Saturated	Watch glass
37.	Sodium Hydroxide, 10%	Watch glass
38.	Sodium Hydroxide, 20%	Watch glass
39.	Sodium Hydroxide, 40%	Watch glass
40.	Sodium Hydroxide, Flake	Watch glass
41.	Sodium Sulfide, Saturated	Watch glass
42.	Sulfuric Acid, 33%	Watch glass
43.	Sulfuric Acid, 77%	Watch glass
44.	Sulfuric Acid, 96%	Watch glass
45.	Sulfuric Acid, 77% and Nitric Acid, 70%, equal parts	Watch glass
46.	Toluene	Cotton ball & bottle
47.	Trichloroethylene	Cotton ball & bottle
48.	Xylene	Cotton ball & bottle
49.	Zinc Chloride, Saturated	Watch glass

* Where concentrations are indicated, percentages are by weight.

(iii) **Performance Test Results (Heat Resistance):**

Hot water (190° F - 205° F) shall be allowed to trickle (with a steady stream at a rate not less than 6 ounces per minute) on the finished surface, which shall be set at an angle of 45° from horizontal, for a period of five minutes. After cooling and wiping dry, the finish shall show no visible effect from the hot water treatment.

(iv) Performance Test Results (Impact Resistance):

A one-pound ball (approximately 2" diameter) shall be dropped from a distance of 12 inches onto the finished surface of steel panel supported underneath by a solid surface. There shall be no evidence of cracks or checks in the finish due to impact upon close eye-ball examination.

(v) Performance Test Results (Bending Test):

An 18 gauge steel strip, finished as specified, when bent 180° over a 1/2" diameter mandrel, shall show no peeling or flaking off of the finish.

(vi) Performance Test Results (Adhesion):

Ninety or more squares of the test sample shall remain coated after the scratch adhesion test. Two sets of eleven parallel lines 1/16" apart shall be cut with a razor blade to intersect at right angle thus forming a grid of 100 squares. The cuts shall be made just deep enough to go through the coating, but not into the substrate. They shall then be brushed lightly with a soft brush. Examine under 100 foot-candles of illumination. Note: This test is based on ASTM D2197-68, "Standard Method of Test for Adhesion of Organic Coatings".

(vii) Performance Test Results (Hardness):

The test sample shall have a hardness of 4-H using the pencil hardness test. Pencils, regardless of their brand are valued in this way: 8-H is the hardest, and next in order of diminishing hardness are 7-H, 6-H, 5-H, 4-H, 3-H, 2-H, F, HB, B (soft), 2-B, 3-B, 4-B, 5-B (which is the softest).

The pencils shall be sharpened on emery paper to a wide sharp edge. Pencils of increasing hardness shall be pushed across the paint film in a chisel-like manner until one is found that will cut or scratch the film. The pencil used before that one-that is, the hardest pencil that will not rupture the film-is then used to express or designate the hardness.

c) Upper Cabinet Construction (Wall Units):

- (i) Upper cabinets shall have a completely finished interior same as exterior and shall be designed so that no mounting hardware is visible when installed.
- (ii) End uprights shall be formed at front, bottom and back to provide maximum strength and rigidity. Front edge of end upright shall be 3/4" wide. A pilaster shall be added to the inside front of the upright for cabinet and hinge reinforcement and shall be perforated for hinge screws, and shelf adjustment holes.
- (iii) Cabinet tops shall be formed with a 7/8" high C formation at the front edge and turned down at the back to engage a wall hanging rail.
- (iv) Cabinet flush bottoms shall be formed with a 7/8" high C formation at the front edge.
- (v) Cabinet false bottoms shall be formed down on all four edges and shall be removable.

- (vi) Cabinet backs shall be welded to the top, bottom and ends. Backs shall be perforated for shelf adjustment holes. Holes shall be enclosed by end uprights.
- (vii) Adjustable shelves shall be formed down 3/4", returned back 7/8" and up 1/4" into a channel formation front and rear, formed down 3/4" at each end. Shelves over 42" long shall be further reinforced with a channel formation welded to underside of shelf. Shelves shall be adjustable on not more than 1" increments.

Glazed doors shall be 3/4" thick and consist of an inner and outer door pan welded together to form a single unit. Outer door pan shall be 18 gauge steel, formed into a channel or flanged shape at all four sides. It shall be pierced and formed to create a 3" wide frame with a beveled edge around the glass opening in the center of the door. Inner door pan shall be 18 gauge steel, flanged at all four sides, and pierced for a glass opening in center of the door. Glass shall be held in place by a rubber or vinyl gasket around the entire edge of the glass. Doors shall be glazed with 1/8" float glass

d) Steel Full Height Cabinet Construction (Tall Units):

- (i) Full height storage cabinets shall have a completely finished interior same as exterior.
- (ii) End uprights shall be formed at front, bottom and back to provide maximum strength and rigidity. Front fascia of upright shall be 1-1/4" wide with inside edge formed in a channel 1/2" x 3/8". A full height box reinforcement shall be fitted to the channel, formed to provide a recessed strike for door and to reinforce the cabinet. The backside of the reinforcement shall be perforated with shelf adjustment holes spaced at not more than 1" centers. Back of upright shall be formed in a 2-1/2" formation. 16 gauge hinge reinforcement shall be welded to inner side of front uprights.
- (iii) Cabinet tops shall be formed into a channel shape at front with flange at rear and sides for electro-welding cabinet top to cabinet back and ends. Front fascia channel shall be strengthened with electro-weld reinforcements.
- (iv) Cabinet bottoms for storage cabinets shall be formed down on sides and back to create a square edge transition welded to cabinet end panels, and front edge shall be offset to create a seamless door recess rabbet for dust stop. Cabinet bottoms shall be formed to provide a flush 1" face rail with a return flange to give a 9/16" deep x 5" high toe space. All cabinets shall have a cleanable smooth interior.
- (v) Toe space rails shall interlock in back of bottom rail and with end panel to provide a welding plate, and shall extend to the floor with a flange turned back and up for support.
- (vi) Cabinet backs shall be welded to the top, bottom and ends. Backs shall be perforated for shelf adjustment holes on not more than 1" centers. Holes shall be enclosed by a formation in cabinet back and enclosed by end uprights.

- (vii) Adjustable shelves shall be formed down 3/4", returned back 7/8" and up 1/4" into a channel formation front and rear; formed down 3/4" at each end. Shelves over 42" long shall be further reinforced with a channel formation electro-welded to underside of shelf. Shelves shall be adjustable on not more than 1" increments.

Glazed doors shall be 3/4" thick and consist of an inner and outer door pan welded together to form a single unit. Outer door pan shall be 18 gauge steel, formed into a channel or flanged shape at all four sides. It shall be pierced and formed to create a 3" wide frame with a beveled edge around the glass opening in the center of the door. Inner door pan shall be 18 gauge steel, flanged at all four sides, and pierced for a glass opening in center of the door. Door glazing shall be held in place by a rubber or vinyl gasket around the entire edge of the glass. Doors shall be glazed with 1/8" float glass

e) Work Tops:

- (i) The worktops shall be of 18/19mm Jet black Granite of an even surface and the level Tolerance less than 1 mm. The front edge of the granite shall be chamfered at an angle of 28 deg and smoothened. The back splash for the wall bench shall be granite 18/19mm thick material for an height of 4" from the finished table top level.

f) Polypropylene Molded Sinks:

- (i) The sinks should be injection molded from Poly propylene co-polymer resin. Polypropylene to have very high resistance to attack from a wide range of chemicals and the ability to withstand temperatures up to 100 deg C. The impact resistance should be high which will minimize damage during and after installation. The sinks should be with self draining base and should be suitable for mounting on top or underside of the work benches. The sinks should be compatible to a vast number of acids, alkalis and reagents. The size of the sink is 600Lx450Dx315Hmm AND BOWL SIZE: 550Lx400Dx315Hmmm. This sinks shall have bottle trap with reducing coupler of size 51x31mm and with 38mm polypropylene pipe of one foot length. All gaskets and O-rings are made from Nitrile.

g) Reagent Rack in Island Bench:

- (i) Reagent racks are designed to be fix on top of worktop. It will have 12"/9" Wide & 36"/24" Height vertical Uprights made of 1.2mm thick CRCA. Each Reagent rack will have 12" wide 10mm thick Glass shelves with shelf supports and will be designed to have 2 Tier at 12" gap between each shelf. Upright will have provision for fixing 2 Nos. Sockets with switch and it will be located between the bottom shelf & the worktop. Each Shelves will have SS316 Retaining Rod all around.

h) Dual Purpose Eye Wash/Drench Hose Units:

- (i) Deck mounted eye wash/drench hose units shall be capable of use as a fixed eye wash with hands-free operation or as a drench hose. Units shall have two Gentle Spray outlet

heads mounted parallel and angled forward, each with a self-regulating volume control, reticulated polyurethane filter and removable spray cover. Dust covers shall be hinged swing-away style and shall be permanently attached to the spray head with a stainless-steel pin. The valve shall be self-closing type with a stainless-steel squeeze handle and a locking clip to hold the valve open once activated. Units shall be furnished with a deck flange with locator guide to hold the unit facing forward and an 8 ft. reinforced PVC hose.

i) Slotted Angle Open Rack:

- (i) The Construction of slotted angle racks will have rigid structure made of 4 nos 2mm thick 50x 50mm angle & should have 6.5 dia holes at 50mm pitch. Unit will be open at all 4 sides. Top & bottom of the unit will be closed permanently and in between will have 5 nos adjustable shelves. The height of open rack will be of 84" & Depth 22" & length varies 24", 30" & 36".

j) Laboratory Service fixtures:

(i) General

- a) All laboratory service fixtures shall have the construction and shall meet the performance requirements set forth in this specification. Fixture types shall be as indicated in the fixture schedule or fixture details included in either the project drawings or these specifications.
- b) All service fixtures shall be factory assembled (including the assembly of valves and shanks to turrets, flanges and other mounting accessories), and each fixture shall be individually factory tested. Fixtures shall be tested in the manner and at the pressures set forth below.
- c) Except as otherwise indicated, faucet and valve handles shall be forged brass Nylon type and shall have a color coded screw-on index disc. Color code requirements for indexing service fixtures shall follow DIN Standard 12920:1995.

k) Finish

(i) General

- a) Laboratory service fixtures and safety equipment shall be furnished with a powder coated finish to enhance the appearance of the fitting and to protect against corrosion. Coating material shall be a blend of epoxy and polyurethane. The hybrid blend shall ensure a finish coating with and optimum combination of chemical resistance, mar and abrasion resistance and resistance to fading under ultraviolet (UV) light.
- b) Fittings inside fume hoods shall have an epoxy finish color-coded to match the fixture service index color. Coating material shall be free flowing epoxy powder with a particle size of 35-70 microns.

(ii) Mar and Abrasion Resistance

Finishes shall have a pencil hardness of 2H-4H with adhesion substantial enough to withstand both direct and reverse impacts of 160 inch pounds. Finish shall have excellent mar resistance and be capable of withstanding scuffing, marring and other ordinary wear.

(iii) Reparability

Finish shall be capable of surface repair in the event that a fixture is scratched or a surface rupture occurs. The service fixture manufacturer shall have available an air-drying aerosol coating, specially formulated to match the existing epoxy coating color, which may be applied in the field to repair coated surfaces.

(iv) Water Faucets and Valves

- a) All faucets and valves for water service shall have a renewable unit containing all working components subject to wear, including a stainless steel replaceable seat and an integral adjustable volume control (designated by the suffix "AC"). The renewable unit shall be interchangeable among all faucets and valves for water service. The renewable unit shall be broached for position locking in the valve body. The unit shall have a high durometer thermoplastic valve disc and a molded TFE stem packing. The unit shall be capable of being readily converted from compression to self-closing, and vice versa, without disturbing the faucet body.
- b) Goosenecks shall have a separate outlet coupling with a 3/8" IPS female thread securely brazed to the gooseneck for attachment of serrated hose ends, aspirators and other outlet fittings. Rigid goosenecks shall have a 3/8" IPS male inlet thread and be threaded directly into the faucet body so as to be absolutely rigid. Swing goosenecks shall utilize a TFE packing with an externally adjustable packing nut.
- c) Water faucets and valves shall be fully assembled and individually tested at 80 pounds per square inch (PSI) water pressure.

(v) Applicable Codes & Standards

- i. SEFA 3 – Scientific Equipment and Furniture Association
- ii. SEFA 8 - Scientific Equipment and Furniture Association
- iii. NFPA 30 - National Fire Protection Association
- iv. NFPA-45 - National Fire Protection Association
- v. UL - Underwriters Laboratories
- vi. ASTM D552 – Bending Test

C. Exhaust System Specification

1.1 Centrifugal PP Exhaust Fan

- a) The exhaust fans supplied and installed shall be of 'Centrifugal Corrosion Resistant' type and shall be capable of delivering the design flow rate against all duct losses.
- b) The fans shall be robust in construction and suitable for continuous duty operation. It shall be mounted with ease of maintenance and shall be installed with proper vibration isolators to minimize vibration transmission to ductwork and support structure.
- c) Fans selected shall be silent and vibration free when running and suitable for outdoor use and shall not exceed 3000rpm.
- d) Aerodynamic performance of the fan shall be tested and comply 'ISO 5801' standards. Sound level shall be tested and comply with 'ISO 5136.2' standards. The casing shall be of self-supporting design, thermoformed welded by machine. The material of construction shall be **polypropylene (PP)** and suitable for use against corrosive 'medium' and a maximum allowable operating temperature of 70°C.

- e) No metal parts shall be exposed and in contact with the airstream.
- f) Impeller material of construction shall be **polypropylene (PP)** and suitable for use against corrosive.
- g) **Electro-galvanized stand** shall be used to support the fan and the motor in view of the corrosive environment.
- h) A standard hub seal shall be fitted onto the impeller hub to prevent the corrosive 'medium' from contacting the shaft.

1.2 Motor And Accessories

- a) The standard TEFC electric motor shall be with class 'F' insulation and class 'B' temperature rise. Motor shall be suitable for outdoor installation with IP55 protection and suitable for operation with 415V/3Ph/50Hz electrical supply. Motor shall be flange mounted (B5) or foot mounted (B3) based on the fan configuration.

1.3 PP/FRP DUCTING:

- a) PP means PPGL: One side smooth & glassy finish and other end is mat finish.
 - (i) The smooth surface should be the inner surface of the duct.
 - (ii) On mat side, FRP lining to be done.
 - (iii) 25 mm x 25 mm Stitch welding is done on inner surface and continuous welding on outer surface with 5 mm welding thickness.
- b) FRP Lining to be done on the outer surface of PPGL I.e. on mat side.
 - (i) One layer FRP is one mm.
 - (ii) The final layer should be with fine mat to have smooth and good finish.
 - (iii) While making the lining, there should not be any air pockets or any sort of uneven finish.
 - (iv) There should be time gap between the FRP layers, allowing each layer to be got dried.
- c) Isothelic resin to be used.
- d) The flange thickness should be 1.5 times of the duct thickness up to 750 mm and 2 times above 750 mm ducting.
- e) All flanges are to be matched with M8, GI fasteners and flat washers on both the sides.
- f) All the flanges should have fasteners at the 4 corners.
- g) All the fasteners to be fixed at a pitch distance of between 125 mm to 150mm.
- h) All the flanges should be properly ground and dressed.
- i) Duct support distance should not be more than 2500 mm.
- j) Any duct length should not be more than 3600 mm.
- k) All square / rectangular ducts with more than 1800 mm length should have a brazing frame at the center on the external surface.
- l) Provide 40 x 40 flanges up 750 mm duct size and 50 x 50 above 750 mm.
- m) The finish paint should be admiral grey unless specified.
- n) 5 mm Thick Neoprene gasket shall be used between the flanges.

1.4 PP Dampers

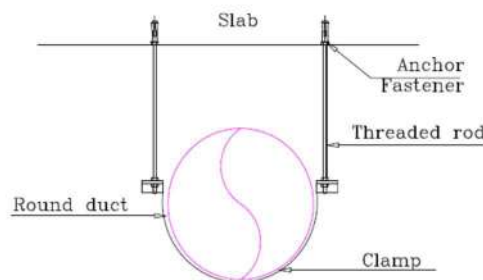
- a) Dampers shall be double thickness heavier than the thickness of the large duct & shall be rigid in construction.
- b) The volume control dampers shall be of an approved type , lever operated & complete with locking devices which will permit the dampers to be adjusted & locked in any positions.
- c) Construct blades of 5 mm thick PP MOC, provide heavy-duty molded self-lubricating nylon bearings, 13mm (1/2") diameter Plastic axles spaced on 225mm (9") centers. Construct frame of 300 mm diameter outer with Flange for fitting minimum 6 bolts and nuts.

1.5 PVC Flexible Hose

- a) Provide flexible duct connections wherever ductwork connects to vibration isolated equipment and on all exhaust final connections to fume hoods, spot extractor and canopy as indicated on the drawings. Construct flexible connections of PVC coated collapsible hose clipped into duct and equipment to make air-tight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse and torsional movement and also capable of absorbing vibrations of connected equipment.
- b) Flexible connections shall be air tight and resistant to water and fire.
- c) Flexible connections shall be fitted to isolate fans from equipments and/or ductwork. The connections shall be arranged to permit the renewal of the connection without disturbing the duct work or the plant.

1.6 Duct Support System

- a) A complete supporting system consisting of fully threaded rods, double L bottom brackets nuts, Washers, clamps for circular ducts and anchor bolts as supplied.



- b) To provide the required thermal brake effect, Neoprene or equivalent material of suitable thickness shall be used between duct joints.

1.7 Bird screens

- a) Galvanized woven mesh or weld mesh bird screens in rigid galvanized iron frames shall be installed behind all external louvers and over all relief and exhaust air openings to the outside of the building.

1.8 FUME WET SCRUBBER SPECIFICATION

- a) These fume scrubbers are of Single stage packed bed type. Single Stage packed Bed removes the bulk of the contaminant from the air stream and may be continuously wetted to prevent plugging.
- b) In a scrubber, water is the media which removes pollutants from the air. When the water is re-circulated, addition of fresh water is necessary to purge contaminants and replace evaporation losses. Fresh water may be added to the recycle reservoir continuously or periodically.
- c) Scrubbers are frequently used in applications where the air stream is being treated to remove acid fumes. The addition of chemical may be controlled manually.
- d) Fume scrubbers shall be fabricated from PP+FRP with suitable thickness based on the size & volume. The maximum temperature rating for the scrubber is 60°C.
- e) Bolted access ports are provided for inspection of the interior packing and mist eliminator elements. Hardware is MS.
- f) The Scrubber shall be provided with access ports / doors to allow limited access to the internals of the unit. The Scrubber shell has flanged pipe connections or female NPT connections for introducing makeup and drain water as well as recirculation liquid connections.
- g) The Scrubbers are equipped with random-dumped PP rings packed with appropriate depth of the packing.
- h) The Scrubber is equipped with a high efficiency. Material for the mist eliminator is PVC.
- i) The fan and motor is designed for system static pressure per application depending on packing depth and mist eliminator selection. Pressure drop calculations through the Scrubber plus external delta P for the customer's ductwork losses.
- j) Single Stage Packed Bed scrubbers complete with auxiliaries and options described herein. The system shall include but is not limited to the following:
- k) All scrubber internals necessary to provide adequate process capture and to achieve the designed performance.
- l) Mist eliminator to separate the water mist from carrying over.
- m) Flanged connections for all external water fill, water makeup and drain, overflow piping as required.
- n) Complete shop coating of required areas with coat or resistant paint for external surfaces.
- o) Self-contained recirculation pumps system.

1.9 Exhaust Blower Electrical Control Panel

- a) Electrical panel for Exhaust System (Consider all equipment such as Fan). The Panel should consist of Incomer MCCB, Variable speed drive (For fan), Contactors, DOL by-pass starters for VFD, Relays, Push button (On/Off/Reset), Indicating Lamps (Start / Stop / Trip) etc. The panel should have the necessary instrument cooling fan, inlet louvers & Filters for VFD, view panel, necessary relays & contactor for BMS application interlocks etc.
Armoured Power Cabling from starter panel to individual motors of Fan and pump with double copper gland and termination with necessary earthing laid on cable tray.

Farmer Training Hostel - Schedule (Civil) No. 1 to 10

Schedule No.	Item	Location	Description of Item/ Brief Specification
1	Schedule of Wall		
1.1	External Wall		
1.1.1		Farmer Training Hostel	Fly ash brick masonry
1.2	Internal Wall (Dry Area)		
1.2.1		Farmer Training Hostel	Fly ash brick/ glass partitioning.
1.3	Internal Wall (Wet Area)		
1.3.1		Farmer Training Hostel	Burnt Clay brick
2	Schedule of Flooring		
2.1		Ground Floor	
2.1.1		Gents' dormitory. Dormitory, Ladies dormitory, Driver dormitory, common hall & reading room, Open court-4, Office, visitors room, Hostel room-1 Hostel room -2, Hostel room-3, Living room-1, Living room-2, Living room-3, Bed room-1, Bed room-2 Bed room-3, Care taker room, care taker drawing room, Audio visual farmers	Full body Vitrified tiles as per requirement.
2.1.2		Kitchen, Dining hall, scientist interface facility & Reception,	Granite flooring as per requirement
2.1.3		Toilets, Balconies /bathrooms	Vitrified anti-skid flooring as per requirement.
2.1.4		Common circulation area, lobby, Circulation area, Lifts & lift lobby	Granite flooring as per requirement.
2.1.5		Main staircase	18 mm thick single piece granite stone in flooring in treads & risers with dado of matching permanent finish specification.
2.1.6		Fire escape stair case	18 mm thick flamed granite in single piece in treads & risers with dado of matching permanent finish specification.
2.1.7		Kitchen counter	18 mm thick pre polished granite with nosing as per design
2.8		First Floor	
2.8.1		Store room 3 nos., Hostel room 13 nos., Double bed room 6 nos., Audio visual farmers &	Full body Vitrified tiles as per requirement.

		scientist interface facility, Common Hall & reading room, Office 2 nos.,	
2.8.2		Toilets, Balconies /bathrooms	Granite flooring as per requirement.
2.8.3		Common circulation area, lobby, Circulation area	Granite flooring as per requirement.
2.8.4		Main staircase	18 mm thick single piece granite stone in flooring in treads & risers with dado of matching permanent finish specification.
2.8.5		Fire escape stair case	18 mm thick flamed granite in single piece in treads & risers with dado of matching permanent finish specification.
2.8.6		shuttle court 2 nos.	Rubber flooring
3	Schedule of Door, Windows, Ventilators, Fittings, Fixtures & Glazing details		
3.1	Doors (shutter)		
3.1.1		Entrance door, Gents dormitory, ladies' dormitory, Gents dormitory. Toilet main entrance door 3 nos, common hall & reading room 2 nos, Dining hall, Audio visual farmers & scientist interface facility- 2 nos., Reception, Kitchen, Lobby -2Nos.,	35mm Flush door with teak veneered ply/anodized/powder coated/polyester powder coated aluminium shutters with toughened glass glazing wherever required as per CPWD specification / as per design & drawing.
3.1.2		Dormitory, Driver dormitory, Office, visitors room, Hostel room-1 Hostel room -2, Hostel room-3, Living room-1, Living room-2, Living room-3, Bed room-1, Bed room-2 Bed room-3, Care taker room, care taker drawing room,	35mm Flush door with teak veneered ply wherever required as per CPWD specification / as per design & drawing.
3.1.3		Kitchen	35mm Flush door with teak veneered ply wherever required as per CPWD specification / as per design & drawing.
3.1.4		Toilets, Ladies toilet, Gents toilet (2 nos toilet, 2 nos bath) (Main Entrance door)	35mm Flush door with laminate on one side and teak veneered ply on other side wherever required as per CPWD specification / as per design & drawing.
3.1.5		Toilets (Water Closet cubicles)	35mm Flush door with laminate on one side and teak veneered ply on other side in attached toilet to rooms wherever required as per CPWD specification / as per design & drawing and Compact Cubicles laminate with SS frame work in public/common toilets.

3.1.6		Fire rated doors at Lift Lobby / Staircase	Fire rated fully Glazed doors at Lift Lobby / Staircase fire rated fixed non-load bearing double leaf swing door system with 120 minutes of integrity.
3.1.7		Fire Shaft Doors	Polyester powder coated aluminium shutters with float glass glazing wherever required as per CPWD specification.
3.2	(Ground & First Floor)		
3.2.1		Store – 3 nos., Main entrance, lobby 2 nos., common hall & reading room 2 nos., Audio visual farmers & scientist interface facility-2 nos.,	Flush door with teak veneered ply/anodized/powder coated/ / as per design & drawing.
3.2.2		Dormitory, Driver dormitory, Office, visitors room, Hostel room-1 Hostel room -2, Hostel room-3, Living room-1, Living room-2, Living room-3, Bed room-1, Bed room-2 Bed room-3,Care taker room, care taker drawing room,	Flush door with teak veneered ply/anodized/powder coated/polyester powder coated aluminium shutters with toughened glass glazing wherever required as per CPWD specification / as per design & drawing.
3.2.3		Toilets (Main Entrance door)	35mm Flush door with laminate on one side and teak veneered ply on other side in attached toilet to rooms wherever required as per CPWD specification / as per design & drawing and Compact Cubicles laminate with SS frame work in public/common toilets.
3.2.4		Toilets (Water Closet cubicles)	
3.2.5		Fire rated doors at Lift/ Staircase Lobby	Fire rated doors at Lift/ Staircase Lobby fully glazed fire rated fixed non-load bearing double leaf swing door system with 120 minutes of integrity.
3.2.6		Fire Shaft Doors	Polyester powder coated aluminium shutters with float glass glazing wherever required as per CPWD specification.
	Note : Curtain rods with required accessories on all windows and doors in all rooms except kitchen, toilet, bath.		
3.3	Windows / Ventilators(shutters)		
3.3.1		Room, Kitchen	UPVC extruded profile having 2.3mm thick wall with SS-304 grade wire-mesh as per design & requirement.
3.3.2		Toilets	UPVC extruded profile having 2.3mm thick wall with SS-304 grade wire-mesh as per design & requirement.
3.4	Fittings and Fixtures		
3.4.1		Room, Kitchen	Stainless steel SS-304 grade
3.4.2		Toilets	Stainless steel SS-304 grade
3.5	Details of Glazing		

3.5.1		Room, Kitchen	5 mm thick toughened glass
3.5.2		Toilets	5 mm thick frosted toughened glass
3.6	Frame		
3.6.1		Rooms, Kitchen	2nd class teak wood
3.6.2		Toilets	Solid PVC Door Frames
3.6.3		Windows/ventilators	UPVC.
4	Schedule of Internal Finishing painting, wall panelling, dado & false ceiling		
4.1	Plastering		
4.1.1		Masonry work at all location (internal external)	a) All external & internal walls shall be plastered with 12 mm plaster of 1:6 (1 cement: 6 fine sand) mix after fixing chicken wire mesh on walls surface at junction of masonry work and RCC works as per CPWD specifications. b) 6 mm 1:3 (1 cement: 3 fine sand) Ceiling plaster and RCC surface shall be as per CPWD specifications. c) Necessary drip course shall be provided in chajjas, balconies, projecting roofs, beams etc.
4.1.2		RCC members at all location	6 mm cement plaster 1:3 (1 cement: 3 fine sand)
4.2	Painting		
4.2.1		Internal: - All walls, ceiling	Acrylic emulsion paint (low VOC) over Putty as per approved architectural design up to sill level/1200mm height or ceiling height.
4.2.2		All steel work	Synthetic enamel paint with primer.
4.3	False Ceiling		
4.3.1		Ground & First Floor Living room 3 nos, Bed room 3 nos, Hostel room 3 nos., Care taker room, Care taker DRG room, Dining hall, Gents dormitory, Dormitory, Driver Dormitory, Ladies dormitory, Common hall , Audio visual farmers & Scientist interface facility, Visitors room, Office, Reception, Double bed room 6 nos., Hostel room 13 nos., Common hall & reading room, Store 3 nos., Office 2 nos., Passage.	Calcium silicate false ceiling tiles of size 595x595 of approved design and pattern as per architectural requirement/design.
4.3.2		All Toilets & bathrooms	Calcium silicate false ceiling tiles of size 595x595 of approved design and pattern as per architectural requirement/design.

5	Schedule of Cupboards, wardrobe, kitchen cabinet/modular kitchen/platform		
5.1	Cupboards		
5.1.1		G.F. – Kitchen	Boxes shelves, and shutters of both sides laminated 19 mm thick block board stainless steel drawers with telescopic channel.
5.2	Hardware fittings		
5.2.1		Kitchen	SS 304 stainless steel OR colour anodized aluminium. 125x64x1.90 mm stainless steel butt hinges.
5.3	Wardrobes		
5.3.1		G.F. - Caretaker room, Hostel room-3 F.F. - Hostel room-4, Hostel room-5, Hostel room-6	Boxes shelves, and shutters of both side laminated 19 mm thick block board 20mm round or oval diameter aluminium hanger rods with slotted (non-screw type) brackets Clear distance of hanger rod below the board bottom: 40mm. Or S.S 304
5.4	Kitchen platform		
5.4.1		Kitchen	18mm thick gang saw cut black granite; edges rounded, Height above finished floor level: 900 mm.
6	Schedule of External finishing painting, Cladding, Structural glazing		
6.1	Finishing / Facade		
6.1.1		External finishing	Providing and fixing wet cladding up to one storey with 40mm thick gang saw cut stone with machine As per CPWD specification and plaster & external acrylic distemper on above floors.
7	Schedule of Internal Water Supply, Sanitary lines and fittings fixtures		
7.1	Water Supply lines		
7.1.1		Toilets & baths, kitchens, washing area (Concealed and exposed)	Concealed CPVC pipe lines with fittings as per approved drawing & design of required dia.
7.2	Sanitary lines		
7.2.1		All internal	Hub less centrifugally cast (spun) iron pipe epoxy coated inside & outside IS :15905 with fittings as per approved drawing & design.

7.2.2		All manhole	Manholes shall be constructed using sewer bricks as per IS 4885 with minimum size of 90x80x45 cm for branch lines and 120x90x100 cm for main lines. The Manholes shall be circular if the depth of manholes is exceeding 1.0 m depth. The construction shall be as per CPWD specifications, as per best engineering practices or as approved by the Engineer-in-Charge with custom engraved/embossed SFRC cover as per approved design by the Engineer-in-Charge and frame of HD-20 tonne category. Vertical stack of waste water and other drainage except soil pipe shall discharge in to SW gully trap with chamber and cover (as per CPWD specifications) of 150 mm dia. which shall further discharge into nearest manhole. In sub-soil or adverse soil conditions, manholes & encasing pipes shall be as per approved credible structural design to avoid sinking and settlement of lines/manholes. Manholes projecting above natural ground level shall be finished with external plaster above NGL as per CPWD specifications. No manholes shall project above the finished levels. Note: Orange colour safety foot rest of minimum 16mm thick plastic encapsulated to be provided complete as per IS: 10910 and CPWD specifications.
7.2.3		Pipe between manhole & service manhole	RCC NP-2 pipe of minimum 200 mm dia. with cement concrete M10 all around the pipes shall be provided for smooth/healthy drainage system with proper slope as per approved design. The connecting pipe from gully trap to first manhole shall be minimum 150 mm dia. of C.I. including all fittings, joints and accessories
7.2.4		Chambers for: a) Valves b) Fire Hydrant	Brick masonry chambers of appropriate size with C.I. surface box complete as per specification.
7.2.5		Thrust Blocks	CC 1:2:4 (1Cement: 2 Coarse sand: 4 graded stone aggregate 20 mm nominal size) of required size and location as approved by Engineer-in-charge.
7.3	Wash Basin/ Kitchen Sink / Toilet fitting & fixtures (as per PAR 2025)		
7.3.1		In Kitchen	Stainless steel AISI 304 (18/8) kitchen sink as per IS 13983 with drain board.
7.3.2		In all toilets (Ground & first floor)	EWC/IWC with trap (EWC with seat rim and cover) and low level dual flushing cistern.
7.3.3		Toilets (Ground & first floor)	Water jet/ Health faucet with each EWC
7.3.4		In toilets & washing area.	Wash basin with CP brass basin mixture for hot & cold water, single lever quarter turn type with ceramic cartridge.
7.3.5		Toilets and kitchen	Tap (in kitchen, toilet, bath & WC) CP brass bib cock provided quarter turn type ceramic cartridge.

7.3.6		In all attached bathrooms with bedroom	Shower with CP brass diverter/ mixture single liver type for hot & cold water with ceramic cartridge.
7.3.7		One towel ring with CP brass towel rail each wash basin and CP brass towel rail in each ring	One towel ring with CP brass towel rail each wash basin and CP brass towel rail in each ring
7.3.8		With each wash basin	Mirror with frame and glass shelf having stainless steel frame/guard bar/ brackets 600x450 mm with each wash basin as per design.
7.3.9		Each EWC	CP brass toilet paper holder
7.3.10		One in each Wash basin and bathroom	Soap rack as per architectural design and specification
7.3.11		Applicable for All blocks	Separate tanks for kitchen and toilets for dual flushing system as per requirements with provision of online filter (Storage tank of capacity as per NBC 2025 provision for separate tank for WC & Drinking Water.)
7.3.12		In each male dormitory toilet	3 nos urinals
7.4	Dado/Sill lining/Jambs		
7.4.1		Toilets (Up to false ceiling)	Glazed vitrified tiles of minimum size 600x600 mm as per approved size & design including decorative bands at certain intervals.
7.4.2		Kitchen (Up to door lintel height)	18 mm thick pre-polished granite stone of approved shade and in approved pattern.
7.4.3		Lift lobby (Up to ceiling Height)	18 mm thick pre-polished granite stone of approved shade and in approved pattern.
7.4.4		Windows sill & Jambs	18 mm thick pre- polished granite stone with 10 mm projection all around inside & outside including edge moulding of high gloss.
8	Schedule of External Water Supply, Sanitary lines		
8.1	Water Supply line		
8.1.1		All external work	GI pipe lines with fittings as per approved drawing & design.
8.1.2		All rain water pipe	centrifugally cast (spun) iron pipe epoxy coated inside & outside IS :15905 with fittings as per approved drawing & design.
8.1.3		Main water supply pipe	Providing grid of Ductile iron class K-9 IS 8329 of required dia. including all fittings, joints and accessories in proposed developed area.
8.2	Sanitary line		
8.2.1		All external work	Hub less centrifugally cast (spun) iron pipe epoxy coated inside & outside IS :15905 with fittings as per approved drawing & design
9	Schedule of Waterproofing on terraces, toilet slabs, lift pits, basement rafts & walls, water tanks, UG sumps, OHTs and any other liquid retaining structures		
9.1		All terraces/ Roof/ mumty	Brick bat Coba on terrace.

9.2		In sunken Toilets, WC, bathroom	100mm Sunken floor slab depression for maintaining slopes with Integral crystalline slurry of hydrophilic in nature all over the structure as per DSR Item 22.23 of DSR-2023. However, covering of water supply and sanitary line of upper floor to be done by false ceiling as per the architectural drawings.
9.3		Expansion Joints on floor	Providing and fixing of expansion joint system related with floor location as per drawings and direction of Engineer-In-Charge. The joints system will be of extruded aluminum base members, self-aligning / self-centring arrangement and support plates etc. as per ASTM B221-02. The system shall be such that it provides floor to floor /floor to wall expansion control system for various vertical location in load application areas that accommodates multi directional seismic movement without stress to its components. System shall consist of metal profiles with a universal aluminum base member designed to accommodate various project conditions and finish floor treatments. The cover plate shall be designed of width and thickness required to satisfy projects movement and loading requirements and secured to base members by utilizing manufacturer's pre-engineered self- centring arrangement that freely rotates / moves in all directions. The Self - centring arrangement shall exhibit circular sphere ends that lock and slide inside the corresponding aluminium extrusion cavity to allow freedom of movement and flexure in all directions including vertical displacement. Provision of Moisture Barrier Membrane in the Joint System to have watertight joint is mandatory requirement all as per the manufactures design and as approved by Engineer-in-Charge. (Material shall confirm to ASTM 6063) For floor joint of approved size as per structural drawing and as per DSR 2023 item no 5.44
9.4		Expansion Joints on Wall	Providing and fixing of expansion joint system related with wall joint (internal/external) location as per drawings and direction of Engineer-In-Charge. The joints shall be of extruded aluminium base members, self-aligning / centring arrangement and support plates as per ASTM B221- 02. The material shall be such that it provides an Expansion Joints System suitable for vertical wall to wall/ wall to corner application, both new and existing construction in office Buildings & complexes with no slipping down tendency amongst the components of the Joint System. The Joint System shall utilize lightweight aluminium profiles exhibiting minimal exposed aluminium surfaces mechanically snap locking the multicellular to facilitate movement. (Material shall confirm to IS 1285:2023) for wall joint

			of approved size as per structural drawing and as per DSR 2023 item no 5.45
9.5		Expansion Joints on Roof	Refer figure no 22.7 of CPWD specification 2019 Vol. 2.
9.6		All water retaining structures	1.Integral crystalline admixture as per DSR Item 22.22 of DSR-2023 2.Integral crystalline slurry of hydrophilic in nature all over the structure as per DSR Item 22.23 of DSR-2023 3.Treatment of joints & holes with Integral crystalline as per DSR Item 22.25 of DSR-2023 4.Integral water proofing treatment of horizontal and vertical surfaces using rough Kota stone as per DSR Item 22.1 & 22.2 of DSR-2023 outside area of U.G Tank. 5.Ceramic tile in floor & walls of inner side of water retaining structure. 6.PVC water stops as per DSR 2023 item no. 22.4.1, 22.4.2, 22.4.3 for construction/ expansion joints
10	Schedule of Railing and Grills		
10.1	Railing		
10.1.1		All Staircases, Lobby, Balconies, Ramps, around courtyard etc..	Modular knockdown type factory made SS 304 L railing as per approved design with tubed not less than 2mm thickness with clear height with or without glass as per Architectural design.
	Note : Hand rail of the balcony railings in multi storey flats may be so designed that clothes drying lines in sufficient numbers are provided along with		
10.2	Grills		
10.2.1		All windows & ventilators	Stainless steel
10.3	Façade / Jali of Shaft		
10.3.1		All shaft & façade	Aluminium louvers, to cover exposed Rain water pipe shafts, Toilet shafts and other areas shall be provided as per requirement. The sections for fixing of such louvers shall be designed as per codal provisions to withstand wind loads, seismic movements etc.
10.4	Parapet wall on terrace		
10.4.1		Terrace	Fly ash brick with top CC band and 40 mm stone coping projecting both side as per architectural design.
❖ Specifications of items not covered in schedule (civil) no. 1 to schedule (Civil) no. 10, shall be as per General Specifications/ Guidelines PAR 2025. In this regard the decision of Engineer- in-charge shall be final and binding.			

Admin Block – Schedule (Civil) No. -1 to 10

Schedule No.	Item	Location	Description of Item/ Brief Specification
1	Schedule of Wall		
1.1	External Wall		
1.1.1		Admin block	Fly ash brick
1.2	Internal Wall (Dry Area)		
1.2.1		Admin block	Fly ash brick/ dry wall partitioning/ glass partitioning
1.3	Internal Wall (Wet Area)		
1.3.1		Admin block	Burnt clay brick
2	Schedule of Flooring		
2.1		Parking Area/ Ramp/ Open Parking Area on Ground Floor	Vacuum Dewatered Concrete Flooring as per DSR 2023 item no 16.75 including panel shuttering and making & filling of grooves etc.
2.1.1		From Ground floor to sixth floor at Admin building- Main entrance, Entrance lobby, Reception cum waiting area, corridor, stair case, lobby/hall, all type of counters, lift lobby, kitchens & machine rooms, Lifts	Granite flooring as per requirement.
2.1.2		Main staircase	18 mm thick single piece granite stone in flooring in treads & risers with dado of matching permanent finish specification
2.1.3		Fire escape stair case	18 mm thick flamed granite in single piece in treads & risers with dado of matching permanent finish specification.
2.1.4		Ground floor to Sixth floor – All toilets All toilets & bathrooms at all floors and janitor room	Granite flooring as per requirement.
2.1.5		Canteen at all floors	Full body Vitrified tiles as per requirement.
2.1.6		Approach pathway/Walking Path way at ground floor with side kerb stone	Precast paver block
2.1.7		Electrical shaft/UPS Room/Housekeeping room	Kota stone flooring
2.1.8		All stores & central store (From ground to 6 th)	Kota stone flooring

2.2		Ground floor -Library, In-charge library,	Full body Vitrified tiles as per requirement.
2.2.1		CIF LABS, I/C CIF	Granite flooring as per requirement.
2.3		First floor -Director room, PS room, Rest room, ,Committee rooms, Record room, Hindi cell, IJSC room, Women cell, ARIS cell cum computer centre, , I/C ARIS , Estate office, I/C Estate, DDO ,Dispatch, bill & cash office, Purchase office, I/C purchase, Visitor room, , AO room , AAO room , Admin office, PME office ,I/C PME, I/C ITMU, Finance office, FAO, AFAO	Full body Vitrified tiles as per requirement.
2.3.1		Director room	Wooden flooring
2.3.2		Utility room, Server room, Common utility	Granite flooring as per requirement.
2.4		Second floor -HOD rooms, office of HOD, Seminar rooms, Classroom, Staff rooms, Digestion rooms, Scientist rooms (10 nos), Divisional library, Visitor rooms	Full body Vitrified tiles as per requirement.
2.4.1		Core labs 4 nos., Sample preparation rooms 4nos., Sterilization rooms, Cold rooms, Utility room	Granite flooring as per requirement
2.5		Third floor - HOD rooms, office of HODs, Seminar rooms, Classroom, Staff rooms, Scientist rooms 10 nos., Divisional library, Visitor rooms.	Full body Vitrified tiles as per requirement.
2.5.1		Core labs 4 nos., Utility rooms, Sample preparation rooms 4 nos., Sterilization rooms, Cold rooms	Granite flooring as per requirement
2.6		Fourth floor -HOD rooms, office of HODs, Seminar rooms, Classrooms, Staff rooms, Scientist rooms 10 nos., Divisional library, Visitor rooms	Full body Vitrified tiles as per requirement.
2.6.1		Core labs 4 nos., Utility rooms, Sample preparation rooms 4 nos., Sterilization rooms, Cold rooms,	Granite flooring as per requirement
2.7		Fifth floor - I/C LPM, Common rooms, Seminar rooms, Classrooms, Staff rooms, Scientist rooms 10 nos., Divisional library, Visitor rooms	Full body Vitrified tiles as per requirement.
2.7.1		Core labs 4 nos., Utility rooms, Sample preparation rooms 3 nos., Sterilization	Granite flooring as per requirement

		rooms, Cold rooms, Media Labs, I/C CUS	
2.8		Sixth floor- I/C Office, Common room, Class room, Scientist rooms 10 nos., Seminar Room, I/C AHS	Full body Vitrified tiles as per requirement.
2.8.1		Core labs 4 nos., Utility room, Sample preparation rooms 2 no., Cell Culture Lab 01 no., Cold room 2 nos., Bio Lab, Digestion lab, Fermentation lab, Sterilization room	Granite flooring as per requirement
3	Schedule of Door, Windows, Ventilators, Fittings, Fixtures & Glazing details		
3.1	Doors (Frame) At all floors		
3.1.1		Entrance door/Main door /	Providing and fixing automatic glazed (Toughened Glass) sensor sliding door with etching with required door fittings, all complete as per direction of Engineer in charge. The fittings should be got approved from the Engineer-in-charge and all the fixings etc. shall be done as per CPWD Specifications-2019, manufacturer's specification and corresponding codes described in the description of the fitting.
3.1.2		All type of Rooms in admin building.	2nd class teak wood
	Note: Zebra Blinds with required accessories on all windows except kitchen, toilet, bath shall be provided as per approved design and pattern.		
3.1.3		Toilets	2nd class teak wood
3.1.4		Mumty Doors	SS Door including SS Frame.
3.1.5		Fire rated doors at Lift/ Staircase Lobby	Fire rated doors at Lift/ Staircase Lobby fully glazed fire rated fixed non-load bearing double leaf swing door system with 120 minutes of integrity.
3.1.6		Fire Shaft Doors/Machine room	Fire Shaft Doors fixing 50 mm thick, glazed powder coated Mild sheet door shutters.
3.2	Doors(shutters)		
3.2.1		All type of Rooms from ground to sixth floor.	Flush door with teak veneered ply/anodized/powder coated/polyester powder coated aluminium shutters with toughened glass glazing wherever required as per CPWD specification / as per design & drawing.

3.2.2		Toilets (Main Entrance Door)	Flush door with teak veneered ply wherever required as per CPWD specification / as per design & drawing.
3.2.3		Toilets (Water Closet cubical	Compact Cubicles laminate with SS frame work.
3.3	Window /Ventilator (Frame)		
3.3.1		Admin cum laboratory building (All windows)	Part of Unitized/system aluminium windows
3.3.2		All Toilets in Admin cum laboratory building.	Part of Unitized/system aluminium windows
3.4	Window /Ventilator (shutter)		
3.4.1		Admin cum laboratory building	Part of Unitized/system aluminium windows
3.4.2		All Toilets in Admin cum laboratory building	Part of Unitized/system aluminium windows
3.5	Fittings and Fixtures		
3.5.1		Admin cum laboratory building	Part of Unitized/system aluminium windows
3.5.2		All Toilets in Admin cum laboratory building	Part of Unitized/system aluminium windows
3.6	Details of Glazing		
3.6.1		Admin building	Double glass unit with toughened glass.
3.6.2		At all location of admin building (Toilets)	5 mm thick frosted toughened glass
4	Schedule of Internal Finishing painting, wall panelling, dado & false ceiling		
4.1	Plastering		
4.1.1		Plaster on walls (External/Internal)	a) All external & internal walls shall be plastered with 12 mm plaster of 1:6 (1 cement: 6 fine sand) mix after fixing chicken wire mesh on walls surface at junction of masonry work and RCC works as per CPWD specifications. b) 6 mm 1:3 (1 cement: 3 fine sand) Ceiling plaster and RCC surface shall be as per CPWD specifications. c) Necessary drip course shall be provided in chajjas, balconies, projecting roofs, beams etc.

	Note: Necessary SS 304 grade chicken wire mesh of approved make in 300 mm width shall be fixed with nails etc. on all junctions of dissimilar materials such as on junction of masonry and RCC surface, on both sides external and internal walls. Stated fibre mesh shall also be fixed over chase in masonry for conduits.		
4.2	Painting		
4.2.1		(At admin cum lab building) Ground floor to sixth floor Corridors (above 1.2 mtr height of cladding up to ceiling height)	Acrylic emulsion paint (low VOC) over Putty as per approved architectural design up to sill level/1200mm height or ceiling height.
4.2.2		(At admin cum building) Ground floor to sixth floor Circulation area, staircase area (above 1.2 mtr height of cladding up to ceiling height)	Acrylic emulsion paint (low VOC) over Putty as per approved architectural design up to sill level/1200mm height or ceiling height.
4.2.3		(At admin building) Ground floor to sixth floor at all rooms	Acrylic emulsion paint (low VOC) over Putty as per approved architectural design up to sill level/1200mm height or ceiling height.
4.2.4		(At admin building) Ground Floor to sixth floor- All kitchens (above 1.5 mtr height of cladding up to ceiling height	Acrylic emulsion paint (low VOC) over Putty as per approved architectural design up to sill level/1200mm height or ceiling height.
4.2.5		(At admin building) Ground Floor- CIF Labs (above 1.5 mtr height of cladding up to ceiling height)	Acrylic emulsion paint (low VOC) over Putty as per approved architectural design up to sill level/1200mm height or ceiling height.
4.2.6		(At admin building) First Floor-Utility room, common utility room (above 1.5 mtr height of cladding up to ceiling height)	Acrylic emulsion paint (low VOC) over Putty as per approved architectural design up to sill level/1200mm height or ceiling height.
4.2.7		(At admin building) Second Floor-Core Labs, Sterilization rooms, Sample preparation rooms, cold rooms (above 1.5 mtr height of cladding up to ceiling height)	Acrylic emulsion paint (low VOC) over Putty as per approved architectural design up to sill level/1200mm height or ceiling height.
4.2.8		(At admin building) Third Floor- Core Labs, Sterilization rooms, Sample preparation rooms, cold rooms (above 1.5 mtr height of cladding up to ceiling height)	Acrylic emulsion paint (low VOC) over Putty as per approved architectural design up to sill level/1200mm height or ceiling height.

4.2.9		(At admin building) Fourth Floor- Core Labs, Sterilization rooms, Sample preparation rooms, cold rooms (above 1.5 mtr height of cladding up to ceiling height)	Acrylic emulsion paint (low VOC) over Putty as per approved architectural design up to sill level/1200mm height or ceiling height.
4.2.10		(At admin building) Fifth Floor- Core Labs, Sterilization rooms, Sample preparation rooms, cold rooms, Media Lab, I/C CUS (above 1.5 mtr height of cladding up to ceiling height)	Acrylic emulsion paint (low VOC) over Putty as per approved architectural design up to sill level/1200mm height or ceiling height.
4.2.11		(At admin building) Sixth Floor- Core Labs, Sterilization rooms, Sample preparation rooms, cold rooms, Media Lab, I/C AHS, Cell culture Lab, Fermentation Lab (above 1.5 mtr height of cladding up to ceiling height)	Acrylic emulsion paint (low VOC) over Putty as per approved architectural design up to sill level/1200mm height or ceiling height.
4.2.12		(At admin building) Steel work	Synthetic enamel paint with primer.
4.3	Dado/Sill lining/Jambs		
4.3.1		(At admin building) Ground floor to sixth floor- All Toilets, janitor rooms (Up to ceiling height)	Glazed vitrified tiles of minimum size 600 x 600 mm as per approved size & design including decorative bands at certain intervals.
4.3.2		(At admin building) Ground floor to sixth floor Corridors (1200 mm height)	18 mm thick pre-polished granite stone of approved shade and in approved pattern.
4.3.3		(At admin building) Ground floor to sixth floor Lift lobby facia (Up to ceiling height)	18 mm thick pre-polished granite stone of approved shade and in approved pattern.
4.3.4		(At admin building and other misc. str) Ground floor to sixth floor Circulation area, staircase area (1200 mm height)	18mm thick pre polished granite in all design and shades with 100 mm Skirting.
4.3.5		(At admin building) Ground floor to sixth floor Skirting at all rooms (100 mm height)	With matching floors.
4.3.6		(At admin building) Ground floor to sixth floor Windows sill & Jambs	18 mm thick pre- polished granite stone with 10 mm projection all around inside & outside including edge moulding of high gloss.
4.3.7		(At admin building) Ground Floor to sixth floor- All kitchens (1500 mm height)	18 mm thick pre-polished granite stone of approved shade and in approved pattern
4.3.8		(At admin building and) Ground Floor- CIF Labs (1500 mm height)	18 mm thick pre-polished granite stone of approved shade and in approved pattern

4.3.9		(At admin building) First Floor-Utility room, common utility room (1500 mm height)	18 mm thick pre-polished granite stone of approved shade and in approved pattern
4.3.10		(At admin building) Second Floor- Core Labs, Sterilization rooms, Sample preparation rooms, cold rooms (1500 mm height)	18 mm thick pre-polished granite stone of approved shade and in approved pattern
4.3.11		(At admin building) Third Floor- Core Labs, Sterilization rooms, Sample preparation rooms, cold rooms (1500 mm height)	18 mm thick pre-polished granite stone of approved shade and in approved pattern
4.3.12		(At admin building) Fourth Floor- Core Labs, Sterilization rooms, Sample preparation rooms, cold rooms (1500 mm height)	18 mm thick pre-polished granite stone of approved shade and in approved pattern
4.3.13		(At admin building) Fifth Floor- Core Labs, Sterilization rooms, Sample preparation rooms, cold rooms, Media Lab, I/C CUS (1500 mm height)	18 mm thick pre-polished granite stone of approved shade and in approved pattern
4.3.14		(At admin building) Sixth Floor- Core Labs, Sterilization rooms, Sample preparation rooms, cold rooms, Media Lab, I/C AHS, Cell culture Lab, Fermentation Lab (1500 mm height)	18 mm thick pre-polished granite stone of approved shade and in approved pattern
4.3.15		At all location above sink. (600 mm height)	Vitrified glazed wall tile of size 600x600 mm.
4.4	False Ceiling		
4.4.1		(At admin building) Ground floor to sixth floor -All Toilets, janitor rooms, Server rooms, UPS & housekeeping rooms,	Calcium silicate false ceiling tiles of size 595x595 of approved design and pattern as per architectural requirement/design.
4.4.2		First floor- Director room, PS room, Rest room, Committee room, Record room, Hindi cell, IJSC room, Women cell, ARIS cell cum computer centre, I/C ARIS, Estate office, I/C Estate, DDO, Dispatch, bill & cash office, Purchase office, I/C purchase, Visitor room, AO room, AAO room, Admin office, PME office, I/C PME, I/C ITMU, Finance office, FAO, AFAO, Utility room, Server room, Common utility	Calcium silicate false ceiling tiles of size 595x595 of approved design and pattern as per architectural requirement/design.

4.4.3		Second floor- HOD rooms, office of HODs, Seminar rooms, Classrooms, Staff rooms, Scientist rooms, Divisional library, Visitor rooms, Core labs, Utility rooms, Sample preparation rooms, Stores, Sterilization rooms, Cold rooms	Calcium silicate false ceiling tiles of size 595x595 of approved design and pattern as per architectural requirement/ design.
4.4.4		Third floor- HOD rooms, office of HODs, Seminar rooms, Classrooms, Staff rooms, Scientist rooms, Divisional library, Visitor rooms, Core labs, Utility rooms, Sample preparation rooms, Stores, Sterilization rooms, Cold rooms,	Calcium silicate false ceiling tiles of size 595x595 of approved design and pattern as per architectural requirement/design.
4.4.5		Fourth floor- HOD rooms, office of HODs, Seminar rooms, Classrooms, Staff rooms, Scientist rooms, Divisional library, Visitor rooms, Core labs, Utility rooms, Sample preparation rooms, Stores, Sterilization rooms, Cold rooms,	Calcium silicate false ceiling tiles of size 595x595 of approved design and pattern as per architectural requirement/design.
4.4.6		Fifth floor- I/C LPM, Common rooms, Seminar rooms, Classrooms, Staff rooms, Scientist rooms, Divisional library, Visitor rooms, Core labs, Utility rooms, Sample preparation rooms, Sterilization rooms, Cold rooms, Media Labs, Stores, I/C CUS	Calcium silicate false ceiling tiles of size 595x595 of approved design and pattern as per architectural requirement/design.
4.4.7		Sixth floor- I/C office, Common rooms, Seminar rooms, Classroom, Staff rooms, Scientist rooms, Core labs, Utility room, Sample preparation rooms, I/C AHS, Sterilization rooms, Cold rooms, Digestonative labs, Bio labs, Cell culture labs, Cold rooms Fermentation labs	Calcium silicate false ceiling tiles of size 595x595 of approved design and pattern as per architectural requirement/design.

Schedule No. 5	Schedule of Lab Furniture			
	Name of Lab	No. of Labs	Description	Qty.
1	CIF LAB – Ground Floor (As per drawing and Lab specification)	1	1. Fume Hood of size 1800Lx2400Hx1200Dmm	1
			2. Laminar Air Flow Unit (Vertical) of size 1530x730x933mm	1
			3. Wall hanging storage of size 600x400x900	6
			4. Island table of size 3378Lx1525Dx900H with 4 work station granite worktop and CRS drawer and cabinet with leg space with bench mount glass reagent shelves along with Service enclosure / dropper.	2
			5. Corner sink cabinet of standing height 900mm with granite worktop along with deck mounted double head eye wash / drench.	2
			6. Work station with base of CRS drawer, cabinet, knee space and granite top with dimension 4385Lx762Dx900H with bench mount glass reagent shelves along with Service enclosure / dropper. Socket qty as per drawings & BOQ.	2
			7. Work station with base of CRS drawer, cabinet, knee space and granite top with dimension 3070Lx762Dx900H with bench mount glass reagent shelves along with Service enclosure / dropper. Socket qty as per drawings & BOQ.	1
			8. Work station with base of CRS drawer, cabinet, knee space and granite top with dimension 3299Lx762Dx900H with bench mount glass reagent shelves along with Service enclosure / dropper. Socket qty as per drawings & BOQ.	1
			9. Service dropper 304LX152D X3000mm	2
2	STERLIZATION ROOM - Second Floor (as per drawing & lab specification)	1	1. Work station with base of CRS drawer, cabinet, knee space and granite top with dimension 3476x762x900mm. Socket Qty as per drawings.	1
			2. Sink cabinet of standing height 900mm along with deck mounted double head eye wash and peg board.	2
			3. Service enclosure/dropper.	2

3	CELL CULTURE LAB - Second Floor (as per drawing & lab specification)	1	1. Work station with base of CRS drawer, cabinet, knee space and granite top with dimension 4369Lx762Dx900H with bench mount glass reagent shelves along with Service enclosure / dropper. Socket qty as per drawings & BOQ.	1
			2. Work station with base of CRS drawer, cabinet, knee space and granite top with dimension 4007Lx762Dx900H with bench mount glass reagent shelves along with Service enclosure / dropper. Socket qty as per drawings & BOQ.	1
			3. Corner sink cabinet of standing height 900mm with granite worktop along with deck mounted double head eye wash & peg board.	1
			4. Bio Safety Cabinet (Class 2 A2) of size 1400x920.	1
4	CORE LAB. Second Floor (as per drawing & lab specification)	1	1. Island table of size 4623Lx1830Dx900H with 4 work station granite worktop and CRS drawer and cabinet with leg space with bench mount glass reagent shelves along with Service enclosure / dropper. Socket qty as per drawings & BOQ. Socket qty as per drawings & BOQ.	1
			2. Island table of size 3835Lx1830Dx900H with 2 work station granite worktop and CRS drawer and cabinet with leg space with bench mount glass reagent shelves along with Service enclosure / dropper with 1 no. sink cabinet with eye wash & acrylic peg board. Socket qty as per drawings & BOQ.	1
			3. Corner sink cabinet of sitting height 750mm along with deck mounted double head eye wash/drench.	2
			4. Work station sitting height 750mm with base of CRS drawer, cabinet, 3qty knee space and granite top with dimension 5794LX762DX750H. Socket qty as per drawings & BOQ.	1
			5. Work station sitting height 750mm with base of CRS drawer, cabinet, 3qty knee space and granite top with dimension 5476LX762DX750H	1
			6. Work station sitting height 750mm with base of CRS drawer, cabinet, 3qty knee space and granite top with dimension 6045LX762DX750H. Socket qty as per drawings & BOQ.	1
			7. Wall hanging glazed storage of size 600x400x762	7

			8. Fume Hood of size 1800Lx2400Hx1207Dmm	1
			OR	
			Laminar Air Flow Unit (Vertical) of size 1530x730x933mm	1
5	SAMPLE PREPARATION - Second Floor (as per drawing & lab specification)	1	1. Work station with base of CRS drawer, cabinet, knee space and granite top with dimension 4007Lx762Dx900H with bench mount glass reagent shelves along with Service enclosure / dropper. Socket qty as per drawings & BOQ.	1
			2. Work station with base of CRS drawer, cabinet, knee space and granite top with dimension 4369Lx762Dx900H with bench mount glass reagent shelves along with Service enclosure / dropper. Socket qty as per drawings & BOQ.	1
			3. Corner sink cabinet of standing height 900mm along with deck mounted double head eye wash & Peg board.	1
			4. Bio Safety Cabinet (Class 2 A2) of size 1400x920.	1
6	MEDIA LAB- Fifth Floor (as per drawing & lab specification)	1	1. Work station with base of CRS drawer, cabinet, knee space and granite top with dimension 4369Lx762Dx900H with bench mount glass reagent shelves along with Service enclosure / dropper. 3 knee space. Socket qty as per drawings & BOQ.	1
			1. Work station with base of CRS drawer, cabinet, knee space and granite top with dimension 4007Lx762Dx900H with bench mount glass reagent shelves along with Service enclosure / dropper. 3qty Knee space. Socket qty as per drawings & BOQ.	1
			2. Corner sink cabinet of standing height 900mm along with deck mounted double head eye wash & Peg board.	1
			3. Bio Safety Cabinet (Class 2 A2) of size 1400Lx920D.	1
7	BIO LAB - Sixth Floor (as per drawing & lab specification)	1	1. Work station with base of CRS drawer, cabinet, knee space and granite top with dimension 4517Lx762Dx900H with bench mount glass reagent shelves along with Service enclosure / dropper along with 3qty knee space. Socket qty as per drawings & BOQ.	1

			2. Work station with base of CRS drawer, cabinet, knee space and granite top with dimension 6238Lx762Dx900H with bench mount glass reagent shelves along with Service enclosure / dropper along with 4qty knee space. Socket qty as per drawings & BOQ.	1
			3. Corner sink cabinet of standing height 900mm along with deck mounted double head eye wash/drench.	1
			4. Wall hanging storage of size 600x400x762	6
8	DIGESTION LAB - Sixth Floor (as per drawing & lab specification)	1	1. Work station with base of CRS drawer, cabinet, knee space and granite top with dimension 4517Lx762Dx900H with bench mount glass reagent shelves along with Service enclosure / dropper along with 3qty knee space. Socket qty as per drawings & BOQ.	1
			2. Work station with base of CRS drawer, cabinet, knee space and granite top with dimension 6238Lx762Dx900H with bench mount glass reagent shelves along with Service enclosure / dropper along with 4qty knee space. Socket qty as per drawings & BOQ.	1
			3. Corner sink cabinet of standing height 900mm along with deck mounted double head eye wash/drench.	1
			4. Wall hanging storage of size 600x400x762	6
9	FERMENTATION LAB - Sixth Floor (as per drawing & lab specification)	1	1. Work station with base of CRS drawer, cabinet, knee space and granite top with dimension 4007Lx762Dx900H with bench mount glass reagent shelves along with Service enclosure / dropper. 3qty Knee Space. Socket qty as per drawings & BOQ.	1
			1. Work station with base of CRS drawer, cabinet, knee space and granite top with dimension 4369Lx762Dx900H with bench mount glass reagent shelves along with Service enclosure / dropper. 3qty Knee space. Socket qty as per drawings & BOQ.	1
			2. Corner sink cabinet of standing height 900mm along with deck mounted double head eye wash & Peg board.	1
			3. Bio Safety Cabinet (Class 2 A2) of size 1400x920.	1

Schedule No.	Location	Description of Item/ Brief Specification
6	Schedule of External finishing painting, Cladding, Structural glazing	
6.1	Finishing / Facade	
6.1.1	External finishing (upto height 7.8 m)	Providing and fixing wet cladding up to one storey with 40mm thick gang saw cut stone with machine as per CPWD specification
6.1.2	External finishing (upto height 7.8 m)	Over 1 mm thick putty & texture acrylic paint as per approved design.
6.1.3	Structure Glazing (Full height)	25% of area of front elevation of Admin building as per approved design and drawing.
6.1.4	Director's room (up to ceiling height)	Wall pallelling with 18mm thick BWP grade commercial ply over adequate 6mm thick veneering with premium adequate polishing
7	Schedule of Internal Water Supply, Sanitary lines and fittings fixtures	
7.1	Internal Water Supply lines	
7.1.1	All internal (concealed and exposed)	Concealed CPVC pipe lines with fittings as per approved drawing & design of required dia.
7.2	Sanitary lines	
7.2.1	All internal	Hub less centrifugally cast (spun) iron pipe epoxy coated inside & outside IS :15905 with fittings as per approved drawing & design.
7.2.2	All manhole	Manholes shall be constructed using sewer bricks as per IS 4885 with minimum size of 90x80x45 cm for branch lines and 120x90x100 cm for main lines. The Manholes shall be circular if the depth of manholes is exceeding 1.0 m depth. The construction shall be as per CPWD specifications, as per best engineering practices or as approved by the Engineer-in-Charge with custom engraved/embossed SFRC cover as per approved design by the Engineer-in-Charge and frame of HD-20 tonne category. Vertical stack of waste water and other drainage except soil pipe shall discharge in to SW gully trap with chamber and cover (as per CPWD specifications) of 150 mm dia. which shall further discharge into nearest manhole. In sub-soil or adverse soil conditions, manholes & encasing pipes shall be as per approved credible structural design to avoid sinking and settlement of lines/manholes. Manholes projecting above natural ground level shall be finished with external plaster above NGL as per CPWD specifications. No manholes shall project above the finished levels. Note: Orange colour safety foot rest of minimum 16mm thick plastic encapsulated to be provided complete as per IS: 10910 and CPWD specifications.
7.2.3	Pipe between manhole &	RCC NP-2 pipe of minimum 200 mm dia. with

		service manhole	cement concrete M10 all around the pipes shall be provided for smooth/healthy drainage system with proper slope as per approved design. The connecting pipe from gully trap to first manhole shall be minimum 150 mm dia. of C.I. including all fittings, joints and accessories
7.2.4		Chambers for: a) Valves b) Fire Hydrant	Brick masonry chambers of appropriate size with C.I. surface box complete as per specification.
7.2.5		Thrust Blocks	CC 1:2:4 (1Cement: 2 Coarse sand: 4 graded stone aggregate 20 mm nominal size) of required size and location as approved by Engineer-in-charge.
7.3	Wash Basin/ Kitchen Sink / Toilet fitting & fixtures		
7.3.1		In all Kitchen / canteen (Ground to sixth floor)	Stainless steel AISI 304 (18/8) kitchen sink as per IS 13983 with drain board.
7.3.2		In all toilets (Ground to sixth floor)	EWC/IWC with trap (EWC with seat rim and cover) and low level dual flushing cistern.
7.3.3		In all labs (Ground to sixth floor)	As per furniture schedule.
7.3.4		All Toilets (Ground to sixth floor)	Water jet/ Health faucet with each EWC
7.3.5		In All toilets (Ground floor to sixth floor)	Wash basin with CP brass basin mixture for hot & cold water, single lever quarter turn type with ceramic cartridge.
7.3.6		In All Toilets and kitchen (Ground floor to sixth floor)	Tap (in kitchen, toilet, bath & WC) CP brass bib cock provided quarter turn type ceramic cartridge.
7.3.7		CP brass towel rail and towel ring	One towel ring with each wash basin and towel rail in each bathroom.
7.3.8		With each wash basin	Mirror with frame and glass shelf having stainless steel frame/guard bar/ brackets 600x450 mm with each wash basin as per design.
7.3.9		Each EWC	CP brass toilet paper holder
7.3.10		One in each Wash basin	Soap rack as per architectural design and specification
7.3.11		Applicable for All blocks	Separate tanks for kitchen and toilets for dual flushing system as per requirements with provision of online filter (Storage tank of capacity as per NBC 2025 provision for separate tank for WC & Drinking Water.)
7.3.12		In all gents toilet (Ground to sixth floor)	2 Urinals
8	Schedule of External Water Supply, Sanitary lines		
8.1	Water Supply line		
8.1.1		All external work	GI pipe lines with fittings as per approved drawing & design.
8.1.2		All rain water pipe	Centrifugally cast (spun) iron pipe epoxy coated inside & outside IS :15905 with fittings as per approved drawing & design.

8.1.3		Main water supply pipe from pump room to admin block	Providing grid of Ductile iron class K-9 IS 8329 of required dia. including all fittings, joints and accessories in proposed developed area
8.2		Sanitary line	
8.1.1		All external work	Hub less centrifugally cast (spun) iron pipe epoxy coated inside & outside IS :15905 with fittings as per approved drawing & design
8.3		Sewage Treatment Plant	
8.3.1		external work	The Sewage treatment plant of approximate 50 KLD Capacity with MBBR Technology.
9		Schedule of Waterproofing on terraces, toilet slabs, lift pits & walls, water tanks, UG sumps, OHTs and any other liquid retaining structures	
9.1		All Terraces/Roof/Mumty	Brick bat Coba on terrace.
9.2		All water retaining structures	1. Integral crystalline admixture as per DSR Item 22.22 of DSR-2023 Vol. II 2. Integral crystalline slurry of hydrophilic in nature all over the structure as per DSR Item 22.23 of DSR-2023 3. Treatment of joints & holes with Integral crystalline as per DSR Item 22.25.1 and 22.25.2 of DSR-2023 4. Integral water proofing treatment of horizontal and vertical surfaces using rough Kota stone as per DSR Item 22.1.1 & 22.2.1 of DSR-2023 outside area of U.G Tank. 5. Ceramic tile in floor & walls of inner side of water retaining structure. 6. PVC water stops as per DSR 2023 item no. 22.4.1, 22.4.2, 22.4.3 for construction/expansion joints
9.3		Retaining wall, liquid storage tank walls (including overhead and underground)	1. Integral crystalline admixture for water proofing treatment @ 0.80% (minimum) to the weight of cement content per cubic meter of concrete) or higher as recommended by the manufacturer's specification in reinforced cement concrete. 2. It will also be in scope of contractor to provide Injecting cement grout of cement and polymer-based water proofing compound (non-shrinkage grouting compound) in proportion as specified in these nozzles at a pressure of 2.5 to 3.0 Kg/Sq.cm. f. (if required) to check any kind of leakage/seepage and nothing extra shall be payable on that account. After the grout the nozzles are cut and filled with cement mortar 1:2 mixed with polymer-based water proofing compound in proportion as specified and finished smooth. 3. The outer RCC wall up to 30cm above higher ground level from the base of RCC raft shall be finished with 20 mm cement plaster 1:3 (1 cement:

			3 coarse sand) mixed with water proofing compound in recommended proportion including rounding off junctions of vertical and horizontal surface. Before plastering, the junction shall be grouted as per CPWD specification for every 30cm interval. Nothing extra shall be payable on this account. 4. If required, then this shall also be in scope of contractor for Providing and applying crystalline mortar by mixing in the ratio of 4.5: 1 (4.5 parts crystalline mortar: 1 part water) for the treatment of construction joints, cracks, tie rod holes and spalled & honeycombed surface of RCC underground structures like water tanks, bridge deck etc. to ensure water tightness. The crystalline mortar shall conform to the EN 1504-3 having compressive strength Class R4 ≥ 45 MPa and adhesive bond strength Class R3 ≥ 1.5 MPa. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage for sealing cracks and faulty construction joints, routed out/making U-shape groove size 25x25mm and then primed the area with integral crystalline slurry @0.05kg/ running metre and while the surface is tacky filled the groove up to surface with crystalline mortar @1.50kg/ running metre. Once crystalline mortar is touch dry then finally applied two coats of integral crystalline slurry @0.05kg/running metre per coat as per DSR 2023 item no. 22.25.1 & 22.25.2. Nothing extra shall be payable on this account. 5. PVC water stops as per DSR 2023 item no. 22.4 for construction/expansion joints between two RCC members and fixed to the reinforcement with binding wire before pouring concrete etc. shall be provided wherever required and as per direction of Engineer-in-charge
9.4		In sunken Toilets, WC, Bathrooms.	100mm Sunken floor slab depression for maintaining slopes with Integral crystalline slurry of hydrophilic in nature all over the structure as per DSR Item 22.23 of DSR-2023. However, covering of water supply and sanitary line of upper floor to be done by false ceiling as per the architectural drawings.
9.5		Expansion Joints on floor	Providing and fixing of expansion joint system related with floor location as per drawings and direction of Engineer-In-Charge. The joints system will be of extruded aluminium base members, self-

			aligning / self-centring arrangement and support plates etc. as per ASTM B221-02. The system shall be such that it provides floor to floor /floor to wall expansion control system for various vertical location in load application areas that accommodates multi directional seismic movement without stress to its components. System shall consist of metal profiles with a universal aluminium base member designed to accommodate various project conditions and finish floor treatments. The cover plate shall be designed of width and thickness required to satisfy projects movement and loading requirements and secured to base members by utilizing manufacturer's pre-engineered self-centring arrangement that freely rotates / moves in all directions. The Self - centring arrangement shall exhibit circular sphere ends that lock and slide inside the corresponding aluminium extrusion cavity to allow freedom of movement and flexure in all directions including vertical displacement. Provision of Moisture Barrier Membrane in the Joint System to have watertight joint is mandatory requirement all as per the manufactures design and as approved by Engineer-in-Charge. (Material shall confirm to ASTM 6063) For floor joint of approved size as per structural drawing and as per DSR 2023 item no 5.44
9.6		Expansion Joints on Wall	Providing and fixing of expansion joint system related with wall joint (internal/external) location as per drawings and direction of Engineer-In-Charge. The joints shall be of extruded aluminium base members, self-aligning / centring arrangement and support plates as per ASTM B221- 02. The material shall be such that it provides an Expansion Joints System suitable for vertical wall to wall/ wall to corner application, both new and existing construction in office Buildings & complexes with no slipping down tendency amongst the components of the Joint System. The Joint System shall utilize lightweight aluminium profiles exhibiting minimal exposed aluminium surfaces mechanically snap locking the multicellular to facilitate movement. (Material shall confirm to IS 1285:2023) for wall joint of approved size as per structural drawing and as per DSR 2023 item no 5.45
9.7		Expansion Joints on Roof	Refer figure no 22.7 of CPWD specification 2019 Vol. 2.
10	Schedule of Railing and Grills, Jali (Admin building and other misc. structures)		
10.1	Railing		

10.1.1		All Staircases, Entrance, Balcones, Ramps, atrium/ cut out reception/ lobby/ corridors etc.	Modular knockdown type factory made SS 304 L railing as per approved design with tubed not less than 2mm thickness with clear height with or without glass as per Architectural design.
10.1.2		All Soft area/park	S.S railing of approved design and pattern.
10.2	Grills		
10.2.1		All windows & ventilators	Stainless Steel.
10.3	Façade / Jali of Shaft		
10.3.1		All shaft & façade	Aluminium louvers to cover exposed Rain water pipe shafts, Toilet shafts and other areas shall be provided as per requirement. The sections for fixing of such jalis shall be designed as per codal provisions to withstand wind loads, seismic movements etc.
10.4	Parapet wall on terrace		
10.4.1		Terrace /Roof/Mumty at All location	Fly ash brick with top CC band and 40 mm stone coping projecting both side as per architectural design.

(A) Sanitary ware and other fittings and fixtures (at all Location)

The following sanitary will be fixed with the prior approval of Engineer-in-charge.

Description
Counter top wash basin – Cascade NXT
C.P. brass towel ring
Connecting pipe 600mm
Soap dish holder
CP brass twin robe hooks
Single Lever Sink Mixer (Table Mounted)
CP brass bottle trap
Coral Health Faucet - Chrome
Single flow rain shower 200mm dia (Brass/chrome)
C.P. brass Shower Mixer
C.P. brass mixer for wash basin (Quarter-turn Range with Ceramic Inner head)
Grab Bar (Towel bar)
Hinged Grab Rail
Liquid Soap dispenser
C.P. brass angle valve
Paper holder with flap recessed type (Stainless Steel)
Towel rack 600 mm long with 3 hooks (Stainless Steel)
Stainless steel sink single bowl with big drain board)
Stainless steel sink single bowl sink)
White vitreous china pedestal type water closet (European type W.C. pan)
Water closet squatting pan (Indian type W.C. pan)
White vitreous china flat back half stall urinal
C.P. brass long body bib cock with aerator
C.P. brass Two-way bib cock

NOTE:

1. The above list is only indicative and not exhaustive. The contractor has to plan and execute all the fittings/ fixtures / items to make the building to the full use and fit for occupation. Nothing extra shall be paid on this account.
2. **Agency is permitted to use richer specifications from above with the approval of Chief Engineer (Ghaziabad), CPWD at no extra cost.**

List of Approved Makes 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 Engineer-in-Charge are listed below. However, approved equivalent materials 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 and subject to approval of the alternate brand by the Engineer-in-Charge, (See also conditions of contract).

Sl. No	Details Of Materials	Manufacturers/Model/Make Name
<u>A</u>	<u>Concrete/RCC Work</u>	
1	Cement (OPC 43 Grade) And Cement (PPC)	ACC, Ambuja, Ultratech, JK Cement, Birla, Shree Cement, Jaypee Cement,
2	Ready Mixed Cement Concrete	ACC, Ultratech, JK,
3	White Cement	Birla White, J.K. White, Ultratech
4	Admixtures For PCC/RCC/Mortar	Fosroc, Sika, BASF, Mapei, Pidilite Industries, Ferrous Crete,
5	Curing Compound	Fosroc, Sika, Cico, BASF, Pidilite Industries, Ferrous Crete.
<u>B</u>	<u>Steel Work</u>	
1	Steel (TMT Fe-500D Or Other Grade)	Sail, Tata Steel Ltd., RINL, Jindal Steel & Power Ltd, JSW Steel Ltd.
2	Structural Steel Sections	Sail, Tata Steel Ltd, Rinl, Jindal Steel & Power Ltd, JSW Steel Ltd, Apl Apollo.
3	Steel Section for Door/ Window Frame.	Tata, Jindal, Apl Apollo
4	S.S. Staircase Railing	Kich, Dorma, Ozone,
5	Stone Cladding Clamps	Hilti, Fisher, Bosch, Wuerth.
6	Welding Rods	Advani, ESAB
7	Dash, Anchoring Fasteners, Chemical Anchor, SS Clamp System for Stone Cladding, Re-barring Chemical	Hilti, Fischer, Bosch, Ripple, Wuerth.
<u>C</u>	<u>Masonry Work</u>	
1	Stone Adhesive	Ardex Endura, Weber, Myk Laticrete, Mapei, Ferrous Crete.
2	Stone Surface Sealer/Impregnation & Cleaning Agents	Ardex Endura, Weber, Myk Laticrete, Mapei
3	Polymer Modified Mortar	Sika, Fosroc, Laticrete, Ultratech, Weber
4	Micro Concrete	Sika, Fosroc, Basf, Laticrete, Ultratech
5	GRC Jali	Unistone, Birla White, Sanderson, Dalal
6	Terracotta Cladding Tiles	Hunter Douglas, Clayton, Moeding, Unistone
7	AAC Blocks	ACC, Tata Tiscobuild, Ultratech, Birla Aerocon, Ferrous Crete.

<u>D</u>	<u>Door, Window, Wood Work, PVC Work, Joineries</u>	
1	Factory Hot Pressed Laminated/Factory Veneered Polished Door	Green (Green Doors), Duro (Tower Doors), Century (Century Doors Pro), Greenlam/ Greenpanel (Greenpanel Doors- Pine Fillers)
2	Flush Door Shutters- (Blockboard Construction)	Green (Green Doors), Duro (Tower Doors), Century (Century Doors Pro), Greenlam/ Greenpanel (Greenpanel Doors- Pine Fillers)
3	LVL Flush/Panel Door Shutters & Frames	Duro, Century, Green/Greenlam/Greenpanel
4	Veneered/Laminated Particle Board/MDF/HDF/HDHMR Board	Green/Greenlam/Greenpanel, Century, Action Tesa,
5	Block Board, Plywood (Pine Board)	Green, Duro, Century, Merino
6	Laminate/HPL/Compact Laminate	Euro Décor, Greenlam, Century, Merino,.
7	Veneer Ply/Teak Ply	Century, Duro, Green Panel
8	Ss 304/316, Brass Hardware/Fittings/Joineries for Door Windows, Wardrobes	Dorma, Hafele, Ozone, Godrej, Kich
9	Hydraulic Door Closer &, Floor Spring	Dorma, Hafele, Yale, Ozone, Kich,
10	Wood Adhesive	Fevicol, 3m, Sika
11	Looking Mirror	Atul, Modiguard, Saint Gobain
12	Toilet Cubicles	Greenlam, Dorma, Merino
13	Acrylic Solid Surface	Lg Hi-Macs, Dupont Corion, Neonnex, Luxor (Durlax)
14	PVC -Boards & Shutters	Rajshri, Sintex, Avsl, Amulya Mica.
15	WPC-Board, Jali, Door Frames & Shutters	Avsl, Amulya Mica.
16	UPVC- Doors & Windows	Encraft, Fensta, Komerling, Veka, Aluplast, Saintgobin
17	Wooden/Metal/Glazed/Acoustic Fire Rated Door Frames, Shutters and Accessories	Godrej, Promat, Navair, Pacific, Shakti Hormann
<u>E</u>	<u>Flooring</u>	
1	Vitrified Tiles/ Glazed Ceramic Tiles	Kajaria (Eternity), Johnson, Somany, Hindware.
2	Composite Marble/Quartz Stone	Johnson, Nitco,
3	Cc Chequered/Tactile Tiles	Johnson, Kajaria, Eurocon, Unistone
4	Tile Adhesive, Epoxy/Cementitious Tile Grout	Ardex Endura, Myk Laticrete, Ferrous Crete, Jk Maxx
5	Polysulphide Sealant	Basf, Fosroc, Sika, Mapei, Ardex Endura, Pidilite
6	Wooden Flooring	Armstrong, Pergo, Mikasa (Greenlam), Vista
7	Floor Hardener	Ironite, Ferrok, Hardonate, Ferrous Crete.

8	Expansion Joints	Construction Specialties Hercules, Cameo inc, Bizzar
F	<u>Roofing</u>	
1	Calcium Silicate Tiles/Board False Ceiling & Framing	Aerolite, Saint Gobain, Hilux, USG Boral
2	Mineral Fibre/ GRG False Ceiling	Armstrong, Gyproc, Aerolite, USG Boral, Gyptech, Bollard,
3	Tubular & Metal False Ceiling System	Hunter Duglus, Armstrong, Lindner, Credence, Gyptech, Mcra., Mcra, Royal Krft, Bollard,
4	Gypsum False Ceiling, Board, Partition, Tiles	Gyproc, Lafarage, India Gypsum, Usg Boral, Gyptech
5	Cement Fibre Boards	Everest, Brila Aerocon, , Century (Zykron), Saint Gobain.
6	Tensile Fabric	Blue Stone, Encon, Structure Flex, Saint Gobain
7	PUF Panel	Lloyd, Jindal, Tata
8	Polycarbonate Sheet	Ge Plastic, Lexan, Mg Polyplast.
9	Profile Steel Sheet (Precoated)	Ezy deck Of Tata, Llyod Superdeck, JSW Jindal, Apl Apollo.
10	Acoustical False Ceiling & Panelling	Armstrong, Himalyan, Gettone, Gyptech, Bollard
G	<u>Finishing & Furnishing</u>	
1	Water-Proof Cement Paint	Snowcem, Asian, ICI.
2	Synthetic Enamel Paint	Asian (Apolite Premium Gloss/Satin Enamel), ICI (Dulux Gloss/Satin), Kansai Nerolac (Synthetic Enamel Hi Gloss/Satin Enamel Smooth Finish)
3	Plastic/Premium Emulsion Paint	ICI (Dulux Velvet Touch/ Dulux Superclean), Nerolac (Beauty Gold), Asian Paints (Royale Luxury Emulsion/Royale Matt)
4	Oil Bound Distemper/Acrylic Washable Distemper	Asian Paints (Tractor Emulsion), ICI (Dulux Promise Interior), Nerolac (Impressions Ecoclean/ Impressions Ideaz), Jk Maxx (Jumbo).
5	Epoxy/Pu Paint	Asian, ICI, Kansai Nerolac
6	Textured Exterior Paint	Asian Paints (Apex With Honeycomb Roller Finish) ICI (Weather Shield With Honeycomb Roller Finish, Kansai Nerolac (Excel With Honeycomb Roller Finish), JK Maxx (Patternz)
7	Exterior Emulsion/Paint	Asian (Ultima Protek), ICI (Dulux Weathershield Max), Nerolac (Excel Total) Jk Maxx (Ultra).

8	Steel Primer/ Wood Primer/Wall Primer	Berger, Nerolac, Asian, ICI, British, Makphalt, JK Maxx.
9	Exterior Waterproofing Paint	Asian, ICI, Nerolac.
10	Anti-Bacterial Paint	ICI, Asian, Berger.
11	Melamine & Pu Polish	Asian, ICI, Nerolac, Berger
12	Gypsum Plaster	Gyproc (Elite-90), Ultra Tech, USG Boral, Birla White, Ferrous Crete
13	Ready Mixed Plaster	Fosroc, Sika, Pidilite, Ferrous Crete.
14	Wall Putty	Jk, Birla, Asian, Berger, Ferrous Crete,
15	Powder Coating	Akzo Nobel, Jotun, Asian Ppg, Nippon.
16	Bitumastic Paint	Berger, Shalimar, Nerolac, Asian.
17	Fire Paint	Asian Paints, Akzo Nobel, Promat, Jotun.
18	Plaster Of Paris (Pop)	Gyproc, Ultratech, Birla, Trimurti
19	Window- Blinds & Tracks, Roller, Curtains	Vista, Mac, Marvel, SSG, Deck, Hunter Douglas.
H	<u>Roadwork</u>	
1	CC/SFRC Precast Drain Cover/Kerb Stone/Channel	Kk, Nitco, Dalal Tiles, Chelsea, KJS Concrete, Unistone.
2	CC Pavers/ Grass Paver	Nitco, Unistone, Ultra Tiles, Kjs Concrete, Chelsea.
3	Thermoplastic Paint/Road Marking Paint	Nerolac, Asian, Shalimar, Berger, Stp Ltd.
I	<u>Water Supply & Fittings</u>	
1	C.P. Brass Faucets, Fittings for Toilets I/C Wellness Products and Accessories Like Towel Rod, Toilet Paper Holder, Rob Hook, Soap Dish Holder, Liquid Soap Container Etc.	Jaquar, Kohler, Grohe, Roca, Toyo.
2	PTMT Fittings	Prayag, Polytuf, Prima, Supreme.
3	S.S. Pipes & Fittings	Jindal, Viega, Aquinox India.
4	G.I. Pipes	Tata, Jindal Hisar, Sail, Prakash Surya, Apl Apollo
5	G.I. Pipe Fittings	Unik, ICS, KS, Zoloto.
6	D.I. Pipes & Fittings	Kesoram, Electrosteel, Tata, Jindal, Kapilansh.
7	Brass/Gunmetal- All/Gate/Globe/ NRV/Foot/PRV- Valves	Leader, Sant, Zoloto, Kirloskar.
8	Ci-Butterfly/Sluice/NRV/Foot/Air Release- Valves	Leader, Sant, Zoloto, Kirloskar.
9	Float Valve (Ball Type)	Leader, Zoloto, IBP, Arco.

10	Y Type Strainer	Emerald, Sant, Zoloto, Leader
11	Forged Steel Fittings/Flanges	Johnson, VS Forge, JK Forging, True Forge, Indus, MEC (Jainsons)
12	Pipe Hangers/Supports/Clamps	Hilti, Fischer, Wuerth, Euroclamp, Gmgr, Neco, Easyflex
13	Ms Pipes	Jindal Hisar, Tata, Surya, Apl Apollo
14	C.I./D.I. Manholes Covers, Gratings	Bic, Rif, Neco, Aco, Skf
15	PVC Water Storage Tanks	Sintex, Sheetal, Supreme, Polyplast, Prayag, Prince.
16	PVC Perforated Pipes	Rex Polyextrusion, Supreme, Akash, Zenplas.
17	CPVC Pipes & Fittings	Ashirwad, Finolex, Supreme, Astral, AKG, Prince.
18.	UPVC Pipes & Fittings	Ashirwad, Finolex, Supreme, Astral, AKG, Prince.
J	<u>Sanitary Installations</u>	
1	Vitreous China Sanitaryware	Kohler, Jaquar, Hindware (Italian), Toyo.
2	Centrifugal Cast (Spun) Iron (S & S) / Hub less Pipes And Fittings	SKF, Neco, Bic, Saint Gobain.
3	Centrifugally Cast (Spun) Iron Pipes (Class La)	Electrosteel, Neco, Bic.
4	C.P. Bottle Traps	Camry, Jaquar, Roca, Kohler.
5	Cp Brass Spreader, Waste Coupling	Camry, Jaquar, Roca, Kohler.
6	Ss/Cp Brass Anti Cockroach Trap/Grating For Drainage Pipes	Viking, Jayna, Chillis, Kich.
7	Stoneware Pipes & Gully Traps	Perfect, Taya, Parry, Anand, Hind.
8	RCC Pipes	Lakshmi, Sood & Sood, Jain & Co, Pragati Concrete, KK, Usha, Diwan Spun Pipe.
9	Ci/Plastic Encapsulated/Plain Foot Rest	KK India, KGM, Accurate Buildcon, Neco.
10.	Ss Sink	Kingston-Kobra, Niralli, Jaynam, Prayag.
K	<u>Aluminium</u>	
1	Aluminium Hardware Fittings for Aluminium Windows & Doors	Alualpha, Geze, Roto, Dr Hann, Schuco.
2	Aluminium Extruded Sections for Doors & Windows Etc.	Jindal, Hindalco, Bhoruka
3	EPDM Gasket	Hanu, Anand, Alp, Mona.
4	Silicon Gasket	Kich, Hafele, Jaquar, Godrej, Saint Gobain.
5	Float Glass	Modiguard, Saint Gobain, Schott, Asahi.
6	Masking Tape	3m, Sun, Wonder Polymer.
7	Reflective Glass	Saint Gobain, Asahi (India), Pilkington, Guardian.
8	Adhesive Tape/Structural Sealant Tape	Norton, 3m, Penta Gun.

9	Silicon Sealant	Ge Momentive, Dow Corning, Wacker, Mapei, Mc-Bauchemie.
10	Aluminium Composite Panel	Alucobond, Alubond, Aludecor, Virgo Product, Alutech, Eurobond.
11	Rock Wool/Glass Wool	U.P Twiga, Rock Wool India Ltd., Llyod Ltd.,.
<u>L</u>	<u>Water Proofing Products, Sealants & Grouts</u>	
1	PVC Water Stop/ Swellable Water Bar	Sika, Fosroc, Penetron, Basf.
2	Pu/Epoxy/Cementitious Grouting Compound	Laticrete, Weber, Mapei, Sika, Fosroc, Makphalt.
3	High Performance Epoxy Based Resin Anchor System	Fosroc, Wurth, Fisher, Hilti.
4	Epoxy Mortar/Putty	Fosroc, Sika, BASF, Laticrete, Mapei, Ardex Endura.
5	Solvent Based Silicone Repellent Coating	Fairmate, Wacker, Weber, Laticrete, Mapei.
6	Crystalline Water Proofing Compound	Xypex, Penetron, Kryton, Makphalt
7	Pu/Epoxy Sealant for Cracks	Sika, Fosroc, BASF, Laticrete, Weber, Makphalt, .
8.	Integral Crystalline Water Proofing Compound	Penetron, Xypex,
9.	Crystalline Water Proofing Coating	Penetron, Xypex
10.	High Strength Crystalline Mortar	Penetron, Xypex
11.	Waterproofing Membrane: Self-Adhesive & (HDPE), PVC Membrane.	Fosroc, Zypexx, Hygie, Mapei, Sterling Technotrade, Pidilite, Spanotech, Technonicol, Makphalt.
12.	Single/Double Component Liquid Pu Elastomeric Membrane.	Fosroc, Zypexx, Hygie, Mapei, Sterling Technotrade, Pidilite, Spanotech, Technonicol.
13.	Polymer Modified Cementitious Gout.	Fosroc, Zypexx, Hygie, Pidilite, Sika, Sterling Technotrade, Technonicol.
14.	Silicon Sealants.	Wacker, Zypexx, Mapei, Spanotech, Pidilite.
<u>L</u>	<u>Laboratory Furniture</u>	
1	Laboratory Furniture	Godrej, Kewaunee, Durian

Note:

Makes other than specified above (if necessary) shall be approved by the **Executive Engineer, Meerut Division, CPWD, Meerut with prior consent/ approval of Chief Engineer (Gzb).**

The firm has to ensure that equipment manufacturer comes under definition of local manufacturers as per Govt. of India, Policy of Public Procurement (Preference to make in India) order, 2017 (PPM-MII order 2017) issued by Department of Industrial Policy and Promotion. Only products conforming to above policy shall be allowed to be used in the work.

**Executive Engineer,
Meerut Division, CPWD, Meerut**

ANNEXURE-II**Guarantee to be Executed by Agency for removal of Defects after Completion in respect of Water Proofing works**

The agreement made this.....day of year two thousand and between (Hereinafter called the Guarantor of the one part) and the PRESIDENT OF INDIA (Hereinafter called the Government of the other part).

WHEREAS THIS agreement is supplementary to a contract (Hereinafter called the contract) dated and made between the GUARANTOR OF THE ONE PART AND the Government of the other part, whereby the agency inter-alia, undertook to render the building and structures in the said contract recited completely water and leak proof.

AND WHEREAS THE GUARANTOR agreed to give guarantee to the effect that the said work will remain water and leak proof for ten years from the date of giving of water proofing treatment.

NOW THE GUARANTOR hereby guarantees that water proofing treatment given by him will render the structures completely leak proof and the minimum life of such water proofing treatment shall be ten years to be reckoned from the date after the maintenance period prescribed in the contract.

Provided that the guarantor will not be responsible for leakage caused by earthquake or structural defects or misuse or alteration and for such purpose.

- a) Misuse of roof shall mean any operation which will damage proofing treatment, like chopping of firewood and things of the same nature which might cause damage to the proof.
- b) Alteration shall mean construction of an additional storey or a part of the roof or construction adjoining to existing roof whereby proofing treatment is removed in parts.
- c) The decision of the Engineer-in-Charge with regard to nature and cause of defects shall be final.

During this period of guarantee, the guarantor shall make good all defects and in case of any defect being found render the building water proof to the satisfaction of the Engineer-in-Charge at his cost and shall commence the work for such rectification within seven days from the date of issue of the notice from Engineer-in-Charge calling upon him to rectify the defects failing which the work shall be got done by the Department by some other agency at the Guarantors risk and cost. The decision of the Engineer-in-Charge as to the cost payable by the Guarantor shall be final and binding.

That if guarantor fails to execute the waterproofing or commits breach thereunder; then the guarantor will indemnify the principal and his successors against all loss, damage, cost any default on the part of the GUARANTOR in performance and observance of this supplementary agreement. As to the amount of loss and/ or damage and/or cost incurred by the Government, the decision of the Engineer-in-Charge will be final and binding on the parties.

IN WITNESS WHEREOF these presents have been executed by the obligator and By..... For and on behalf of the PRESIDENT OF INDIA on the day, month and year first above written.

SIGNED, sealed and delivered by OBLIGATOR in the presence of:

1. 2.

SIGNED FOR AND ON BEHALF OF THE PRESIDENT OF INDIA

By in the presence of:

1. 2.

PART–C

CHAPTER-C

Scope and Technical Specifications of Electrical and Mechanical Services

PROFORMA OF SCHEDULES

SCHEDULE A TO F (E & M WORKS) MINOR COMPONENT
(OPERATIVE SCHEDULES TO BE SUPPLIED TO EACH INTENDING BIDDER)
 (Separate Performa for Civil & Elect. in case of Composite **Tenders**)
 (Operative Schedule to be supplied separately to each intending Tenderer)

SCHEDULE 'A'

Schedule of financial quote combined rates for Civil & Electrical works and ancillary works as per page 615 -617

SCHEDULE 'D' Extra schedule for specific requirements/documents for the work, if any.

-NIL-

SCHEDULE 'E'

Reference to General Conditions of Contract: General Conditions of Contract 2024 for EPC Projects in CPWD as amended / modified up to previous day of the last date of submission of Bid.

Name of Work: Construction of Babugarh campus of ICAR-CIRC at Babugarh Hapur, UP. (SH:C/o Administration cum Laboratory building and Farmers Training Hostel i/c Land development at Site A, in EPC Mode -I)

Estimated cost of work: Rs. 102,13,30,153/- (Civil work -Rs. 73,56,78,489/- + Electrical work-Rs. 28,56,51,664/-)

Earnest Money: Rs. 1,12,13,302/- (to be refunded after receiving the performance guarantee)

(i)	Performance Guarantee	A) 5% of Tendered Value or Estimated Cost put to tender (ECPT) (Whichever is higher) B) Where the tendered amount is less than eighty percent (80%) of the Estimated 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.
(ii)	Value of Security Deposit	2.5% of Tendered Value.
(iii)	Period of Completion	20 Months (4 Months for planning, design and obtaining Approval+16 months for execution and completion of work)

SCHEDULE 'F' (GENERAL RULES & DIRECTIONS)

Officer inviting bid: Executive Engineer Meerut Division, CPWD, Income Tax Office Campus, Bhainsali Ground Meerut (UP)-250001.

Applicable Mode of EPC contract	Mode - 1
Type of Building	Permanent
List of approved construction technologies	As per major component

Definitions:

2(vi)	Engineer-in-Charge for Civil works	Executive Engineer Meerut Division, CPWD, Income Tax Office Campus, Bhainsali Ground Meerut (UP)-250001
	Engineer-in-Charge for E&M Works	Executive Engineer (E), Hindon Electrical Division Ghaziabad, CPWD,
2(viii)	Accepting Authority	Chief Engineer (GZB) C.P.W.D, CGO -1, Hapur Road Ghaziabad Uttar Pradesh (201002)
2(x)	Percentage on cost of materials and labour to cover all overheads and profits	15%
2(x)(b)	Standard Schedule of Rates Civil work,	DSR 2023 and Plinth area rates 2025 (Civil) with amendments up to the previous date of the last date of submission of bids.
	Electrical work	Delhi Schedule of Rate 2025 and Plinth area rates 2025- (E&M) with amendments up to the previous date of the last date of submission of bids.
2(xi)	Department	Central Public Works Department (CPWD)
9(ii)	Standard CPWD contract Form GCC 2024, CPWD Form as modified & corrected up to date.	General Conditions of Contract-2024 for EPC Projects in CPWD corrected up to the previous date of the last date of submission of bids.
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.		As per major component

ii) Maximum allowable extension with late fee @ 0.1% per day of performance guarantee amount beyond the period provided in (i) above	As per major component

Clause 2

(i) Authority for fixing compensation under clause 2	Chief Engineer (GZB) CPWD, CGO -1, Hapur Road, Ghaziabad (U.P.)

Clause 5

(i)	Authority to convey the decision of shifting of milestone and extension of time.	As per major component
(ii)	Authority to decide rescheduling of milestone and extension of time.	As per major component
(iii)	Authority to decide shifting of date of start in case of delay in handing over of site.	As per major component

Time allowed for execution of work: **20 months.**

Number of days from the date of issue of letter of acceptance for reckoning date of start Mile Stone as table given below

: **As per major component**

Table of Mile stones

Sl.No	Description of Mile stone	Time allowed in days (From date of start)	Amount to be withheld in case of non-achievement of mile stone (% of T.A.)
	As per major component		

Note: Withheld amount shall be released if and when subsequent milestone is achieved within respective time specified. However, in case milestones are not achieved by the Bidder for the work, the amount shown against milestone shall be withheld.

Monthly recovery for delay in submission of the monthly progress report within specified period Rs. 50,000/- per month for each month default

PROFORMA OF SCHEDULES Clause 5 Schedule of handing over of site

Part	Portion of site	Description	Time Period for handing over reckoned from date of issue of letter of intent.
Part A	Portion without any hindrance	As per major Component	
Part B	Portions with encumbrances		
Part C	Portions dependent on work of other agencies		

Schedule of issue of Designs Not Applicable

Part	Portion of Design	Description	Time Period for issue of design reckoned from date of receipt of tenders
Part A	Portion already included in NIT	Available	---
Part B-1	Portions of Architectural Designs to be issued	To be submitted by bidder for approval of Engineer-in-charge	
Part B-2	Portions of Civil Designs to be issued		
Part B-3	Portions of E&M Design to be issued		

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	Rs. 1.40 Cr.

Clause 7A

(i)	Whether clause 7A shall be applicable.	As per major component

Clause 8

Details of building/infrastructure project to be completed early for use:

S. No.	Name of building/infrastructure project to be completed	Remarks
1.	Admin cum Laboratories Bldg	
2.	Farmers training Hostel	

Clause 8A

Authority to decide compensation on account if contractor fails to submit completion plans.:

As per major component

Clause 10B (ii)

Whether clause 10B(ii) shall be applicable	As per major component

Clause 10B (iii)

Whether clause 10B(iii) shall be applicable	As per major component

Clause 10CC:

Applicable

a. For construction Period

S. No.	Relevant Component of Material/ Labour for price escalation	Percentage of total value of work
1	Cement Component	As per major Component
2	Labour Component	
3	Civil component other construction material	
4	E & M (Electrical and Mechanical) component of construction materials	
5	POL (Diesel) component	
6	Reinforced steel bars/TMT bars/structural steels (including strands and cables) component	
7	Component of Bitumen	
	Total	

a. For Maintenance Period

Not Applicable**Clause 11**

Specifications to be followed for execution of work	Civil work: CPWD Specifications 2019 Volume- I & II with corrections slips upto the previous date of the last date of submission of bids. CPWD Green Rating Manual 2021 with correction slips upto the previous date of the last date of submission of bids. CPWD Hand book on Safety, Health and Environment with correction slips upto the previous date of the last date of submission of bids. CPWD Manual on Accessible Built Environment 2019 with correction slips upto the previous date of the last date of submission of bids.
	Electrical work: CPWD General Specification for Electrical Works Part I Internal - 2023. CPWD General Specification for Electrical Works (Part II External)-2023. CPWD General Specification for Electrical Works (Part III Lifts & Escalators)-2003. CPWD General Specification for Electrical Works Part IV Substation - 2013. CPWD General Specification for Electrical Works Part V Wet riser & sprinkler system - 2020.

	CPWD General Specifications for Electrical Works Part V Fire Detection and Alarm System – 2018. CPWD General Specification for Electrical Works Part VII DG Sets - 2013. CPWD General Specification for Electrical Works Part VIII Gas Based Fire Extinguishing System - 2013. General Specification for Heating, Ventilation & Air-Conditioning (HVAC)/VRF/VRV - 2024 (I) All above specifications shall be applicable with corrections slips up to the previous date of the last date of submission of bids. (II) Wherever the CPWD Specification are not given, the works shall be executed as per the additional Specification & terms & conditions mentioned in the NIT. (III) The direction of the Engineer-in-Charge shall be followed in absence of the above two at Serial No. I&II.
Building information model (BIM) is applicable	Yes

Clause 12

Deviation limit beyond which clause 12.2 and 12.3 shall apply for building work	As per major Component.

Clause 16

Competent Authority for deciding reduced rates.	Chief Engineer (GZB) CPWD, CGO -1, Hapur Road, Ghaziabad (U.P.)

Clause 19 Competent Authority to decide penalty for each default–

Clause 19C	Penalty for each default	As per major Component
Clause 19D	Penalty for each default	
Clause 19G	Penalty for each default	
	Enhanced penalty per day for each default	
Clause 19K	Penalty for each default	

Clause 25

(i)	Conciliator:	ADG(RL), CPWD or his successor thereof.
(ii)	Arbitrator appointing authority:	Chief Engineer (Ghaziabad), CPWD or his successor thereof.
(iii)	Place of arbitration	Meerut

Clause 32**“Requirement of Technical Representative (s) and Recovery Rates”**

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 36 (i)
	Qualification	Strength (Major + Minor component)			
As per major Component					

Clause 38

- (i) (a) Schedule/statement for determining theoretical quantity of cement & bitumen on the basis of **Delhi Schedule of Rates 2023** printed by CPWD with up-to-date correction slips till last date of submission of tender.
- (ii) Variations permissible on theoretical quantities:
- a) Cement
- (i) For works with estimated cost put to tender not more than Rs. 25 lakhs 3% plus/minus
- (ii) For works with estimated cost put to tender more than Rs 25 lakh 2% plus/minus
- b) Bitumen for all works. 2.5% on plus side only & nil on minus side
- c) Steel Reinforcement and structural steel sections for each diameter, section and category. 2% plus/minus
- d) All other materials. Nil

SCOPE OF ELECTRICAL AND MECHANICAL WORKS

The scope of work includes Planning, Design, preparation of Drawings, Supply, Installation, Testing and commissioning of following E&M services for Admin cum Laboratories Bldg& Farmers training Hostel at ICAR-CIRC Babugarh, Hapur, Uttar Pradesh.

Description		Approximate Built-up Area (to be constructed as per details given in this Tender document)
1.	Admin cum laboratory building	15421.66 sqm
2.	Farmer training hostel	3262.40 sqm
3	Development (Site A)	1,05,200sqm (approximate)
4.	Miscellaneous & Allied Works as per norms of NBC 2016 and mentioned in this document: (i) Plumbing & Sanitary (ii) External Water Supply & Sewerage, Storm Water Drainage System, Rain Water Harvesting including Recharge Wells (iii) Lifts (iv) Electrical Services, substation equipment's, LT distribution system, DG sets, rising mains, UPS. (v) Fire Fighting & Fire Alarm system. (vi) Water supply Pumps. (vii) Site Development & Landscaping including roads and CC Pavement, Foot paths, works. (viii) STP/ETP, Over Head Tank, Underground water tank with pump house etc. (ix) External Lighting, Signage works, CCTV, External Service Connections	
5.	Electric Sub Stations and other allied services as per requirements of service provider or regulatory body.	

1. Internal Electrical Installations i/c Street light

Scope of this sub head covers Design and execution of Wiring for Internal Electrical Installations i.e., Light & fan points, Light plug & Power plug wiring with modular accessories as per the requirement, Telephone, CCTV & LAN Conduiting. Providing LED light fittings, Ceiling fans, Exhaust & Fresh Air fans etc. Electrical connections to all E & M equipment, including cabling, TTA main panels, Floor panels, Lightning protection, Structural Earthing system, Street/ Compound lighting, landscape lighting are part of the scope. Dimmable light fittings with smart control shall be provided in conference halls, meeting rooms, Director room and other important locations as decided by the Engineer-in-charge with lighting controls. All luminaries used shall be energy efficient LEDs. The Rising Mains for Emergency supply (DG supply) and UPS supply shall be designed based on maximum connected load and 10% additional capacity, cabling & associated misc. works. Provision for additional 3 phase power outlet wiring and power plug wiring in the furniture of laboratories has also been taken in this NIT as per Annexure A. If any item required to make the building / scheme habitable and functional, is not specifically mentioned in the scope of services, the same is deemed to

be included within the scope of this tender and nothing extra shall be paid on this account.

Design and preparation of inventories, detailed layout drawings with marking of individual power plugs, light circuits, power circuits, submains etc. shall be done. Design and selection of Electrical fixtures to get the required illumination (lux level calculation at various places), selection of ceiling fans, Exhaust fans in toilets as per relevant standards is in the scope of work. Cables and various services from substation and other areas shall be routed to the main building through under ground duct/ tunnel.

2. Firefighting:

Design and installation of **Fire fighting system with wet riser & Sprinklers for the the Admin cum Laboratories buildings i/c all other service buildings and down comer system in Farmers training Hostel ,Water curtain systems wherever required, Gas suppression system for server rooms, Electrical panels and other relevant areas of the building as per NBC 2016** with up-to-date amendments, Fire bye-laws of Govt. of Uttar Pradesh and CPWD specifications. This will also include peripheral header /ring mains and isolation of ring mains in the header around the building, the provision of testing valve in the fire pump house with the facility to transfer the water again into the fire sump to avoid wastage of water, isolation valve in the feeder pipeline to each wet riser in the building before entering to the building. Preparation of inventory, preparation of detailed layout drawings with marking of various firefighting accessories/ equipment i.e., location of sprinklers, water curtains, internal & external hydrants are in the scope of work.

3. Fire Alarm System & PA System

Design, installation of Intelligent addressable automatic fire alarm system complete with detectors, addressable fire alarm panel and all other related accessories, Fire Dampers, AHUs, Smoke Ventilation System, Public Address System and Gas suppression system as required in the Admin cum Laboratories Building and other buildings i/c for Farmers training Hostel in compliance to the requirement soft relevant CPWD specifications, fire services norms of local body and NBC 2016 whichever is more stringent. This includes installation of Digital Public Address System, fire evacuation system/ plan in the fire control room and at each floor of the Admin cum Laboratories Bldg. The wiring for the detectors shall be done with armored copper conductor fire survival cable. Braille signages and all requirements of accessible India Campaign and Fire norms should be met . Preparation of inventory, preparation of detailed layout drawings with marking of Detectors, MCPs, fault isolators, hooters /speakers, Main panel, repeater panel, various fire alarm accessories are in the scope of work.

4. Lifts:

Total 5 Nos. Lifts. In **Admin cum Laboratories Building** (2 Nos. 13 Passenger Lift and 1 No. 13 Passenger Fire Lift) and in **Farmers training Hostel** (2 Nos. 13 passenger lift), with speed of 1.0/1.5 meter per second, stainless steel car interior and doors, ARD, Barrier free features, LT Panel, Cabling, Earthing, Architrave work at Lift Entrance and as per following details is in the scope of work.

5. Substation:

Scope of this sub head covers Design and execution of 11KV/0.433 KV Substation of with Dry type transformers of **(2x1250 kVA capacity)** 1 working and 1 standby **for Admin cum Laboratories**

Building & Farmers training Hostel and other Buildings like Substation ,STP, ETP etc. and Future plans of Buildings Electrical load in 33% of development area of Site-A in ICAR-CIRC Campus, comprising of HTV CB Panel, HT Cables, LT Cables MV TTA Main Panels, Essential Panels, surge protection system, Sandwich Type Bus trunking, Safety equipment, LT distribution to various E & M services. Planning and design comprising of calculation of electrical load complete with EI & Medical and other equipment loads of the building and electrical load of other E&M equipment and calculation of total working capacity of the transformers considering diversity factor of the system are in the scope of work. The contractor shall prepare the drawings of Distribution system, SLDs and layout of the equipment. During the approval of design and drawing, the contractor shall submit the data sheets and catalogues of the various equipment in support of their design. Preparation of inventory is also in the scope of this work.

The sizes of cables shall be designed by taking the additional load of 25% for future extension. LT Panels shall be designed for essential and UPS supply. APFC Panel for each transformer shall be provided to improve power factor to a minimum 0.99 lagging. Suitable size of sandwich type compact bus trunking between transformer/DG Sets to different essential and non-essential panels is in the scope of work. Earthing for System and safety of equipment shall be provided as per CPWD specifications/ IE rules.

6. DG Sets:

Scope of this subhead covers Design and execution of **DG sets with minimum capacity of 2 X 500 KVA** 1 working and 1 standby for Admin cum Laboratories Bldg & Farmers training Hostel, 415 V, silent type D.G. Sets, AMF panel complete with Automatic load transfer facility /synchronization panel, Bus Trunking from DG Set Synchronization panel to main LT panel, control cables, Earthing of DG Sets, exhaust piping as per latest CPCB norms with statutory approvals i/c supporting structure/ arrangement is in the scope of this work. The facility of manual bye-pass arrangement from the normal supply shall be in the scope of the work in case of failure of AMF panel. Planning and design comprising of making SLD for the distribution system, Calculation of essential load, sizes of cables/bus trunking, layout of the equipment as per site condition, submission of data sheets and catalogues of various equipment in support of their design is also in the scope of this work. Earthing and safety of equipment shall be Provided.

7. UPS:

Provision of **minimum 1 x100 KVA(for Admin cum Laboratories Bldg)** (Parallel redundant with 2 or more units in parallel)**3 phase Modular type UPS supply with 30 min. battery backup** is in the scope of this work. Planning and design comprising of detailed calculations, distribution system for UPS with the sandwich copper vertical rising mains in the **Admin cum Laboratories Bldg** completewithtap-offboxes, cables, distribution board each floor and as per the requirement of NBC2016. Preparation of SLD, submission of datasheets and catalogues of the various equipment in support of their design is in the scope of this work. VRLA Sealed maintenance free batteries shall be provided on a suitable size of rack.

8. VRV/ VRF BASED AIR CONDITIONING SYSTEM (Heating and Cooling):

Scope of this sub head covers Design and execution This part involves design, supply, installation, testing and commissioning of **VRF system (minimum 1000 HP capacity) (for Heating & Cooling) for Admin cum Laboratories Bldg** as per design calculation & as per guidelines issued by ASHRAE, ISHRAE, BIS, CPWD Specifications, NBC 2016, and the requirement of at ICAR-CIRC Babugarh, Hapur, Uttar Pradesh and additional specifications. Area to be Air conditioned: - 1) All the rooms/LABs Areas of Admin cum Laboratories Bldg except corridor, toilets, lift lobby, Reception, Waiting area, Store rooms, Tuck shop. The Capacity of VRV system for heating and cooling shall be based on heat load calculation of the Admin cum Laboratories Bldg. Design shall be carried out for peak winter, summer and Monsoon as per outdoor ambient temp of at ICAR-CIRC Babugarh, Hapur,Uttar Pradesh

9. Solar water Heating system:

Scope of this sub head covers Design and execution of Solar water heating systemhaving minimum capacity 500 LPD (**Total capacity 4000 Ltr**) based on a closed-circuit indirect heat transfersystem and capable of producing hot water at 60 deg C. The areas which are catered by the hot water are Labour Complex including Kitchen, Canteen and other are as per Admin cum Laboratories Bldg & Farmers training Hostel requirement.

10. LAN System

Scope of this subhead covers Planning, Designing, Supply, Installation, Testing and commissioning of LAN system comprising of core switches & L2 switches with 10G, 10giga SFP modules, WIFI access points, WIFI controller, network management software, racks, CAT6 A cable, patch panels, OFC etc. with software license.

11. EPBAX System:

Scope of this sub head covers Planning, Designing, Supply, Installation, Testing and commissioning of IP based EPBAX system of minimum 1000 Telephones & expandable up to 2000 telephones shall be located at server room. All the Telephones in the Complex will be IP Based and will use the existing LAN Network for the communication within the complex (inside buildings & in between buildings) as well as for outside the complex. All Rack Panels of Individual buildings shall be connected to Central PABX (private automatic branch exchange) system through Optical Fiber Cable IP based voice communication system with PRI (Primary Rate Interface) Trunklines (30channels) with clip facility for minimum 500 IP users license for 5 Years.. The system shall have redundancy at the level of core switch as well for the backbone

12. CCTV System

Scope of this sub head covers Design and execution of IP based CCTV system for building security comprising of PTZ, Fixed Bullet and Dome camera, NVRs of suitable capacity with viewing and recording facility, cabling, display system using required number of FHD LED Monitors at control room as per the requirement complete with various hardware and software supports. The complete networking for the CCTV should be separate and exclusive for CCTV System only and not to be mixed with other LAN System. Software provided shall support for remote monitoring through PCs.

13. Audio Video Conference System:

Scope of this sub head covers Planning, Designing, Supply, Installation, Testing and commissioning of Audio Visual / Conference system with Microphones, Speakers, Amplifiers, mixers, Digital signal processors, Display TV units, Cameras, cables, controllers, Software etc .in Conference halls & Seminar halls as per detailed specifications.

14. STP: (Sewerage Treatment Plant) & ETP (Effluent Treatment Plant)

Scope of this sub head covers Design and execution of STP, marking of pump sets, tanks, sumps etc. on the architectural drawing is in the scope of work. **STP of minimum 100 KLD** based on the MBBR technology & **ETP of minimum 25 KLD capacity** with Sump Tanks, Pumps, Vessels, Air Blowers, Piping, UV System, Electrical control panels etc. for treatment of Bio medical waste from OTs/Labs, infected waste water and normal waste water. The plant should be capable of catering the mandatory requirements of CPCB. Permission to establish and operate STP shall be taken from the local statutory bodies/ CPCB, which is within the scope of the contractor.

15. Solar Photo Voltaic Power Generation system:

Scope of work shall include Planning, Designing, Supply, Installation, Testing and Commissioning of **On-Grid Solar Photo voltaic Power Plant of minimum 130KWp capacity** with net metering on roof top area of Admin cum Laboratories Bldg conforming to MNRE specifications as amended, consisting of Mono PERC half cut solar panels, mounted on Aluminium structure of suitable strength related civil works for erection and installation of Solar PV panels, inverters, DC/ACDB, energy meters, Bidirectional meters, termination to required Panel as per SLD. Lightning protection, earthing and cable interconnection between various system device either in block panel or rising mains(if available) at terrace itself located near Admin cum Laboratories Bldg. Obtaining NOC from the state electricity board for installation of Solar PV. Area to be Covered: Roof top area available for solar power installation on Admin cum Laboratories Bldg.

16. Split AC:

Scope of this sub head covers Design and execution This part involves design, supply, installation, testing and commissioning of Split Air Cooled Hi Wall split type Air conditioners Inverter Type - Cooling only 1.5/2 TR capacity minimum 40 Nos. for Farmers training Hostel as per as per CPWD specification and IS : 1391 Part II 2023. Area to be Air conditioned: Various rooms of Farmers training Hostel as per client requirement.

17. R.O. water plant:

Scope of this sub head covers of planning, design & preparation of drawings, supplying, installation, testing& commissioning of 2 Nos. (1 for each block) R.O. plant each of minimum 500 LPH capacity shall be provided drinking water for Admin cum Laboratories Bldg, Farmers training Hostel requirement. If any item is required to make the Scheme functional, is not specifically mentioned in the scope and specifications, the same is deemed to be included within the scope of this tender. Minimum 9 Nos. stainless-steel watercoolers of minimum 40/80 litres capacity shall be provided in all floors of the Building.

18. Water Supply System.

Scope of this sub head covers Design and execution of water supply pump set system along with electrical panels for the all buildings and associated facilities and specialized areas such as the STP and other buildings for potable water, treated water, and rainwater reuse, providing efficient and reliable water supply across the campus **as per NBC 2016 norms** and building requirement. The design should consider varying water demand scenarios, including pressure maintenance systems, ensuring consistent water pressure across all facilities. Size and select pump sets based on hydraulic calculations, ensuring that each pump can meet the water demand for the respective facilities include redundancy and backup and submit the design documents for approval to engineer-in-charge after that install electrical panels, wiring, and control systems, including automatic pump starters, level sensors, and flow meters, piping networks, valves, pressure gauges, and fittings for each pump set. , including necessary civil works such as foundation and mounting for pump sets, earthing's. Ensure all installations comply with safety standards, working in coordination energy-efficient pump sets to minimize operational costs and environmental impact.

Water supply pump sets shall be installed with following design guidelines:

(a) Minimum 25% additional capacity pumps have to be installed for drinking water purpose. Theoretical calculation of pumps as well as specifications shall be got approved by Engineer-in-charge before execution.

(b) 02 working + 01 standby drinking water pumps shall be provided for each sump. All necessary NRVs, valves, pressure gauges, electrical panels for above drinking water system and borewell pumps to be provided.

Pumps for borewell to be designed and installed based on data obtained from Civil wing based on water table level.

(a) 50% redundancy (or minimum 1 set of equal capacity) to be supplied and handed over for borewell pump.

(i) Dewatering pumps (2 nos.) inside Substation / STP if required

(ii) Gardening pumps (3 nos.)(2 working + 1 No. Standby)

The work shall be executed as per detailed technical specifications mentioned in NIT and as per directions of Engineer-in-Charge.

19. Emergency Light and illuminated Signage.

The scope of work includes design, supply, installation, testing and commissioning of Emergency lighting and signages for corridor areas, lift lobby, entry/ exit, staircase and other areas required as per NBC 2016 for Admin cum Laboratories Bldg& Farmers training Hostel and utility building, pump house etc. The design shall be as per NBC 2016 and fire by laws of Uttar Pradesh Govt. The purpose is to use the internally illuminated emergency exit light with directional pictogram to enable safe evacuation & to avoid panic & stampede. It shall also include LED indication for monitoring the status of exit lights. The system shall be state of the art, capable to provide fault indication in emergency exit lighting, fast acting, approved & reliable electrically operated System. Wiring / cabling for Emergency lighting and signages as per NBC 2016 shall be in the scope of work.

C-A: ELIGIBILITY OF SPECIALIZED AGENCIES:

1. The Main Contractor should either himself meet the eligibility conditions for the respective E&M components or otherwise he shall have to Associate with Agencies, fulfilling the eligibility requirements mentioned below and consent letter from at least one eligible Associate Agency of the respective components of E&M work shall also be submitted as per attached Form.
2. The Main Contractor shall also be eligible to carry out himself any or all of these works without associating with any specialized agency, provided, the directly procures the equipment of approved make from manufacturer and gets it installed from Authorized Agency/ Service Provider of the Manufacturer/Specialized Agency as per the eligibility criteria mentioned below.
3. The Main Contractor has to submit the following documents for Association of Contractor within one month of award of work. In support of the eligibility conditions of the proposed Associated Agency copy of their registration documents, Verifiable completion certificates of the work, Electrical Contractor's License, GST Documents duly attested by the Main Contractor shall be submitted to the Executive Engineer Meerut Division, CPWD who will in turn submit these documents to the Executive Engineer (E), Hindon Electrical Division Ghaziabad, CPWD for deciding the eligibility.
4. Each such Associated Agency will certify that they are not debarred, as on the day of submission of documents. Proposal for Associating Agency for minor components of work shall be submitted with consent letter from each Associated Agency independently for all Electrical and Mechanical components. The Main Contractor shall submit an Affidavit of MOU signed with eligible Associated Agencies. The Affidavit of MOU in the enclosed Form shall be signed by both the parties i.e., Main Contractor as first party and Associated Agency as 2ndparty. MOU for all Electrical and Mechanical components shall be submitted, independently.
5. In the event of the concerned E&M Agency not performing satisfactorily or failure of Associated Agency to complete the E&M work, the Main Contractor on written directions of the department, shall remove the Associate Agency, deployed on the work and shall submit name of new Associate who fulfills the conditions mentioned in NIT to execute the left-over work without any loss of time or variation in cost to the department.
6. Such Associates shall also give an undertaking along with the Main Contractor that, both of them together will stand guarantee for the equipment already supplied for which payment has been released by the department. If any equipment supplied for the work, during the currency of the earlier Associate Agency becomes redundant /not in a position to be put to beneficial use, the main contractor shall be liable for replacement of the equipment(s) at no cost to the Department. No change of Associated Agency will be allowed with out prior approval of the Engineer-in-charge of the work.
7. In respect of all E & M works, the materials shall be procured only from the original equipment Manufacturers/Authorized dealers of OEM. The contractor shall submit all documentary details in fulfillment of these conditions regarding procurement of materials including relevant test certificates.
8. Executive Engineer (E) shall be the Engineer-in-charge for E & M works. Separate tender schedule and Special Conditions for E&M Work are appended with this tender. It will be obligatory on the part of the Contractor to sign the tender documents for all the component parts.
9. The Main Contractor shall be responsible and liable for proper and complete execution of the E & M works and ensure coordination and completion of both civil and E & M work. The Associated Agency shall attend the inspection of the work by the Engineer -in-charge of E&M works as and when required.

10. The Associated Agency should have successfully completed similar works including capacity of the equipment required as applicable during the last 7 years ending up to previous day of last date of submission of tenders. The value of executed works shall be brought to current costing level by enhancing the actual value of work at simple rate of 7% per annum, calculated from the date of completion to the last date of submission of bid.
11. The completion certificate shall be issued by an officer not below the rank of Executive Engineer or equivalent, duly attested. The rough cost and capacity of various Sub heads/Equipment given in the Eligibility criteria should not be used or interpreted for any other purpose.
Minimum Eligibility Criteria for Associated Agency for Execution of E&M Components and Specialized Works wherever applicable

Sl. No	Component of E&M works	Approx cost in cr.	Eligibility
1	Internal & External Electrical Installations i/c Lightning conductor, Street light etc.	10.45	The main contractor should have valid electrical license of appropriate class, otherwise shall have to associate with contractor registered in composite category in appropriate class in CPWD and possessing valid Electrical Contractor License of appropriate Class for execution of this component. OR The main contractor should fulfill the eligibility criteria as below, otherwise shall have to associate with specialized agency fulfilling the following eligibility criteria - Having successfully completed following works during last seven years ending up to previous day of last date of submission of tender. Three similar works, each of value not less than 40% of component cost OR Two similar works, each of value not less than 60% of component cost OR One similar works, each of value not less than 80% of component cost Similar work shall mean "SITC of Internal & External Electrical Installations i/c Lightning conductor, Street light"
2	Fire Fighting System	2.00	The main contractor should fulfill the eligibility criteria as below, otherwise shall have to associate with specialized agency fulfilling the following eligibility criteria Eligibility Criteria:- Having successfully completed following works during last seven years ending up to previous day of last date of submission of tender. Three similar works, each of value not less than 40% of component cost

			OR Two similar works, each of value not less than 60% of component cost OR One similar works, each of value not less than 80% of component cost Similar work shall mean "SITC of Fire Fighting System". The Buildings & Roads category contractor is also be eligible to carry out himself/ herself any or all of these works without associating any specialized agency provided: (a) He fulfills the prescribed eligibility criteria respectively for these work(s). OR He directly procures the equipment of approved make from manufacturer and gets it installed from authorized agency/service provider of the manufacturer or specialized agency as per criteria mentioned in NIT.
3	Fire Alarm System with PA system	1.02	The main contractor should fulfill the eligibility criteria as below, otherwise shall have to associate with specialized agency fulfilling the following eligibility criteria Eligibility Criteria:- Having successfully completed following works during last seven years ending up to previous day of last date of submission of tender. Three similar works, each of value not less than 40% of component cost OR Two similar works, each of value not less than 60% of component cost OR One similar works, each of value not less than 80% of component cost Similar work shall mean "SITC of Fire Alarm System with PA system" The Buildings & Roads category contractor is also be eligible to carry out himself/ herself any or all of these works without associating any specialized agency provided: (a) He fulfills the prescribed eligibility criteria respectively for these work(s). OR He directly procures the equipment of approved make from manufacturer and gets it installed from authorized agency/service provider of the manufacturer or specialized agency as per criteria mentioned in NIT.

4	Lifts	1.07	The main contractor shall associate with the one of the Lift Manufacturers of Preferred Makes satisfying NIT conditions. No other Associated Agency shall be eligible to execute the work.
5	Substation	2.02	The main contractor should fulfill the eligibility criteria as below, otherwise shall have to associate with specialized agency fulfilling the following eligibility criteria Eligibility Criteria:- Having successfully completed following works during last seven years ending up to previous day of last date of submission of tender. Three similar works, each of value not less than 40% of Estimated Component cost and Capacity not less than 80% of the Individual Transformer capacity OR Two similar works, each of value not less than 60% of Estimated Component cost and Capacity not less than 80% of the Individual Transformer capacity OR One similar work, value not less than 80% of Estimated Component cost and Capacity not less than 80% of the Individual Transformer capacity. Similar work shall mean "SITC of Sub-Station Equipment etc." The Buildings & Roads category contractor is also be eligible to carry out himself/ herself any or all of these works without associating any specialized agency provided: (b) He fulfills the prescribed eligibility criteria respectively for these work(s). OR (c) He directly procures the equipment of approved make from manufacturer and gets it installed from authorized agency/service provider of the manufacturer or specialized agency as per criteria mentioned in NIT.
6.	DG Set	1.16	The main contractor should fulfill the eligibility criteria as below, otherwise shall have to associate with specialized agency fulfilling the following eligibility criteria Eligibility Criteria:- Having successfully completed following works during last seven years ending up to previous day of last date of submission of tender. Three similar works, each of value not less than 40% of Estimated Component cost and Capacity not less than 80% of the Individual DG Set capacity OR Two similar works, each of value not less than 60% of Estimated Component cost and Capacity not less than 80% of the Individual DG Set capacity OR One similar work, value not less than 80% of Estimated Component cost and Capacity not less than 80% of the Individual DG Set capacity. Similar work shall mean "SITC of DG Set."

			The Buildings & Roads category contractor is also be eligible to carry out himself/ herself any or all of these works without associating any specialized agency provided: (a) He fulfills the prescribed eligibility criteria respectively for these work(s). OR (b) He directly procures the equipment of approved make from manufacturer and gets it installed from authorized agency/service provider of the manufacturer or specialized agency as per criteria mentioned in NIT.
7	UPS System	0.21	The main contractor should fulfill the eligibility criteria as below, otherwise shall have to associate with specialized agency fulfilling the following eligibility criteria Eligibility Criteria:- Having successfully completed following works during last seven years ending up to previous day of last date of submission of tender. Three similar works, each of value not less than 40% of component OR Two similar works, each of value not less than 60% of component cost OR One similar works, each of value not less than 80% of component cost Similar work shall mean "SITC of UPS System" The Buildings & Roads category contractor is also be eligible to carry out himself/ herself any or all of these works without associating any specialized agency provided: (a) He fulfills the prescribed eligibility criteria respectively for these work(s). OR He directly procures the equipment of approved make from manufacturer and gets it installed from authorized agency/service provider of the manufacturer or specialized agency as per criteria mentioned in NIT.
8	VRV/ VRF BASED AIR CONDITIONG SYSTEM (Heating and Cooling)	5.85	The main contractor should fulfill the eligibility criteria as below, otherwise shall have to associate with specialized agency fulfilling the following eligibility criteria Eligibility Criteria:- Having successfully completed following works during last seven years ending up to previous day of last date of submission of tender. Three similar works, each of value not less than 40% of component OR Two similar works, each of value not less than 60% of component cost OR One similar works, each of value not less than 80% of component cost Similar work shall mean "SITC of VRV/ VRF type

			Air conditioning system and Mechanical Ventilation System) The Buildings & Roads category contractor is also be eligible to carry out himself/ herself any or all of these works without associating any specialized agency provided: (a) He fulfills the prescribed eligibility criteria respectively for these work(s). OR He directly procures the equipment of approved make from manufacturer and gets it installed from authorized agency/service provider of the manufacturer or specialized agency as per criteria mentioned in NIT.
9	Solar Water heating system	0.10	The main contractor should fulfill the eligibility criteria as below, otherwise shall have to associate with specialized agency fulfilling the following eligibility criteria Eligibility Criteria:- Having successfully completed following works during last seven years ending up to previous day of last date of submission of tender. Three similar works, each of value not less than 40% of component cost OR Two similar works, each of value not less than 60% of component cost OR One similar works, each of value not less than 80% of component cost Similar work shall mean "SITC of Solar Water heating system" The Buildings & Roads category contractor is also be eligible to carry out himself/ herself any or all of these works without associating any specialized agency provided: (a) He fulfills the prescribed eligibility criteria respectively for these work(s). OR He directly procures the equipment of approved make from manufacturer and gets it installed from authorized agency/service provider of the manufacturer or specialized agency as per criteria mentioned in NIT.
10.	LAN System	0.73	The main contractor should fulfill the eligibility criteria as below, otherwise shall have to associate with specialized agency fulfilling the following eligibility criteria Eligibility Criteria:- Having successfully completed following works during last seven years ending up to previous day of last date of submission of tender. Three similar works, each of value not less than 40% of component cost OR Two similar works, each of value not less than 60% of component cost

			OR One similar works, each of value not less than 80% of component cost Similar work shall mean "SITC of LAN/ WiFi System" The Buildings & Roads category contractor is also be eligible to carry out himself/ herself any or all of these works without associating any specialized agency provided: (a) He fulfills the prescribed eligibility criteria respectively for these work(s). OR He directly procures the equipment of approved make from manufacturer and gets it installed from authorized agency/service provider of the manufacturer or specialized agency as per criteria mentioned in NIT.
11.	EPBAX System	0.76	The main contractor should fulfill the eligibility criteria as below, otherwise shall have to associate with specialized agency fulfilling the following eligibility criteria Eligibility Criteria:- Having successfully completed following works during last seven years ending up to previous day of last date of submission of tender. Three similar works, each of value not less than 40% of component cost OR Two similar works, each of value not less than 60% of component cost OR One similar works, each of value not less than 80% of component cost Similar work shall mean "SITC of IP based EPBAX System" The Buildings & Roads category contractor is also be eligible to carry out himself/ herself any or all of these works without associating any specialized agency provided: (a) He fulfills the prescribed eligibility criteria respectively for these work(s). OR He directly procures the equipment of approved make from manufacturer and gets it installed from authorized agency/service provider of the manufacturer or specialized agency as per criteria mentioned in NIT.
12.	CCTV System	0.39	The main contractor should fulfill the eligibility criteria as below, otherwise shall have to associate with specialized agency fulfilling the following eligibility criteria Eligibility Criteria:- Having successfully completed following works during last seven years ending up to previous day of last date of submission of tender. Three similar works, each of value not less than 40% of component cost

			OR Two similar works, each of value not less than 60% of component cost OR One similar works, each of value not less than 80% of component cost Similar work shall mean "SITC of CCTV System" The Buildings & Roads category contractor is also be eligible to carry out himself/ herself any or all of these works without associating any specialized agency provided: (a) He fulfills the prescribed eligibility criteria respectively for these work(s). OR He directly procures the equipment of approved make from manufacturer and gets it installed from authorized agency/service provider of the manufacturer or specialized agency as per criteria mentioned in NIT.
13.	Audio Video Conference System	1.01	The main contractor should fulfill the eligibility criteria as below, otherwise shall have to associate with specialized agency fulfilling the following eligibility criteria Eligibility Criteria:- Having successfully completed following works during last seven years ending up to previous day of last date of submission of tender. Three similar works, each of value not less than 40% of component cost OR Two similar works, each of value not less than 60% of component cost OR One similar works, each of value not less than 80% of component cost Similar work shall mean "SITC of Audio Video Conference System" The Buildings & Roads category contractor is also be eligible to carry out himself/ herself any or all of these works without associating any specialized agency provided: (a) He fulfills the prescribed eligibility criteria respectively for these work(s). OR He directly procures the equipment of approved make from manufacturer and gets it installed from authorized agency/service provider of the manufacturer or specialized agency as per criteria mentioned in NIT.
14.	STP(Sewerage Treatment Plant) & ETP (Effluent Treatment Plant)	0.86	The main contractor should fulfill the eligibility criteria as below, otherwise shall have to associate with specialized agency fulfilling the following eligibility criteria Eligibility Criteria:- Having successfully completed following works during last seven years ending up to previous day of last date of submission of tender.

			Three similar works, each of value not less than 40% of component cost OR Two similar works, each of value not less than 60% of component cost OR One similar works, each of value not less than 80% of component cost Similar work shall mean "SITC of STP (Sewerage Treatment Plant) & ETP (Effluent Treatment Plant) " The Buildings & Roads category contractor is also be eligible to carry out himself/ herself any or all of these works without associating any specialized agency provided: (a) He fulfills the prescribed eligibility criteria respectively for these work(s). OR He directly procures the equipment of approved make from manufacturer and gets it installed from authorized agency/service provider of the manufacturer or specialized agency as per criteria mentioned in NIT.
15.	Solar Photo Voltic Power Generation system	0.76	The main contractor should fulfill the eligibility criteria as below, otherwise shall have to associate with specialized agency fulfilling the following eligibility criteria Eligibility Criteria:- Having successfully completed following works during last seven years ending up to previous day of last date of submission of tender. Three similar works, each of value not less than 40% of component cost OR Two similar works, each of value not less than 60% of component cost OR One similar works, each of value not less than 80% of component cost Similar work shall mean "SITC of Solar Photo Voltic Power Generation system " The Buildings & Roads category contractor is also be eligible to carry out himself/ herself any or all of these works without associating any specialized agency provided: (a) He fulfills the prescribed eligibility criteria respectively for these work(s). OR He directly procures the equipment of approved make from manufacturer and gets it installed from authorized agency/service provider of the manufacturer or specialized agency as per criteria mentioned in NIT.

16.	R.O. Plant	0.16	The main contractor should fulfill the eligibility criteria as below, otherwise shall have to associate with specialized agency fulfilling the following eligibility criteria Eligibility Criteria:- Having successfully completed following works during last seven years ending up to previous day of last date of submission of tender. Three similar works, each of value not less than 40% of component cost OR Two similar works, each of value not less than 60% of component cost OR One similar works, each of value not less than 80% of component cost Similar work shall mean "SITC of R.O. Plant " The Buildings & Roads category contractor is also be eligible to carry out himself/ herself any or all of these works without associating any specialized agency provided: (a) He fulfills the prescribed eligibility criteria respectively for these work(s). OR He directly procures the equipment of approved make from manufacturer and gets it installed from authorized agency/service provider of the manufacturer or specialized agency as per criteria mentioned in NIT.

CONSENT LETTER FROM ASSOCIATED AGENCY

(Separate for each subhead of E&M work)

Name of Work: Construction of Babugarh campus of ICAR-CIRC at Babugarh Hapur, UP. (SH:C/o Administration cum Laboratory building and Farmers Training Hostel i/c Land development at Site A, in EPC Mode -I)

I/ we here by give consent to Associate with M/s for
Executing the Minor Component/E&M Subhead of work (Mention Sub Head Category)

1. I/We shall 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.
2. I / We shall be responsible for necessary action to handover the installations and for rectification of defects and repair during the warranty period.
3. Also, I / We shall 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.

Dated:

Signature of Associated Agency

Address:

Address:

Telephone:

Telephone:

e-mail:

e-mail:

MEMORANDUM OF UNDERSTANDING [M.O.U] BETWEEN

(Separate for each subhead of E&M work)

- 1) M/S [Name of the firm with full address] [Hence forth, called the Main Contractor] And
- 2) M/S[Name of the firm with full address] [Hence forth, called Associated Agency]

Name of Work

sub-work:.....

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. Incase of any dispute, either of us will go for mediation/ arbitration by the concerned SE/CE and any of us may appeal against the mediation/arbitration to the SE/CE. His decision shall be final and binding on both of us.

We have agreed as under:

1. The Associated Agency will execute all the Electrical & Mechanical works in the whole some manner as per terms and conditions of the agreement. The Associated Agency shall be paid by Main Contractor as per standard procedure followed by the Department and the Agreement between parties. Any type of internal transaction between the Associated Agency and the Main Contractor shall be as per their convenience and mutual understanding without involving the department.
2. The Associated Agency shall be liable for disciplinary action if he is failed to discharge the action[s] and other legal action as per agreement.
3. All the machinery and equipment, tools and tackles required for execution of the electrical works, as per agreement, shall be the responsibility of the Associated Agency.
4. The site staff required for the electrical work shall be arranged by the Associated Agency as per terms and conditions of the agreement.
5. Site order book maintained for the said work shall be signed by the main contractor as well as by the Engineer of the Associated Agency and by Associated Contractor himself.
6. All the correspondence regarding execution of the Electrical & Mechanical works shall be done by the Department with the Associated Agency with a copy tot the Main Contractor. In case of non-compliance of the provisions of agreement, the main contractor, as well as the Associated Agency 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

Agency Address:

Date:

Place:

Address:

C-B: GENERAL CONDITIONS FOR ALL E&M WORKS

1. The present tender is for **“Planning, Design and Construction of Administration cum Laboratory building (G+6), Farmers Training Hostel(G+1) & Land development 1,05,200 sqm (approximate) at Site A, Babugarh, Hapur (UP).** The scope of work includes related external development works and other allied works on Engineering, Procurement and Construction (EPC) basis within controlled architectural parameters. The details of complete scope of work are covered in this tender document . The buildings are to be planned to meet minimum FIVE STAR GRIHA/CPWD GHAR Green rating and conforming to UP ECBC code 2017 amended up to date. Hence all the proposed E&M equipment shall meet the requirements for achieving the same. All the E&M fittings, fixtures, machinery and equipment proposed to be used in the execution shall confirm to ‘5 Star’ rating under star labeling program of Bureau of Energy Efficiency (BEE) wherever available. Machinery and equipment which does not fall under star labeling program of Bureau of Energy Efficiency shall meet Super ECBC 2017 (Up to date) norms.
2. All buildings shall be designed for people with disability (PWD) as per the latest norms of Govt of India.
3. The information and data shown in the drawings and mentioned in the tender documents are furnished for general information and guidance only. The Engineer-in-Charge in no case shall be held responsible for the accuracy thereof or/and deductions, interpretations or conclusions drawn there from. No claim shall be entertained whatsoever on this account, if the site conditions/ information is different or otherwise incorrect. It will be presumed that the contractor has satisfied him self or all possible contingencies, situations, bottlenecks, and acts of coordination which may be required between the different associate agencies by the main contractor.
4. The work shall be executed on EPC basis involving getting all local body clearances/approvals, Design, Drawings & commissioning of services. The preliminary architectural drawings shall be provided by the department. It may please be noted that the agency shall be totally responsible for the quality of the work. The Works shall include all Civil, Electrical, Mechanical, Safety aspects and any work required for completion of the works in all respects and to the satisfaction of the Engineer—in—charge.
5. Scope of work covers planning, designing, supply, installation, testing and commissioning of all Electrical & Mechanical services required to be provided in the said subheads. The work shall be executed as per scope and specifications of E&M works given hereafter in respective sub-heads. If any services/work required to make the building / scheme habitable & functional, including the statutory compliance, is not specifically mentioned in the scope of services, the same is deemed to be included within the scope of this tender.
6. General Specification lays down general guidelines to ensure safe, efficient and reliable E&M services. Contractor has to provide required cutouts for Piping, Ducts and Cabling works wherever required for their works and also as marked in approved drawings. Planning and integration of all E&M services provided in the building is to be carried out in BIM software at the initial stage so that clashes of services can be identified and suitable decision can be taken at the planning stage. All electrical accessories like cable wire, electrical outlets, switches, control panels, etc. should be fire rated, certified for electrical safety.

7. All sundry equipment, fittings, unit assemblies, accessories, hardware items, foundation, foundation bolts, painting, termination lugs for electrical connections, and all other items which are useful and necessary for efficient assembly and installation of equipment 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 documents or not. The tenderers shall take into account the element of wastage in all elements of the work and quote his price, taking into account. Any incidental works/ costs which are not mentioned, but are necessary to complete the work shall be deemed to have been included in the overall amount quoted by the Contractor for various sub head components of work. Nothing extra payable to this account.
8. The tenderer should inspect the site and its surroundings before submitting the tender. Detailed scope, conditions & specifications are included in this tender for each of the sub-head. Since the drawing/ designs/ calculations related to various E&M works and packages are interrelated with one another, the contractor has to ensure that the planning and designing of all E&M works well in advance before execution of the work. CPWD shall bear no responsibility for the lack of knowledge and the consequences thereof to the contractor.
9. The rates quoted by the tenderer, shall be firm and inclusive of all taxes and duties, levies, delivery, installation, testing, commissioning etc. Incidental charges of any kind such as cartage, storage, wastage, safe custody of material etc. are included in the quoted rates and nothing extra shall be paid on this account.
10. No foreign exchange shall be made available by the Department for importing (purchase) of equipment, plants, machinery, materials or any other items required to be carried out during execution of the work. No claim of any kind shall be entertained on account of delay in receipt of items and variation in the foreign exchange rate.
11. The Contractor shall obtain all pre-construction and post construction approvals/ clearances etc. from local body authorities like local Fire department, local town planning authority, Lift inspectorate, Central Electricity Authority, Local electrical distribution company, wherever required. The Contractor has to prepare all the documents as required in the name of Client Department and submit directly to the local statutory bodies. All approvals shall be in the name of the Client Department. The Contractor has to comply and, if necessary, resubmit applications which are required by the local bodies. All statutory fees/ charges required for obtaining clearances from Fire Officer/Lift Inspector /CEA/ Local Bodies etc., paid by the contractor will be reimbursed.
12. The common language used in NBC-2016 for mandatory provisions is by use of word "recommended". Therefore, if in NBC when ever there commended word is used, it is to be treated as a mandatory provision. In case any part of the work specification is not available in the a fore said mentioned documents then part of the work will be carried out in accordance with sound engineering practice and as per directions of Engineer-in-charge.
13. The Contractor shall submit a detailed program chart indicating all construction activities for E&M works to the Engineer-in-Charge in accordance with the milestones.
14. The contractor shall proceed with the preparation of Design and detailed shop Drawings, detailing the equipment that are to be installed and the ancillary works that are to be carried out. The scope of work also covers proof checking of Design and drawings by an Institute of repute as defined/mentioned in the bid-document and shall have to submit for approval of the Engineer-in-Charge, before commencement of work, to ensure that the works will be carried out in accordance with the specifications including changes mutually agreed upon. The contractor shall also submit the data sheets and catalogues of various equipment in support of their design.

15. The Contractor will prepare the co-ordination working drawing after getting all inputs of various services so that the work of any service should not hamper the progress of other works. Before start of work, the Contractor shall submit the Reflected Ceiling Plan(RCP) drawings showing all the services and equipment to get a proper aesthetic look of the building. During execution, if it is found necessary to amend any parameter, the same shall be made by the firm again free of cost with in the quoted rates.
16. Any data and details asked by Engineer in charge to finalize and accept the scheme shall be provided on the established standard/guidelines/codes etc. The scope of E& M work, specifications mentioned in this document are indicative in general but not exhaustive. The work shall be carried out in accordance with true intent and meaning of the specifications and the drawings taken together, regardless of the fact whether the same may or may not be particularly shown on the drawings and/ or described in the specifications, provided that the same can be reasonably inferred there from.
17. The contractor has to offer makes of the equipment/ materials from the “List of Preferred/ Approved Makes” for approval of Engineer-in- charge. It is the responsibility of the Contractor to get the makes and models approved by the department before placing of order.
18. To procure genuine material from Manufacturers / authorized dealers shall be the responsibility of Contractor. Routine tests as prescribed in IS/ CPWD/NBC specifications shall be carried at manufacture facility. The expenses shall be borne by the contractor.
19. The agency shall get themselves acquainted with CPWD specifications and site conditions. The E&M Component of work shall be executed in close co-ordination with the progress of building work. These general conditions are applicable to all sub-heads of work under this part. The work shall be designed executed /carried out as per the following:
 - a) The Electricity rules 2005, IE Rules 1956 & Indian Electricity Act 2003, National Electrical Code 2011 amended upto date.
 - b) National Building Code-2016, Relevant BIS standards as amended upto date.
 - c) Energy Conservation Building Code-2017
 - d) CPWD General Specifications for Electrical Works Part-I (Internal) –2023, Part II (External)-2023, CPWD General Specifications for Electrical Works Part — III (Lifts and Escalators) — 2003, CPWD General Specifications for Electrical Works Part – IV (Sub stations) – 2013, CPWD General Specifications for Electrical Works Part — V (Wet Riser & Sprinkler system) — 2020, CPWD General Specifications for Fire detection and Alarm system Part-VI— 2018, CPWD General Specifications for DG Set Part—VII (DG Set)—2013, CPWD General Specifications for Gas based fire extinguish system Part — VIII —2013, CPWD General Specifications for Air-Conditioning/HVAC/VRF/VRV works—2024 with upto date amendments.
 - e) Factories Act, Workmen’s compensation Act.
 - f) Statutory norms prescribed by Agencies like CEA, Power Supply Co., CPCB etc.
 - g) Additional Technical specifications and list of acceptable makes.

Stringent conditions among the above shall be followed.

20. Any additional item of work, if taken up subsequently, shall also confirm to the relevant specifications mentioned above. Nothing in this specification shall be construed to relieve the

successful tenderer of his responsibility for the design, manufacture and installation of the equipment with all accessories in accordance with currently applicable statutory regulations and safety codes.

21. Safety Codes and Labour Regulations

- a) In respect of all labour employed directly or indirectly on the work the contractor at this 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.
 - b) The contractor shall provide necessary barriers, warning signals and other safety measures while executing the work or wherever necessary so as to avoid accidents. 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 also provide all insurance including third party insurance as may be necessary to cover the risk. No extra payment shall be made to the contractor on this account.
22. Contractor shall arrange for compliance with statutory provisions of safety regulations and departmental requirements of safety codes in respect of labour employed on the work by the Contractor. Failure to provide such safety requirement would make the Contractor liable for fine of Rs 5000/- (Rs Five Thousand only) for each default. In addition, the department will bear liberty to make arrangement for the safety requirements at the risk and cost of the Contractor and recover the cost thereof from him.
 23. Storage and safe custody of all materials shall be the sole responsibility of the Contractor at his own risk and cost. No storage space will be provided by the Department.
 24. Frequency and type of tests of various Materials/Items/Equipment shall be conducted as per specifications and relevant BIS-Codes. The test results shall conform to the specification/codes. The testing plan for quality control for major E&M services shall be carried out as per the guidelines issued by C.P.W.D time to time.
 25. Civil works such as foundation of equipment as per recommendations of OEM, trenches for fuel line & cable, making of openings in walls or in floors, providing Anti vibration isolators etc., as required shall be provided without any additional cost. 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 this cost. He shall remove all unwanted and waste materials arising out of the installation from the site of work from time to time.
 26. The agency shall insure storage, erection including third party insurance right from the start to commissioning and handing over of various equipment. All insurance which the agency is required to enter into under the contract shall be effected with any authorized general insurance company and the agency shall produce the policies of insurance. The beneficiary shall be Engineer -In-charge. Insurance costs shall be borne by the contractor.
 27. In case of any delay in Installation, Testing, Commissioning & handing over, the insurance cover shall be suitably extended by the Contractor at his own cost. If the agency fails to effect and keep in force the insurance, the department may pay such premium as may be necessary for that purpose and deduct the amount, so paid by the department from the Contractor from

his dues.

28. No tools and tackles would be made available by the department. Scaffoldings & any other T&P required for execution, testing and commissioning of work shall be arranged by the contractor. Contractor shall make his own arrangements for electricity and water required for execution, testing & commissioning of work at his own cost.

29. Quality of material and workmanship:

- a) The Contractor shall ensure quality control measures on different aspects of construction including materials, workmanship and correct construction methodologies to be adopted. Quality of the project is of utmost importance.
- b) This shall be adhered to in accordance with the provisions of CPWD specifications and guidelines given in the relevant paras.
- c) The quality assurance program should include method statement for various items of work to be executed along with check lists to enforce quality control.
- d) The Contractor shall make available, on request from the Department, copies of challans, cash memos, receipts and other certificates etc. towards the quantity and quality of various materials procured, as directed by the Engineer-in-Charge. Day to day account of receipt of material shall be maintained at site of work.

30. All parts of the equipment shall be designed to function satisfactorily under all rated conditions of operation. All components of the equipment shall have adequate factor of safety. The work of fabrication and assembly shall conform to sound engineering practice and on the basis of "Fail Safe Design". The mechanical parts subject to wear and tear shall be easily replaceable type. All connections and contacts shall be designed to minimize risk of accidental short circuits caused by animals, birds and vermin etc. All identical items and their component parts should be completely interchangeable.

31. Inspection before Dispatch:

- a) No equipment shall be dispatched from the manufacturing premises before routine tests are conducted and test results recorded. These test certificates shall be given along with the supply of equipment. The Engineer In-charge shall inspect and witness the pre-delivery tests. For this purpose, the agency shall give 15 days' advance notice and arrange for inspection of the department. Department will bear expenses of its officials for inspection as far as traveling boarding and/lodging is concerned.
- b) All routine tests shall be conducted before dispatch of equipment. Routine & Type Test Certificates shall have to be submitted for equipment. Prior to dispatch, all equipment shall be adequately protected & insured for the whole period of transit, storage and erection against corrosion and incidental damages etc.
- c) All the equipment shall be delivered with Manufacturer's test certificate, Manufacturer's technical catalogues and Installation / Instruction (O&M) manuals.
- d) No inspection outside the country is permissible. If required so, the same will be deemed to be waived off and necessary test reports shall be submitted before the dispatch of equipment.

32. The contractor shall dispatch materials to site in consultation with the Engineer-in-Charge. Watch & ward shall be the responsibility of contractor. Program of dispatch of material shall

be framed keeping in view the building progress. Safe custody of all equipment/ items supplied by the contractor shall be the responsibility of the contractor till final taking over by the department.

33. The installation shall be subjected to necessary inspection during every stage of erection, by the Engineer In-charge or his authorized representative. The successful bidder shall provide all facilities and assistance for the purpose. The completed installation shall be inspected and tested by the Engineer-in charge in the manner as will be laid down by him, in consultation the agency. All instruments and facilities necessary for the tests shall be provided by the agency.
34. The Contractor shall submit the running bills in Computerised Measurement Book (CMB), as per the standard format of department.
35. Co-ordination with other Agencies: The successful tenderer shall ensure proper coordination between various Associated Agencies executing the work of different E&M services.
36. Climatic Conditions: All Electrical and Mechanical equipment and accessories provided in the work shall be designed and derated for continues and trouble-free operation in the climatic conditions of the site.
37. Quality Control and Testing of Materials:
 - a) All the material used on works shall bear ISI certification mark. In case ISI marked material are not available, the material to be used shall confirm to CPWD specifications applicable in this tender or IS Code to the satisfaction of Engineer-in-charge. In all cases proof of procurement of materials from manufacturers shall be provided by the Contractor. All materials should be got approved by the Engineer-in-charge before use of said materials in the work.
 - b) As per the QA plan, it is needed to send required number of samples of materials for testing in an accredited laboratory, the Contractor at his own expense shall supply all materials, labour for preparing and testing samples as required by the Engineer- in-Charge. The testing shall be carried out in the presence of the representative of the Engineer- in-Charge. The transportation and testing charges shall also be borne by the Contractor.
 - c) The technical data sheet and manufacturing drawing of all equipment and materials as per contract specifications shall be prepared by the respective manufacturer and will be submitted by Contractor duly signed before placing the order or manufacturing the material. The Engineer-in-charge shall approve as per contract conditions.
38. Supervision of Work: The Contractor shall depute Site Engineers & skilled workers as required for the work. He shall submit organization chart along with details of Engineers and supervisory staff. The Contractor shall also furnish list of persons for specialized works to be executed for various items of work. If during the course of execution of work, the Engineer-in-Charge is of the opinion that the deployed staffs not sufficient or not well experienced, the Contractor shall deploy more staff or better-experienced staff at site to complete the work and to maintain quality and in stipulated time limit.
39. Completeness of work:

- a) The installations shall be completed in all respects and put in to operation even where certain details have not been mentioned / left out in these specifications. Any discrepancy may be brought out in pre-bid meeting.
 - b) All E&M services shall be declared as completed after completion of trial run of 1 month or completion of whole work whichever is later. However, maintenance of these installations during the defect liability period of **36 months** shall be carried out by the agency at his own cost. DLP / Warranty period of all works /equipment shall commence from date of completion of complete work (project).
 - c) All Electrical & Mechanical fittings / fixture / appliances shall have BEE 5-Star-rating wherever certification is available.
 - d) SLD of all installations shall be prepared in color print, got laminated in suitable size and displayed suitably at respective plant room etc. after completion of work.
40. Completion Plan: Contractor shall submit completion drawings of E&M services as and when work is completed. These drawings shall be submitted in the form of soft copy and four sets in hard copy of A 0 size These drawings shall clearly indicate following:
- a) Location and details of equipment and other particulars.
 - b) Complete wiring diagram.
 - c) Single line diagram, power schematic, control schematic with detailed quantity and makes.
 - d) Successful Contractor shall also furnish the Manufacturer's instructions on Installation, Operation & Maintenance for all the capital items.
41. The installations shall be handed over to the department after necessary testing and commissioning. The installations shall be guaranteed against any defective design / workmanship. Similarly, the materials supplied by the Contractor shall be guaranteed against any manufacturing defect, inferior quality. The guarantee period shall be 12Months from the date of handing over to the department. This guarantee is required against un-satisfactory performance and/or breakdown due to defective design, material, manufacture, workmanship or installation.
42. The equipment or component or any part thereof 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 and binding on the Contractor.
43. Preference to PPP-MII Policy (Make in India):
- a) The Government has issued public procurement policy (Preference to Make in India) vide Ministry of Commerce and Industry Development of industrial policy and promotion (PPS) vide order No. P-45021/2/2017-PPBE-II as amended.
 - b) The agency shall submit list of makes of materials proposed to be used on the work from local suppliers (as defined in the above order) along with minimum local content as specified below for approval of the department out of the approved makes kept in the tender.

- c) The department will be approving only makes of the materials having minimum local content of 50% for use on this work, out of the preferred makes list.
- d) The minimum local content of 50% is considered for the complete item including labour component.
- e) The agency shall obtain the certificate for all items except for sundry items.
44. The agency shall run all the Air Conditioning Pipe lines, Firefighting Pipes/Water Supply Pipes, LT Cables and Other service-related Cables through the Service duct/ Trench from service block to Admin cum Laboratories Bldg & Farmers training Hostel with suitable supports. Necessary ventilation fans, Fire Alarm System, Flame Proof light fittings shall be provided in the service Duct. Cables shall be run through suitable size cable trays.
45. Following minimum T& P shall be maintained at site during the execution of work.

S.No.	T & P items	Quantity
1.	Tonge Tester	2Nos
2.	Megger	2Nos
3.	Earth Tester	2Nos
4.	Ladder of different size	1Lot
5.	Multimeter	2Nos
6.	Spanner Set	1Set
7.	Crimping Tools	2 Nos
8.	Chase cutting Machine	4Nos
9.	Any other machine/tool required for Completion of work as per direction of Engineer-In-Charge	As per actual requirement.

The testing plan for quality control for major E&M services

Internal EI, Street Lights /Compound Lights, Substation, DG Set, UPS, Air Conditioning, Firefighting								
Stage/SI no	Material/Process	Standard Applicable/Test Required to be Done	Total Qty (each type) reqd. in agreement or lot size whichever is less	Whether Proof of Dispatch required	Whether Manufacturer's test certificates required	Sample Size	At manufacturer works	At third Party Lab
1	LT Panels with ACB	CPWD specs. Part IV/ QAPlan: Construction, Ratings of SWG, air gaps between Phases, phase to body, IP rating, Short Circuit ratings etc.	Any	Y	Y	100%	Y	N

2	LT Panels with incomer of more than 200A	CPWD specs. Part IV/QA Plan: Construction, Ratings of SWG, airgaps between phases, phase to body, IP rating, Short Circuit rating setc.	Upto 2	Y	Y	0	N	N
			>2 and <10	Y	Y	1	Y	N
			>10	Y	Y	2	Y	N
3	Rising Main and Bus Trunking	CPWD specs part IV/QA Plan	Length upto 500 mtr	Y	Y	10% Length and fittings	N	N
			Length >500 mtr	Y	Y	10% Length and fittings	Y	N
4	Rigid MS Conduit	IS9537 Pt I & 2	up to 2500	Y	N	N	N	N
			>2500 mtr	Y	Y	1 piece of 1 mtr for every 1000 mtr	N	Y

Stage/SI no	Material / Process	Standard Applicable/ Test Required to be Done	Total Qty (each type) reqd. in agreement or lot size whichever is less	Whether Proof of Dispatch required	Whether Manufacturer's test certificates required	Sample Size	At manufacturer works	At third Party Lab
5	Rigid PVC Conduit	IS3419:1989	Upto 2500 mtr	Y	N	N	N	N
			>2500 mtr	Y	Y	1 Piece for every 1000 mtr	N	
6	Cable Tray	CPWD Spec. Part-I/II: Check for perforation area, paint/ Galvanizing thickness and Material Composition	Length upto 500 mtr	Y	Y	N	N	N
			Length > 500 mtr	Y	Y	One piece for every 500 Mtr	N	Y

7	DWC/ Corrugated HDPE Pipe	IS14930, Check for thickness, material, Mechanical Strength and smoothness	Length up to 500mtr	Y	N	N	N	N
	Wire		Length > 500mtr	Y	Y	One piece for every 500Mtr	N	Y
8	Wires	IS694:1990	up to 10000 mtr	Y	N	N	N	N
			> 10000mtr	Y	Y	1 piece for every 100 00mtr or less	N	Y

Stage/SI no	Material/Process	Standard Applicable/Test Required to be Done	Total Qty (each type) reqd. in agreement or lot size whichever is less	Whether Proof of Dispatch required	Whether Manufacturer's test certificates required	Sample Size	At manufacturer's premises	At third Party Lab
9	Poles	Whether in conformity with tender specs	upto 100	Y	Y	N	N	N
			>100	Y	Y	2%	Y	N
10	LT Cable	IS1554 Part I	Upto 2500 meter	Y	N	N	N	N
			>2500 mtr	Y	Y	1 piece for every 2500 mtr	N	Y
11	Fittings	Whether in conformity with tender specs	>100	Y	Y	NA	N	N
12	HT Panel	CPWD specs part IV /QA Plan: CT ratio and accuracy Class should be invariably checked	Any	Y	Y	1	Y	N
13	HT Panel: Metering and protection devices	Check CT ratio and accuracy Class, Relays and Meters	Any	Y	Y	1	Y	N
14	Capacitor Panel	CPWD specs part IV/ QA Plan: Check forty per cent of capacitors used, operation of relay, settings. Change the load and its type and check functionality	Any	Y	Y	1	Y	N

Stage/Sino	Material/Process	Standard Applicable/ Test Required to be Done	Total Qty (each type) reqd. in agreement or lot size which ever is less	Whether Proof of Dispatch required	Whether Manufacturer's test certificates	Sample Size	At manufacturer works	At third Party Lab
15	Transformer	CPWD Specs. Part IV/QA Plan: Physical verification of accessories as per agreement and Routine tests as per IS:2026/IS11171:1985 (whichever Applicable), with particular attention to losses meeting ECBC norms / as per agreement, Type test certificate for exact same design for impulse withstand and short circuit with stand shall be made available by Manufacturer, Temperature rise test of one transformer of each design shall be done. Copies of the certificate for pressure test, test for bushings shall be supplied to the department.	Any	Y	Y	100%	Y	N
16	DG set	Load testing as per CPWD specs	Any	Y	Y	100%	Y	N
17	UPS	Load testing and operation logic as per CPWD specs, Check for input and output power quality as per agreement	Any	Y	Y	100%	Y	N
18	HT Cable	IS1554 Part II	Upto 500mtr.	Y	Y	1	N	N
			>500mtr	Y	Y	1 Piece for every 500mtr	N	Y
			>2500mtr	Y	Y	1 Piece for every 2500mtr	N	Y

Stage/SIno	Material/Process	Standard Applicable/Test Required to be Done	Total Qty (each type) reqd. In agreement or lot size whichever is less	Whether Proof of Dispatch required	Whether Manufacturer's test certificates required	Sample Size	Location of Test	
							At manufacture works	At third Party Lab
19	Chiller	CPWD specs part VI/ECBC Code/Agreement/ QA Plan: COP, Capacity, IKW/TR,1PLV/NPL,V	Any	Y	Y	1	Y	N
20	Package AC Unit	CPWD specs part VI/ECBC Code/Agreement/QA Plan: COP, Capacity, IKW/TR	Any	Y	Y	1	Y*	N
21	Split/WTAC	As per tender specs. And BEE ratings.	Upto 50	Y	Y	NA	N	N
			>50	Y	Y	1 for every 50	Y*	N
22	Pumps	As per tender specs.	Any capacity	Y	Y	100 %	N	N
23	MS Pipes	To be tested for thickness and weight as per applicable IS	Any	Y	Y	1 for every 10 0mtr	N	N
24	Insulation / Acoustics material	To be tested for Density and K value as per tender specs.	up to 1000 Sqm tr	Y	Y	NA	N	N
			>1000 Sq. mtr	Y	Y	1 for every 1000 Sq mtr	N	Y
25	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	Upto 20 fans	Y	Y	NA	N	N
			>20 fans	Y	Y	1 for every 20 fans	Y	N
26	AHU's	CPWD specs. part VI /CM Plan: To be tested for capacity in assembled condition, Fabrication, Cooling coil and filters material & workmanship to be inspected critically.	upto 20 AHU's	Y	Y	NA	N	N
			>20	Y	Y	1 for every 20 AHU's	Y	N

Stage/SI no	Material/Process	Standard Applicable/Test Required to be Done	Total Qty (each type) reqd. in agreement or lot size whichever is less	Whether Proof of Dispatch required	Whether Manufacturer's test certificates required	Sample Size	At manufacture works	Stage/SI no
27	Ducting material	As per Relevant BIS	upto1000 Sq mtr	N	N	NA	N	N
			>1000Sq mtr	Y	Y	1 Sample for every 1000Sqmtr	N	Y
28	Valves	Flow and controls as per data sheet	upto20	Y	N	NA	N	N
			>20	Y	Y	1forevery 20	N	Y
	Y*To be Tested for its capacity at AHRI certified testbed (either at manufacturer's work or at Illrd Party)							

Functions of TPQA

When a Third-Party Quality Assurance agency is engaged. It shall carry out the following functions:

1. TPQ A agency shall do their job by field visits, arranging the necessary quality assurance tests for materials and the construction works, analyzing the test results and furnishing the comments/ observations thereon and providing general observations on construction materials and work. The TPQA agency shall submit their report to CPWD at various stages/as and when needed.
2. TPQ A agency shall check and report whether work is being executed according to the drawings designs and specifications of the agreement and in accordance with the approved drawings.
3. The TPQ A agency shall be responsible for bringing-out in writing, to the notice of CPWD any instances of deviations from accepted quality of construction materials, workmanship and general quality of works at appropriate stages of construction.
4. TPQA agency shall inspect the construction site during the works under progress frequently to achieve the stipulated standard of quality in the project. If there is any discrepancy/ error/ omission the team shall point out the same with suggestion Agency for and remedial measures with codal provisions.
5. TPQA agency shall highlight the problem area, if any, also suggest steps/solutions to rectify the same so as to achieve the overall target of quality assurance.
6. TPQA agency shall arrange testing of materials used in construction work for ascertaining their quality through reputed laboratories/ institutions preferably Government testing Centers. All standard tests shall be arranged. TPQ A agency shall report the results of testing to CPWD with their suggestions and remedial measures.
7. The main contractor should provide all the information and documentation during inspection of site by TPQA agency as per provision in the NIT.

C-1 Internal & External Electrical Installations i/c Lightning conductor, Street light,

1.0 Technical Specification for IEI Works

1.1 The scope of work shall include Planning, designing & preparation of drawings, supplying, installation, testing & commissioning of Internal Electrical Installations and its components in Admin cum Laboratories Bldg & Farmers training Hostel and other Buildings. If any item required to make the scheme functional, it is not specifically mentioned, the same is deemed to be included within the scope of this tender. These technical specifications shall be read along with the General Conditions for all E&M works given under subhead.

1.1.1 Work shall be carried out as per CPWD General Specifications for Electrical Works Part-I (Internal) 2023 & Part-II (External) 2023, NBC 2016 amended up to the last date of submission of tender. All electrical works shall be carried out in accordance with the provisions of Indian Electricity Act, 2003, National Electrical Code 2010 and Indian Electricity Rules, 1956 amended up to date. List of rules of particular importance to electrical installation under these General Specifications for internal electrical works is given for reference.

1.1.2 Conduits and Accessories shall conform to latest edition of Indian Standards. 16/14(16 gauge up to 32mm diameter & 14 gauge above 32mm diameter) gauge MS conduits shall be used. Joints between conduits and accessories shall be securely made by standard accessories to ensure earth continuity. All conduit accessories shall be of threaded type only. Make of conduits and accessories shall be used from the approved list only.

1.1.3 The wiring and conduit route plan /drawings shall be submitted by the contractor and shall be got approved from the Engineer-in-charge.

1.1.4 Check nuts shall be provided while terminating the M.S. conduits in switchboxes. The contractor shall provide only ISI marked metallic junction boxes of required sizes even for PVC conduit laid in the slab. The metallic junction boxes & looping boxes shall be covered with approved makes of phenolic laminated sheet/ GI sheet. The fan box cover shall be made from 3mm thick phenolic laminated sheet as per CPWD specifications.

1.1.5 Four core cables shall be used in place of three and half core cables to minimize heating of neutral core due to harmonic content in the supply system and also avoidance of over load failures.

1.1.6 All Internal Electrical Works shall be carried out with MS conduit. All switches, sockets, AC Sockets, IP Phone socket, Data sockets, stepped type(2 module) fan regulators, bell push and accessories along with matching mounting boxes shall be of antibacterial modular type. All mounting boxes for modular type accessories shall be of metallic construction and of the same make as that of the modular type switches and accessories. Power point for computer shall have 3Nos 5A sockets and 1No 15A switch in one box.

1.1.7 While deciding the size of switch boxes for light points / fan point / exhaust fan point, two extra modules shall be provided for each fan point for fixing of regulator. Wherever extra modules are available, the same shall be provided with blanking plates without any extra cost.

1.1.8 The wires used for point wiring and power wiring shall be of 650/ 1100 Volts grade Flame

Retardant Low Smoke (FRLS) PVC insulated multi stranded copper conductor single core cables. Minimum size of copper conductor for power wiring shall be 4 Sq mm for power sockets, 6 sq mm for AC & Geyser points. Minimum size of copper conductor for Light, fan points wiring and circuit wiring shall be 1.5 sq mm. Submain wiring shall not be done with below 6.0 sq mm copper conductor cable. For conductor sizes less than or equal to 16sq.mm. only copper conductor should be used. Colour coding as per specification shall be adopted in the wiring system.

- 1.1.9 All components in a wiring installation shall be of appropriate ratings of voltage, current and frequency, as required at the respective sections of CPWD specifications of the electrical installations in which they are used. All conductors, switches and accessories shall be of such size as to be capable of carrying the maximum current, which will normally flow through them, without the irrespective ratings being exceeded
- 1.1.10 UPS & Essential DBs shall be separate. The size of DBs at one location shall be same irrespective of number of circuits connected from the DB. The make of MCBDBs, MCBs and RCBOs shall be same every where. All distribution boards shall be marked with circuits controlling the rooms/ area/SDB controlled. Size of distribution board shall be as per number of light /power circuits. All circuits shall be terminated on individual MCBs. All distribution boards shall be double door type.
- 1.1.11 RCBO of 30mA sensitivity of suitable rating shall be provided as Incomer of each Distribution board. The MCB should be 10 KA breaking Capacity and of same make as that of MCB DBs.
- 1.1.12 The Conduiting work for the telephone, LAN and CCTV wiring shall be carried out in such a way that all the other end of wirings can be terminated in Patch panel including rack of each floor and in the EPBAX room/ Control room.
- 1.1.13 Wherever providing of rigid conduits is not possible, flexible MS conduit pipe shall be provided for drawing/running the wires. However, such arrangement has to be kept minimum and only with the prior approval of Engineer-in-charge or his authorized representative.
- 1.1.14 While laying MS conduits for fire alarm system and wiring for other services, sufficient junction outlets are to be provided as per the direction of the Engineer-in-Charge for detectors as required.
- 1.1.15 Wiring with Cat 6A for Intercom / Telephone shall be terminated in suitable size of G.I. Junction box with face plate and RJ-45 socket. All the other end of wiring shall be terminated in Patch panel including rack of each floor and in the EPBAX room. The wiring shall be suitably tagged/marked mentioning the location of each point. The fiber optic cable shall be used for interconnection of networking switches. The patch panels patch chords and layer 2 and layer 3 switches are in the scope of work. In all waiting areas sufficient multiple multistrand 6 A socket outlet should be provided as mobile charging point
- 1.1.16 No ceiling rose /connector/ looping box shall be provided, wherever false ceiling is being provided. The point wiring in that case shall be extended upto the fitting /fan etc. directly without provisions of any termination arrangement in between. The wire from the end points up to the fixture shall be considered to be included in the point wiring.
- 1.1.17 Earthing and all items of work that cannot be checked later, are to be go tap proved from Engineer-in-charge or his authorized representative before proceeding further.

- 1.1.18 The firm shall use only electrically operated chase cutting machine for cutting the chases in the wall for recessed conduit wiring.
- 1.1.19 Tinned copper lugs / Thimbles / ferrules shall be provided for termination of earth wire to all Metallic outlet boxes / fittings / fixtures / fan regulator / MCBDB / switch board / Meter board. Termination should be properly crimped / brazed / soldered. Metal sheath of Co-axial T.V. cable shall be terminated using 'U' shape thimble / lugs / ferrules.
- 1.1.20 A suitable brass / tinned copper neutral links shall be fixed at suitable places in the Metallic outlet boxes of all sizes to terminate neutral wire properly.
- 1.1.21 All hardware material such as nuts / bolts / screws / washers etc. to be used in the work shall be zinc / cadmium plated iron. These hardware items which are essentially required for completing any item as per specifications is deemed to have been included in the item even when the same have not been specifically mentioned. The galvanized boxes of modular switch/sockets etc. shall be of the same make as of switch/socket etc.
- 1.1.22 To facilitate drawing of wires, GI fish wire shall be invariably drawn in recessed conduit. No or minimum junction box shall be provided in the entire length of conduit run for drawing of wires.
- 1.1.23 The ceiling roses wherever required to be provided (along with earthing provision) are included in the scope of work. The connection to incoming switch / isolator / bus bar / MCB shall be made with suitable size of thimble and cable.
- 1.1.24 The Incomer for vertical DBs used for power distribution, shall be suitable rating MCCB of 35/36KA rating breaking capacity.
- 1.1.25 Power supply to DBs located in lift machine room at suitable location as approved by Engineer-in-charge shall be done using suitable insulated armored cable. Supply, installation, testing and commissioning of cable shall be in the scope of work.
- 1.1.26 Inside the lift shaft, there shall be arrangement of one light point at each floor level and one light point at overhead, one light point in lift pit. All light points shall be in group controlled and wired with 2.5 sq mm FRLS PVC insulated copper conductor cable. One 15-amp power plug and one 5-amp power plug shall be provided at each floor with individual switch. Wiring of these power plugs shall be done with 4 sq mm FRLS copper wires. LED Bulkhead fittings of suitable rating to provide minimum 200lux shall be connected with each point of lift shaft.
- 1.1.27 LT panels shall be cubicle TTA type panels only, as per accepted list of makes attached and as per drawings approved by Engineer-in-Charge. All TTA panels shall be strictly as per IEC61439 / BIS/CPWD specifications. Each TTA Panel shall be fabricated from 2 mm thick M.S. sheet powder coated with 7 tank process and shall be equipped with 4 pole MCCBs, Copper Busbars, digital multifunction meter, LED indicating lamps, extended rotary handle and all accessories as required.
- 1.1.28 TTA Floor Panels shall be provided for all UPS and Essential supply panels. Incomer of UPS and Essential panels shall be connected with DG set Supply with Auto change over switch/Auto Transfer Switcher (ATS). Incomer, outgoing, bus bar, indicating instruments etc. shall be designed as per maximum load and shall be got approved from Engineer-in-charge. All TTA panels shall be of same Make.

- 1.1.29 The MCCBs, if used as incomer then it should have Over voltage, earth fault protection and time delay. Earth leakage modules are not acceptable. Breaking capacity of MCCBs for all types of panel boards except DBs shall be as per fault level of that location. The rated service breaking capacity should be equal to rated ultimate breaking capacities ($I_{cs}=I_{cu}=100\%$). MCCBs above 200A rating shall be provided with microprocessor relay with suitable fault level, (Minimum of 35/36 KA breaking capacity) adjustable Over Load, Short Circuit protection.
- 1.1.30 Lightning arresters and aviation obstruction lights (LED Type) shall also be provided.
- 1.1.31 For accommodating various size of cables in road crossings, medium class G.I. pipe of suitable size but not less 150 mm shall be provided. Different power supplies shall be taken in independent pipes. Additional provision of one spare pipe for supply cables, each of minimum 150 mm size, shall be kept for future extension within the quoted rates.
- 1.1.32 Earthing system comprising of Structural Earthing to be made for all the buildings. Necessary provisions for tapping the earth electrode at allocations as required shall be provided. To all those services for which providing tapping from structural earthing is not possible / not advisable separate copper plate earth electrode with earth conductor, earth bus shall be provided as per provision laid down in CPWD specifications part I, 2023. Earthing system should be designed such as to maintain earth resistance as specified in CPWD specifications.
- 1.1.33 A Specialized Agency shall be appointed for Structural Earthing and lightning protection system. The credentials of the Specialized agency from one of the approved makes shall be submitted for approval of Engineer-in-Charge.
- 1.1.34 The wiring shall be done in such a way to provide UPS backup in the areas as mentioned below
- i. Lighting loads of the Admin cum Laboratories Bldg & Farmers training Hostel excluding below mentioned are as (at ii & iii) :25%
 - ii. Lighting loads of staircase, Toilets, Substation Building, Meeting Rooms, Kitchen and Director's Room :100%
 - iii. Power Loads/ Equipment Load of Computers CCTV, Access Control, FA & PA System. :100%
- 1.1.35 Provision is to be taken into consideration during designing for
- i. LED mirror light above each wash basin.
 - ii. Hand driers shall be installed in each toilet.
 - iii. **Power requirement to be provided as per the design and functional requirement of client /NBC 2016.**
 - iv. Two runs of 25 mm x 5 mm thick copper strips shall be provided for each Lift. These earth strips shall be connected with connectors taken out from the Structural Earthing system of the building.
- 1.1.36 Provision of Power Points of rating at least 25% more than the load of the equipment, shall be kept for all medical equipment in the Admin cum Laboratories Bldg & Farmers training Hostel Building. Provision for additional 3 phase power outlet wiring and power plug wiring in the furniture of laboratories has also been taken in this NIT as per Annexure A.

- 1.1.37 Suitable size XLPE insulated copper / Aluminium conductor cables shall be laid for the power and light requirements of the all Medical / Non-Medical equipment in kitchen, lifts, STP plant,, Rising mains and other services from Main LT panels located at substation. Floor/wall mounting electrical panels of important medical services such as etc. shall be fed from two different feeders with Auto Transfer facility.
- 1.1.38 The Electrical supply from the Online UPS shall be through TTA type UPS Panel with necessary MCCB incomers and outgoings of suitable capacity and rating. From the UPS output panel, the connections shall be given to the UPS rising mains. The panel should confirm with IEC 61439-1 & 2 for Type tested assemblies and IEC 61641 for Internal Arc in vertical bus bar, Horizontal busbar and functional unit chambers.
- 1.1.39 The supply from the UPS and DG set to various equipment and E&M services shall be as per the latest relevant guidelines and shall be decided during the execution of work as per the client department.
- 1.1.40 All materials and equipment supplied by the contractor shall be new. They shall be of such design, to satisfactorily function under the rated conditions of operation and to withstand the environmental conditions at site.
- 1.1.41 The make of material has been indicated in the list of acceptable makes. No other make shall be acceptable. The material to be used in the work shall be got approved from the Engineer-in-charge before its use at site. The Engineer-in-charge shall reserve the right to instruct the contractor to remove the material which, in his opinion, is not as per specifications.
- 1.1.42 The materials shall be subjected to quality tests at the discretion of the Engineer-in-charge as per the specifications described for the item/material. Materials brought to the site of work, the contractor shall ,furnish manufacturers test certificates to satisfy the provisions of IS codes relevant to the material and /or the work done.
- 1.1.43 Similar parts of all switches, lamp holders, distribution fuse boards, Switchgears, ceiling roses, brackets, pendants, fans and all other fittings of the same type shall be interchangeable in each installation.
- 1.1.44 Inspection of materials and equipment:
- a) The firm shall be required to procure material as per the approved makes directly from the manufacturer/ authorized dealers to ensure genuineness & quality. Proof in this regard of purchase shall be submitted by the contractor, if required by the department.
 - b) Inspection at factory or at godown of the manufacturer, as required, shall be arranged by the firm for a mutually agreed date. Certificate for genuineness of the fittings shall have to be provided duly signed by the manufacturer's officer not below the rank of Regional Manager. Department shall reserve the right to waive inspection in lieu of suitable test certificate, at its discretion.
- 1.1.45 Materials and equipment to be used in the work shall be inspected by the departmental officers. Such inspection will be of following categories:
- a) Inspection of materials / equipment to be witnessed at the Manufacturer's premises in accordance with relevant BIS/Agreement Inspection Procedure.
- 1.1.46 The contractor shall give a trial run of the equipment and machinery for establishing its

capability to achieve the specifications within laid down tolerances to the satisfaction of the Engineer-in-charge before commencement of work.

- 1.1.47 The contractor shall engage suitably skilled/ licensed workmen of various categories for execution of work duly supervised by technical representative having appropriate qualification and experience to ensure proper execution of work. They shall carryout instructions of Engineer-in-charge and his authorized representatives during the progress of work.
- 1.1.48 The contractor shall provide recesses, holes, openings, etc., as may be required for the electrical, air conditioning and other related works. contractor has also to fix inserts, sleeves, brackets, conduits, base plates, insert plates, clamps etc., if any at the time of casting of concrete, stonework & brick work. These inserts, sleeves, brackets, conduits, base plates, insert plates, clamps etc., shall be arranged by the contractor.
- 1.1.49 The contractor shall ensure quality construction in a planned and timebound manner. Any substandard material or work which is not with in permissible tolerance limits shall be summarily rejected.
- 1.1.50 The contractor shall make sample as per time-line mentioned in the milestone given in this tender document using all approved materials, for approval of Engineer-in-charge, before commencement of execution of mass scale work.
- 1.1.51 After completing the work, necessary test results shall be recorded and submitted to the department
- 1.2 Light Fittings, Fans and Accessories
 - 1.2.1 Light fittings and accessories shall conform to relevant IS standards and specifications as amended up to the date. The common language used in NBC-2016 form and at or y provisions is by use of word "recommended". Therefore, if in NBC when ever the recommended word is used, it is to be treated as a mandatory provision. In case any part of the work specification is not available in the aforesaid mentioned documents, then part of the work will be carried out in accordance with sound engineering practice and as per directions of Engineer-in-charge.
 - 1.2.2 All the light fixtures shall be energy-efficient. Fittings shall be designed for continuous trouble-free operation under any atmospheric conditions without reduction in lamp life or without deterioration of materials and internal wiring. Outdoor fittings shall be weather and rain proof.
 - 1.2.3 All lighting fixtures should be LED type having efficacy more than 110 Lumen/ Watt and CRI >80, THD <10%, LM 79 & LM 80 test report from NABL accredited lab should be submitted by the agency. The Colour temperature maybe 4000 K to 6500 K as per site requirement. External /outdoor light fittings shall be IK 10, IP65/66 rating.
 - 1.2.4 For this specification, the relevant LEDs (Light Emitting Diodes) shall be of specified parameters as per latest data sheet of Original Equipment Manufacturer.
 - 1.2.5 Lighting & Fan Design should be carried out as per National Lighting Code 2010/ NBC 2016 /CPWD specifications/ECBC guidelines. Wherever range of illumination for space is mentioned, higher side of Lux level must be taken for design purpose. Number of LED fittings shall be provided on the basis of average illumination range for different areas. If as per the design, the quantity of light fixtures comes out that does not make the symmetry, then higher number of light fixtures shall be taken to maintain the symmetry in the room. Similarly, number of ceiling fans shall be designed. It may be ensured that at least 25% of lights in the Admin cum Laboratories Bldg & Farmers training Hostel premises shall be connected to UPS supply.

- All the internal lighting load, fans Load of the Admin cum Laboratories Bldg & Farmers training Hostel, Car Parking and other building and external lights shall be connected with essential supply.
- 1.2.6 Dimmable lightings with smart control shall be provided in conference hall/meeting rooms. All the corridor and common area lights shall be sensor based as per ECBC2017 requirements.
 - 1.2.7 To maintain different levels of illumination in labs down lighters can be used in combination with 2'X2'/4'X2' fittings as required.
 - 1.2.8 Ceiling fans shall be provided in every building and at each location except toilets / Bath rooms. Either ceiling fans or wall fans shall be provided in air-conditioned areas considering the ceiling height. All ceiling fans shall be of appropriate sweep and should be BLDC type. Optimum size / number of ceiling fans for room of different sizes shall be as per provision laid down in CPWD specifications for internal EI work 2023 and NBC 2016. Minimum air delivery and service value shall be as per the above specification.
 - 1.2.9 Ventilation fans with ducting /Exhaust fans of suitable capacity and sweep shall be provided in all Toilets/ WC, stores, Substation, STP room, Electrical panel rooms, Pantry and labs (as indicated in ventilation drawings) on the basis of CFM calculations as per NBC-2016, CPWD Specifications and as per the approval of Engineer-in-Charge.
 - 1.2.10 A few cubicles may have a choice of positive or negative operating pressures (relative to the open area). Cubicles usually act as isolation facilities and their lobby areas must be appropriately ventilated in line with the function of an isolation area (i.e., pressure must lie between that in the multi-bed area and the side ward).
 - 1.2.11 Negative pressure isolation rooms: - In these rooms the windows do not open. They have greater exhaust than supply air volume. Pressure differential of 2.5 Pa shall be maintained. Clean to dirty airflow i.e., direction of the air flow is from the outside adjacent space (i.e... corridor, anteroom) into the room. Air from room preferably exhausted other outside.
 - 1.2.12 Positive pressure isolation rooms: - To provide protective environment for patients at highest risk of infection. These rooms should be provided with positive air flow, through HEPA filter. (i.e., air flows from the room to the outside adjacent space). Pressure differential of 2.5 Pa — 8 Pa shall be maintained. The temperature should be 21 ± 1 Deg. C and relative humidity should be $50 \pm 5\%$.
 - 1.2.13 Return air of battery room shall be exhausted. In addition, equal capacity of stand by exhaust fan shall be provided for battery room.
 - 1.2.14 All corridors shall be provided with proper ducted air circulation/ ventilation to achieve the conditions with number of air changes as per NBC-2016.
 - 1.2.15 Gate lighting with decorative LED type post top lantern shall be provided. Illumination to be maintained as per NBC 2016 and shall be controlled by timer switch panel for Auto ON/OFF. Lighting with Bollard fittings shall be provided in Lawns and Internal Walkways.
 - 1.2.16 Illuminated Signages :- Planning, Designing and preparation of drawings obtaining approvals from the department for emergency light and illuminated sign board, SITC of sign board in each building showing exit , floor lift, staircase, electric shaft etc. at every building in the campus as per detailed specifications.

- 1.2.17 The cabling of the compound lights should be in such away that every third or alternate pole shall be connected from each R-Y-B phase of 3-phasesupply line for ensuring minimum light at the time of failure of either of thephase.
- 1.2.18 The light luminaries/electrical light fixtures provided under the contract shall be guaranteed for a period of 5 years from the date of completion/ handing over whichever is later. In this regard contractor shall furnish an undertaking for Guarantee/Warrantee of LED luminaries for 5years from the manufacturer duly endorsed by him.

1.3 Details of the light fittings to be installed in different areas.

2'X2' / 4'X1'LED Recess/Surface Mounting Fitting (Lobbies/Offices / Wards /Doctor/Scientist/ HOD rooms etc)	SITC of Recess / Surface Mounting 2'x2' / 4'X1'LED Tile fitting of 28-36 W, having minimum efficacy 110 lumen /W, with IP 40 protection. LM79 Report from authorized NABL Lab required to verify system lumen output. Luminaire housing should be made of Powder coated CRCA with PC diffuser. CCT of Luminaire 5700K with ANSI Binning, CRI >80. LED Used should have a life of 50000 hrs. LM80 Report should be provided to verify lifespan of LED.LED Driver Should be Isolated type constant current APFC and have Input voltage range of 140-270 Volts, THD-<10%,PF-0.95, Surge protection- 2.5 KV, Driver Efficiency > / =85% and should have Output Short Circuit protection, Open Circuit protection, Over Load protection. Product Should be BIS Approved. Reports Required-LM79/ LM80/Photo biological Safety report.
LED Downlighter 9W /12W /15 W/ 18W Recess /Surface Mounting Fitting (Staircases / Corridors/ Wash rooms etc)	SITC of Recess / Surface Mounting LED Down lighter of 9/12/15/18W having minimum efficacy of 110lm/W with IP 40 protection. LM79 Report from authorized NABL Lab required to verify system lumen output Luminaire housing should be made of Powder Coated aluminium pressure die casting with diffuser to reduce glare. CCT of Luminaire 5700K with ANSI Binning, CRI>80. LED Used should have a life of 50000 hrs. LM80Report should be provided to verify lifes pan of LED. LED Driver Should be Isolated type constant current APFC and have Input voltage range of 140-270 Volts, THD - <10%, PF - 0.95, Surge protection – 2.5KV, Driver Efficiency>/=85% and should have Output Short Circuit protection, Open Circuit protection, Over Load protection. Reports Required - LM79/ LM80/ Photo biological Safety report.
LED Street Light fittings 60W / 90W (Peripheral Lighting)	SITC of LED Street Light fitting suitable for pole mounting of 50W - 90W having minimum efficacy of 110lm/ W with IP65 protection. LM79 Report from authorized NABL Lab required to verify system lumen output Luminaire housing should be made of powder coated aluminium LM06 or ADC 12 pressure die casting with IPPC Lenses to provide batwing light distribution as per requirement. The CCT of Luminaire 5700K with ANSI Binning, CRI >70. LED Used should have a life of 50000 hrs. LM80 Report should be provided to verify lifes pan of. LED Driver Should be completely potted Isolated type constant current APFC and have Input voltage range of 140-270Volts, THD - <10%, PF - 0.95, Surge protection-4KV with 10KV SPD, Driver Efficiency>/ =85% and should have Output Short Circuit

	protection, Open Circuit protection, Reports Required-LM79/LM80/ Photobiological Safety report.
LED Bulkhead Fitting(Terrace/ Lift shafts / Outside the Pump house, Substation & other similar Exposed places)	SITC of Surface /Wall Mount IP65 LED Bulkhead of 9-12 W having minimum efficacy 110lm/W.LM79 Report From authorized NABL Lab required to verify system Lumen output Luminaire housing should be made of Powder Coated aluminium pressure die casting with Polycarbonate diffuser to reduce glare. CCT of Luminaire 5700K with ANSI Binning, CRI>80. LED Used should have a life of 50000hrs @. LM80 Report Should be provided to verify life span of LED. LED Driver Should be Isolated type constant current APFC and Have Input voltage range of 140-270Volts, THD-<10%, PF-0.95, Surge protection -2KV, Driver Efficiency>= 85% and should have Output Short Circuit protection, Open Circuit protection, Over Load protection. Reports Required-LM79/LM80/ Photo biological Safety report.
Post Top Fitting 35-40W (Gate Lighting / Compound Lighting for areas other than Peripheral lighting)	SITC of Pole mounted Post Top fittings,35-40W LED, having minimum efficacy 110lm/W, 400mm (approx.)dia height 300mm Light distribution 120 Degree for uniform lighting all around with PMMA Diffuser for superior Performance. Product should have IP65 protection. CCT should be 5700K/4000K with ANSI Binning. Housing should be made of powder coated Aluminium rust protection with top opening aluminium Cover suitable for Pole dia 60-75mm. Life of LED should Be 50000Hrs and LM80 report should comply the same. CRI>70. Driver should be completely potted with >IP65 Protection, it should be Constant current isolated type and have Input voltage range 150-270V, Surge Protection-2KV, driver efficiency>=85%, THD<10%, Output Short circuit Protection, Open Circuit Protection, Reports Req.-LM79/LM80/ Photo biological Safety report.
10W LED Batten Fitting (Wash-basin Mirror Lights)	SITC of Surface Mounting type 2ft Industrial Grade LED Batten of 10W having minimum efficacy 110lm/W. with IP40 protection LM79 Report from authorized NABL Lab Required to verify system lumen output. Luminaire Housing should be made of Aluminium Extrusion with PC diffuser. CCT of Luminaire diffuser. CCT of Luminaire 5700K with ANSI Binning, CRI >80. LED Used should have a life of 50000 hrs.LM80 Report should be provided to verify life span of LED. LED Driver Should be Isolated type constant current APFC and have Input voltage range of 140-270Volts, THD-<10%, PF-0.95, Surge protection- 2KV, Driver Efficiency>=85% and should have Output Short Circuit protection, Open Circuit protection,

	Over Load protection, should have High voltage cut off @305V± 10V. Reports Required -LM79/ LM80/ Photo biological Safety report.
20W/ 40W LED Batten Fitting (Service Building areas/ Ramps/ Lift machine Rooms and other Misc. Rooms)	SITC of Surface Mounting type 4ft Industrial Grade LED Batten of 20W/40W having minimum efficacy 110lm/W. With IP40 protection LM79 Report from authorized NABL Lab required to verify system lumen output. Luminaire housing should be made of Aluminium Extrusion with PC diffuser. CCT of Luminaire 5700K with ANSI Binning, CRI>80. LED Used should have a life of 50000 hrs. LM80 Report should be provided to verify life span of LED. LED Driver Should be Isolated type constant current APFC and have Input voltage range of 140-270 Volts, THD-<10%, PF-0.95, Surge protection -2.5KV, Driver Efficiency>=85% and should have Output Short Circuit protection, Open Circuit protection, Over Load protection, should have High voltage cut-off @305V± 10V. Reports Required - LM79/ LM80/ Photobiological Safety report.
20W LED Batten with Sensor (Stores / Basement)	SITC of Surface Mount IP40 LED Batten of 20 W having Minimum 110lm/W. LM79 Report from authorized NABL Lab required to verify system lumen output. Luminaire Housing should be made of Powder coated CRCA with PC diffuser. IT should have a in built occupancy sensor for presence detection or movement detection. CCT of Luminaire 5700K with ANSI binning, CRI >80. LED Used should have a life of 50000 hrs. LM80 Report should be provided to verify lifespan of LED. LED Driver Should be Isolated type constant current APFC and have Input Voltage range of 140-270 Volts, THD-<10%, PF-0.95, Surge protection-2KV, Driver Efficiency>=85% and Should have Output Short Circuit protection, Open Circuit protection, Over Load protection. Reports Required -LM79/LM80/ Photo biological Safety report.
80W LED High bay Fitting (for double height Area)	SITC of Surface Mount /Pendent mount LED high bay Fitting of 80W having minimum 110lm/W with IP65 protection. LM79 Report from authorized NABL Lab Required to verify system lumen output. Luminaire Housing should be made of aluminium die cast with PC lens. CCT of Luminaire 5700K with ANSI binning, CRI >80. LED Used should have a life of 50000 hrs. LM80 Report should be provided to verify lifespan of LED. LED Driver Should be Isolated type constant current APFC and have Input voltage range of 120-300Volts, THD-<10%, PF-0.95, Surge protection-4KV, Driver Efficiency>= 85% and should have Output Short Circuit protection, Open Circuit protection, Over Load

	protection. Reports Required - LM79/ LM80/ Photo biological Safety report.
Bollard Light fittings (for Lawns)	10-20W LED decorative bollard made of aluminium Casting with aluminium top. The top head should beat Least 300mm to match the light levels as approved by Engineer in charge. Height should be at least 1100mm with polycarbonate unbreakable diffuser with mechanical impact protection of IK10 and rated as dust protection as IP65. The efficacy of the LEDs should be greater than 100 lumen per watt and should be powered with atleast 3KV surge protection driver. The fixture must have an external surge protection device, Input Voltage - AC240Volt

1.4 Hand Driers:-

Efficient approximate 20-30 seconds to dry hand Rated power usage of <2000 watts. Shuts off automatically when user removes hands, saving electricity. Touch free operation reduces chance of user contamination. Dries excess water from hands quickly, rather than dropping on floor. Noise absorption module decreases noise level. Burn proof ABS plastic. Electrical and temperature sensors for greater safety. Stylisher gonomic design.

Technical Specifications

- i. Operating Voltage: 220–240VAC, 50HZ.
- ii. Warm Air Speed Output: 103m/s.
- iii. Noise Level: 82 dba at 1 meter.
- iv. Motor Type: 2800 rpm motor.
- v. Thermal Protection: Auto resetting thermostat turns unit off, 240V at 221-degree Fahrenheit (105 degree Celsius).
- vi. Heater Element: 1800-2000W heater.
- vii. Mount Type: Wall Mounted.
- viii. Material: High Grade ABS.
- ix. Power: 1800-Watt or above
- x. Operation type: Touch free Infra-red Sensor activation.
- xi. Automatic Cut Off: Upto 60 sec.
- xii. Airspeed: >15m/s.
- xiii. Drying time: 20 Sec–30 Sec.
- xiv. Color: White

1.5 Separate Voltage stabilizer of suitable capacity as per building load calculation should be required for Admin cum laboratory building.

1.6 Should have provision for 3 phase power point supply in each LAB (Minimum 2 nos.).

1.7 Should have provision for dedicated earthing with 3 phase supply points for equipments connections in each LAB.

1.8 Should have provision for sterilization fittings in sterilization lab in addition with normal light.

1.9 Provision has been kept in NIT for BSL-2 Labs as per requirement and drawing

approved from Client Department at the time of making of consultant drawing.

1.10 Agency consultant prepared inventory consultation with Client department & Sign copy from Client department to submit Engineer-in-Charge CPWD.

1.11 EV Charging Points

Minimum 5% slow charging stations and 1.5% fast charging stations of total parking capacity shall be provided for 4W/2W parking in the basement for charging of Electrical Vehicles.

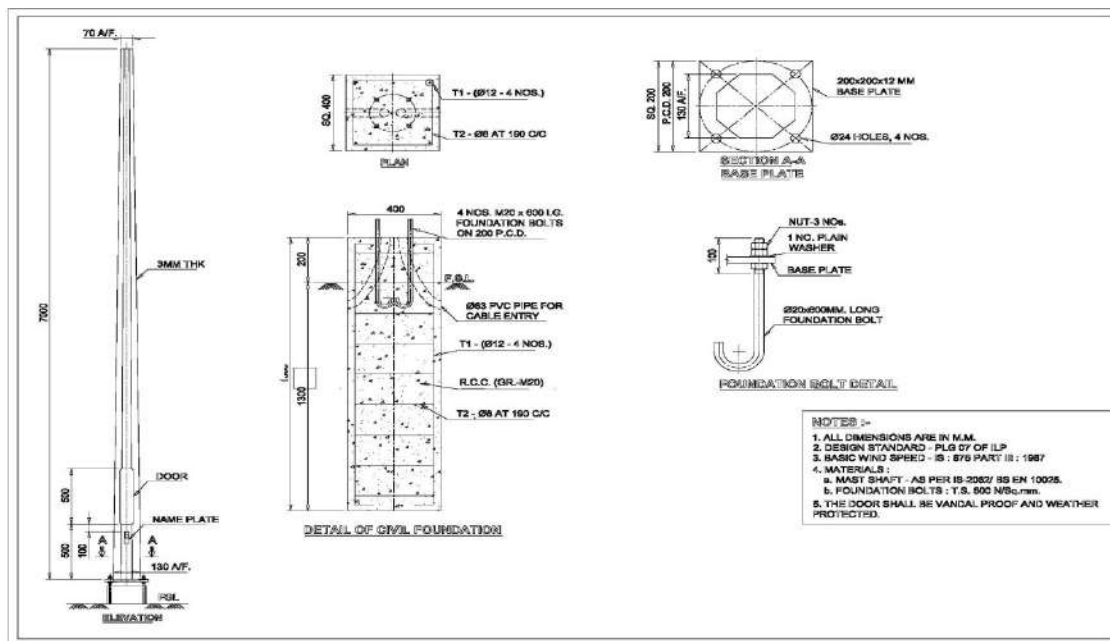
1.12 Post Top Pole (Ornamental)

The pole should be of 4 meter black painted galvanized decorative designer steel poles indifferent sections, top 60mm dia., bottom 140mm dia. With gold colour painted ornamental ring having lockable weather proof flush door junction box in bottom section, base plate dia. 280-350mm complete erected in an approved manner on existing foundation. Suitable size & type of foundation bolts 4 nos. X 16mm X 450mm 'J' type (EN8 grade). These poles shall be provided in the front side of the building to cover the area as other than covered by Peripheral Lighting.

1.13 Street light 7 Meter Octagonal Pole (Peripheral Lighting)

These streetlight poles with fittings shall be provided all around the building other than front sides.

Height of mast:	7meters
No. of sections:	One
Material construction:	S355 grade as per BS-EN10025
Base dia. And top dia meter(A/F):	Top:70mm,
	Bottom:130mm
Plate thickness & section Length:	Top:3mm,Length-7000MM
Cross section of Mast:	8sidepolygons.
Standard for of galvanisation:	As per BS EN ISO 1461
Base Plate	200X200X12
Lightning protection finial:	Not required
Max. wind speed:	As per IS:875(Part-III)
Number of foundation bolts:	4nos.
PCD of foundation bolts:	200
Type/diameter/length of found At bolts:	TS600/20mmdia/600mmlong



1.14 Lightning Protection System

1.14.1 The Indian Standard specifications and Codes of Practice will apply to the equipment and the work covered by the scope of the contract. Wherever appropriate Indian Standards are not available, relevant British and/ or IEC Standards shall be applicable.

1.14.2 It is to be noted that updated and current Standards shall be applicable even though those are listed below. Code of Practice for the protection of buildings Structures against Lightning IS2309:1989, IS/IEC62305 Code of Practice for Earthing IS3043:1987

1.14.3 The Lightning Protective System shall comprise of Air Terminations, Down Conductors, Earth Terminations etc. as required. The System shall preferably use the same conducting material throughout and will comply to the detailed specifications as detailed here in after. The entire lightning system should be mechanically strong to withstand the mechanical forces produced in case of a lightning stroke. The system shall be designed as per NBC/CPWD specifications.

1.14.4 Materials

The materials of which the protective system is composed shall be resistant to corrosion or be adequately protected against corrosion. The material shall comply with the following requirements:

1.14.4.1 Copper - When solid or stranded copper wire is used, it shall be of the grade ordinarily required for commercial electrical work and generally designated as being of 98% conductivity when annealed, conforming to Indian Standard specifications.

1.14.4.2 Galvanized Steel - Galvanized steel used shall be thoroughly protected

against corrosion by hot dipped Zinc coating. The material coating shall withstand the test specified in 182309:1968. The strips to be used shall be in maximum lengths available as manufactured normally, avoiding unnecessary joints.

1.14.5 AIR Terminations

1.14.5.1 Vertical Air Terminations

Vertical air terminations shall comprise of finials made of 25 mm dia. GI tube with multiple prongs at the top. Vertical terminations wherever provided shall project 30cms above the projects alien pointor network on which it is fixed

1.14.5.2 Horizontal Air Terminations

Horizontal air terminations should be so interconnected that no part of the roof is more than 9.0 meter away from the nearest horizontal conductor. For a flat roof, horizontal air termination along the outer perimeter of the roof is to be used . For a roof of larger area, a network of parallel horizontal conductors shall be installed. Horizontal air terminations should be coursed along contours such as ridges, parapets and edges of the flat roofs and wherever necessary, over flat surfaces in such away as to join each air termination to there stand should them selves form a closed network.

All metallic finials, chimneys, duct, vent pipes, railings, gutters, and the like on or above the main surface of the roof of the structure should be bonded to and form part of the air termination network.

1.14.5.3 Down Conductors

These shall be distributed around the out sidewalls of the structure and shall preferably be run along the corners and other projections. Lift shafts shall not be used for fixing the down Conductors.

The routing of the down Conductors shall be such that it is accessible for inspection, testing and maintenance.

1.14.6 Testing Joints And Bends

1. The lightning protective system should have as few joints in it as possible.
2. Wherever joints in the down conductor above ground level are necessary, they shall be mechanically and electrically effective.
3. In the down conductor below ground level there shall be no joints.
4. The joints may be clamped ,screwed, bolted, riveted, brazed or welded . Bolted joints should be used on test points or on bonds to existing metal.
5. Each down conductor should be provided with a testing joint in a position convenient for testing but in accessible.

1.14.7 Fasteners

Conductors shall be securely attached to the building by fasteners which shall be substantial in construction, not subject to breakage. These shall be of galvanized steel or other suitable materials with suitable precautions to avoid corrosion. The method and nature of the fixing should be simple, solid and permanent . The lightning conductors shall be secured at not more than 1.20m apart for horizontal run and 1.00m for vertical run.

1.14.8 Earth Termination

All down conductors shall have earth termination to the structural Earthing done to the building and all earth terminations should be interconnected through the structural earthing system.

1.14.9 Earth resistance

The whole of the lightning protective system should have a combined resistance to earth not exceeding 5 ohms before any bonding has been effected to metal or on a surface or to surface below ground.

1.15 LED-Based Aviation Obstruction Warning Light

Supplying, Installation of Two or more steady-burning red Aviation Obstruction lights suitable for 230V, single phase, AC supply diagonally or on diametrically opposite positions to ensure an unobstructed view of one or more lights by a pilot.

1.15.1 Features:

- i. LED Warning Light shall be a “fit - and-forget” solution that utilizes the latest In P LED technology to eliminate hazard and frequent replacement.
- ii. Aviation Obstruction Light (AOL) shall be made by utilizing highly reliable high luminosity LEDs to offer the following features:
 - a) Long life of 1,00,000 hours (on continuous burning basis), thus requiring further replacement on ceffitted.
 - b) Low power consumption of 10 to 15 watts only, giving significant reduction in energy costs.
 - c) Solid-state reliability; built-in fail-safe feature due to parallel circuits.
 - d) Shock-proof, vibration-resistant construction.
 - e) Ability to withstand voltage fluctuations.
 - f) Improvement in power factor.

1.15.2 Construction and other details.

The AOL shall have multiple-LED units fitted in an LM-6 alloy cast metal AOL body and covered with thick clear glass cover. The AOL unit shall have In P technology LED design giving total 360° (integrated) luminous intensity (of all LEDs nominal 300cd), resulting in a signed radial (directional) intensity of 15cd (average) in any direction in the horizontal plane.

1.15.2.1 Physical Data Enclosure : Model ‘A’ design Protection: Weather proof IP65 Construction: Cast metal LM-6 alloy

Gasket: Endless neoprene Cable entry: ET19mm

Terminals: Fitted in a weather proof box on the body of the unit, Earth terminal shall be provided externally

1.15.2.2 Light Service Data

LEDs: Multiple In P technology LEDs Colour: Red (wave length: 615-650 nm) Total designed integrated candela: 300 candela nominals, resulting in a signed radial (directional) intensity of 15-18cd in any direction in the horizontal plane

1.15.2.3 Electrical Data

Each unit shall be tested at 280VAC (20% over voltage) for 100 hours or seven days to ensure reliability. This also serves as a test for verification of use of In P Technology LEDs, as well as for a technically sound circuit design.

1.15.2.3.1 Typical power consumption: 15W maximum at 230VAC.

- 1.15.2.3.2 Input voltage variability: shall withstand a fluctuation of $\pm 25\%$.
- 1.15.2.3.3 PIV protection: LEDs shall be internally protected against reverse voltages of upto 1kV.
- 1.15.2.3.4 Insulation resistance: 10 M Ω at 500VDC
- 1.15.2.3.5 Dielectric strength: 2.5kV
- 1.15.2.3.6 Spike Protection: Surge protectors shall be provided.
- 1.15.2.3.7 EMI/RFI Protection: Filter shall be incorporated for protection against electro magnetic and radio frequency interference and random line noise.
- 1.15.2.3.8 Flashing Requirement: The light shall be supplied with a flasher for operating in flashing mode for warning indication. The flasher circuit shall be placed externally to the lighting unit, in an indoor environment.

1.16 Structural Earthing PME System

All the Buildings shall have integrated earthing which shall be suitable for all purposes (i.e., Lighting protection, electrical systems, telecommunication systems). This earth termination system shall be connected to the main equipotential bonding bar of the building. Thus, all the buildings shall have foundation /structural earthing system. Necessary coordination shall be done with structural earthing Agency in this regard.

The Lightning protection system and the foundation earthing system are the integral part of the building reinforcement/ Structure. Therefore, it is necessary that the agency for the Structural earthing be decided well in advance so that the reinforcement drawing shall incorporate the foundation earthing design also. The Structural earthing shall be carried out by an authorized and certified agency of the approved makes given in the list of preferred makes. Proper documentation shall be submitted for approval of the engineer-in-charge before this work is carried out.

Earthing system shall confirm the following regulation and standards

- CEA regulations for Measures relating to Safety and Electric Supply 2010 IS 3043, IS732:2019, NEC:2011(SP30)&NBC2016
- TN-S system with PME-Double earthing

Earthing for safety, voltage reference, shielding and lightning current dissipation shall confirm the requirement as per the above standards. TN-Switch double earthing for transformer, electrical panels and major equipment satisfying IS3043, IS732, IEC60364

Earthing shall satisfy the requirement of PE conductor, Supplementary PE and reduce resistance less than 50ohms, Less than 10ohms and less than 0.2ohms depending upon the application as per the above standards. Earthing shall include type B Earthing for Lightning Protection and provisions to make STAR/MESH/ RING/ IBN or other defined earthing topologies for IT enabled areas/buildings

The earthing system shall ensure that protection is achieved in the prescribed time

specified in IS732. After completion of the electrical installation, resistance need to be measured for each panel / equipment and need to be recorded to ensure safety. Earthing and Structural bonding system shall confirm to the requirements of IS/IEC 62305 (all parts) as well as NBC2016.

Structural bonding system consists of an additional conductor installed inside an RCC column along with structural steel. The grid thus formed shall be used for the interconnection of PE conductor with the structure and shall reduce over voltages due to fault inside the building. The conductor shall be of continuous length from basement to the top of the building. This conductor shall support the electrical installation and act as supplementary PE conductor. Sizing of the conductor shall be as per the loop resistance/fault current requirement of the installation confirming the standards. The conductor shall have minimum joints and all joints shall be exothermically welded for application in soil and under foundation. Clamp joints are permitted only inside concrete / exposed in air. All conductors for this purpose shall be copper coated and the coating thickness of conductor shall confirm to NBC-2016 and shall be minimum 100 microns.

Exothermic weld shall confirm the requirements of IEEE 837:2014. Every component used shall be able to withstand the fault current with minimum temperature rise.

The earth studs shall be 100 % corrosion resistant and shall confirm the requirements of IEC 62561.

- 1.17 Earth Conductor & Earth Stud: The earth conductor (e.g. - 10 mm round) sizes specified based on lightning protection and 18mm round based on transformer short circuit level. Copper coated steel tested to IEC 62561 shall be used as dedicated earth conductor in concrete as well as ring earth in case if the foundation has water proof plastic membrane. Earth studs are for the purpose of bringing the electrical connection between structural steel with other steel installations in the building. Both earth conductor as well as earth stud shall be corrosion resistant and shall be tested acc. to IEC 62561. Earth stud shall be connected to earth conductor by exothermic welding.

1.17.1 Earth Conductor for soil and in concrete.

- a) 10mm round conductor SRC10-CU for applications like Lightning protection, Panel and equipment earthing.
- b) 17-25 mm round conductor for applications like generators, Transformer and Panels area only.
- c) Exothermic Weld for all inter connections in soil

1.17.2 Earth Studs:

- a) Corrosion-free SS earth stud (Irms: 5kA per sec)
 - b) Corrosion-free SS earth stud (Irms: 8kA per sec)
 - c) Corrosion-free SS plate with copper terminals of earth stud (Irms: 28kA per sec)
 - d) Corrosion-free SS plate with copper terminals of earth stud (Irms: 40kA per sec)
- 1.17.2 8 to 10mm suitable for 16 to 32 mm steel reinforcing rod for Equipotential bonding purpose.
- 1.17.3 Straight connector used for 17-25mm copper bonded steel ROD Floor to floor inter connection for electrical panels purpose
- 1.17.4 Cross Connector used for mesh junction for Electrical room and DG areas
Straight connector used for 10mm copper bonded ROD floor to floor inter connection for Lightning protection purpose
- 1.17.5 Cross Connector used for mesh junction for Lightning protection at terrace
- 1.17.6 Diagonal clamps used for inter connection of earth studs with 10mm Conductor

and reinforcement steel.

1.17.7 Execution:

1.18 Building with plastic waterproof membrane: The installation needs to be carried out Before installing the waterproof membrane, preferably below PCC. The earth conductor shall run under waterproof membrane as a grid of 10 meter by 10 meter. The grid shall be extended up to floor level out side the plastic membrane at every 10 meters. All joints shall be exothermically welded and in addition wrapped with corrosion protection bandage. Puncturing of water proof membrane is not permitted in case if this “under foundation earthing” is not carried before laying the waterproof membrane. Alternatively ring earthing with vertical earth electrodes at floor level can be done with special care. At floor level / above water proof membrane, the conductor shall be connected to Steel in RCC columns, plinth beams.

1.18.1 Buildings with foundation other than raft/mat foundation: the earth conductor shall run throughout the interconnected plinth beam. Plinth beam at the outer wall / perimeter of the building shall have earth studs at every 10 meters for the purpose of ring earthing interconnections.

1.18.2.1 Grid Sizing: The earth grid design shall satisfy NBC-2016 (5meter* 5metergrid) for improvement of the Earth termination system in a power source like: Transformers and Generators.

1.18.2.2 Down Conductor for Lightning Protection as well as Bonding conductor for electrical installations (RCC Building): The dedicated copper coated 10 mm solid round conductor shall run inside columns on the periphery of the building and must be connected to there in forced steel available in the columns will serve the purpose of down conductor for lightning protection as well as base for Equipotential bonding in every floor of a multistoried building. If the distance between 2 columns is lesser than 5 meters, alternate columns shall be selected to route the down conductors. If the distance is more than 10 meters, all the columns shall be used for down conductor routing.

Provisions for interconnection of metal frame of wall cladding shall be provided at every 5 meters in vertical and horizontal sections based on the architectural design.

1.18.2.3 Earthing for safety of LV network: Additional earth studs need to be installed in places where electrical panels & electronic equipment is installed. All electrical rooms as well as every floor level in electrical shaft must have a local Equipotential bonding earth stud extended from the structural earthing. Sizing of earth stud for electrical room shall be based on the short circuit current requirements of the electrical system considering TN-S network. In addition, earth studs for the purpose of testing the efficiency of protection system shall be provided in easily accessible places at top and bottom of the building at every 20 meters around the periphery of the building.

1.18.2.4 Testing of Down conductor: Structural earthing used as a part of lightning protection system, overall resistance shall not be more than 0.2 ohm when measured between the air termination and the earthing test point provided at the ground level.

1.18.2.5 Testing of Earth conductor as supplementary PE: Structural earthing used as supplementary PE conductor, overall resistance of each stud shall be measured, fault clearance time of switchgear need to be established and expected heat generation in cables as well as earth stud / conductors during a fault has to be calculated.

- 1.18.2.6 Air termination system: Air termination system (Horizontal/Vertical) in the roof shall be according to Lightning Protection Level specified in NBC 2016. The air termination system consisting of vertical rods and/or mesh shall be connected to the structural conductor through earth studs provided at the parapet/ columns of the building. For this purpose, sufficient earth studs with provision of mechanically strong connection need to be provided at the parapet / wall / column at the top of the building. Air termination system shall be installed strictly after completion of the installation of all roof mounted electrical/metal installations.

For building with metal roof, the air terminal shall be directly connected to the steel roofing sheet with special leak proof screws. Bonding of roof steel and structural support columns shall be ensured by installing braided wires at every 10 meters.

- 1.18.2.7 Installation, Testing and Certification : The Earth studs type test reports to be submitted for IRMS value tested in CPRI/ERDA to be submitted.

The total installation needs to be carried as per IS/IEC 62035. The installation must also be tested and certified by a qualified lightning protection expert as specified in IS/IEC 62305.

Minimum Requirements of power plug & 3 phase supply in the furniture of laboratories and other structures of Admin-cum-Lab building (As per Annexure - A)

Location	Name of Lab	Nos. of Lab	3 Ø supply 32 AMP TPN		6/16 Amp Power Points	
			Nos. of Points in each lab	Total points	Nos. of Points in each lab	Total points
G.F.	CIF Labs	2	6	12	100	200
2nd Floor	Core Labs	4	2	8	160	640
	Sample Preparation	4	1	4	40	160
	Sterilization Room	1	2	2	24	24
	Cold Room	1	1	1	10	10
3rd Floor	Core Labs	4	2	8	160	640
	Sample Preparation	4	1	4	40	160
	Sterilization Room	1	2	2	24	24
	Cold Room	1	1	1	10	10
4th Floor	Core Labs	4	2	8	160	640
	Sample Preparation	4	1	4	40	160
	Sterilization Room	1	2	2	24	24
	Cold Room	1	1	1	10	10
5th Floor	Core Labs	4	2	8	160	640
	Sample Preparation	3	1	3	40	120
	Sterilization Room	1	2	2	24	24
	Cold Room	1	1	1	10	10

6th Floor	Core Labs	4	2	8	160	640
	Sample Preparation	2	1	2	40	80
	Sterilization Room	1	2	2	24	24
	Cold Room	1	1	1	10	10
	Cell Culture Lab	1	0	0	40	40
	Fermentation Lab	1	2	2	40	40
	Total			86		4330

C-2 Fire Fighting System

2.0 Technical Specifications of Firefighting System

2.1 The scope of work consists of Planning, designing, Supply ,installation ,testing and commissioning of **Fire fighting system with wet riser & Sprinklers for the the Admin cum Laboratories buildings i/c all other service buildings and down comer system in Farmers training Hostel ,Water curtain systems wherever required, Gas suppression system for server rooms , Electrical panels and other relevant areas of the building as per NBC 2016** and Any material or accessories which may not have been specifically mentioned but are necessary for satisfactory operation and maintenance of the equipment, shall be furnished by the Contractor. These technical specifications shall be read along with the General Conditions for all E&M works given under subhead C-B.

2.1.1 Conformity With Statutory Acts Rules, Orders, Standard sand Codes

- a) All components and their installation shall conform to relevant Indian Standard Specifications, wherever existing.
- b) Designing of the system shall be done as per NBC-2016, CPWD General Specification for Electrical Works (Wet Riser)-2020, and local bye laws. Municipal Regulations of the city shall also be taken into consideration while selecting and designing firefighting system.
- c) Contractor shall obtain approval of the installation from the local fire authorities as may be required as per local bye-laws at all stages before and on completion of the installation work. The contractor shall pass on these approvals to the department. Any statutory fee paid to the Government / Municipal Authorities/ Statutory Bodies etc. for obtaining approvals and shall be reimbursed to the contractor on submission of documentary proof.
- d) 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. The entire installation shall be such as to cause minimum transmission of noise and vibration to the building structure.

2.1.2 Drawings for approval on award of the work

The contractor shall prepare and submit the following drawings and get them approved by the Engineer-in-charge before the start of the work. The approval of drawing show ever does not absolve the contract or of his responsibility to supply the equipment /materials as per agreement. In case of any contradiction between the approved drawings and agreement, the decision of the Engineer-in-Charge shall be final and binding on the contractor.

- (a) Layout drawings of the equipment to be installed in the pump room and terrace .Drawings showing the details of erection of entire equipment including their foundations.
- (b) Drawings showing the layout of entire piping, diameter and length of pipes, hydrant, air vessel, valves and isometric drawings showing connections to various equipment
- (c) Sprinkler drawing indicating layout and sizes of pipe, location of valves, sprinklers etc.
- (d) Electrical wiring diagrams for all electrical equipment and controls including the sizes and capacities of the various cables and equipment.

- (e) Drawings showing details of supports for pipes, cable trays, any other drawing(s) relevant to the work.

2.1.3 Documents To Be Furnished on Completion of Installation

Five sets of the following drawings shall be submitted by the contractor while handing over the installation to the Department. Out of this one set shall be laminated on a hard base for display in the fire control room. In addition, soft copy shall be given by the contractor.

- (a) Installation drawings giving complete details of all the equipment, sizes and lengths of all the pipes, sizes and locations of all types of valves, including drawings for the entire piping including the pipe connections to the various equipment.
- (b) Line diagram and layout of all electrical control panels giving switchgear ratings and their disposition, cable feeder sizes and their layout.
- (c) Manufacturer's technical catalogues operation & maintenance manuals of all equipment and accessories.

Before occupation, the building is to be inspected by the representative of Chief Fire Officer and local bodies. The building will be issued N.O.C. for occupation only when all safety provisions including firefighting work are complete to the satisfaction of Fire Officer. As such, firefighting work is to be completed and commissioned with temporary power supply well before other building works and services are completed.

2.1.4 Guarantee

- a) The contractor shall guarantee the complete system to provide the specified flow and pressure under all conditions at outlets.
- b) All equipment shall be guaranteed for a period of 12 months from the date of acceptance and taking over of the installation by the Department against any 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.

2.1.5 System Components for water based fire fighting system:

Following types of fixed firefighting installations are to be provided in the buildings:

- (i) Wet Riser
- (ii) Yard Hydrant
- (iii) Automatic Sprinkler
- (iv) Downcomer
- (v) Fire Extinguishers

Firefighting system shall comprise supply, installation, testing and commissioning of components as mentioned below.

- i. Electric Motor Driven Fire Pumps-2Nos.

- ii. Diesel Engine Driven FirePumps-1No.
- iii. Pressurization Pumps-2Nos.
- iv. Vertical risers in the building
- v. Pipe network inside the building to be protected with Sprinklers
- vi. External pipeline around the building and ringmain on the terrace.
- vii. Internal Hydrants, Yard Hydrant (External Hydrants)
- viii. First-aid hose reel, Hose Pipe and Branch Pipe.
- ix. Air Vessels.
- x. Fire Service Connections, Fire Service Inlet.
- xi. Control components like pressure switches, flow switches level indicator, alarm etc.
- xii. Electrical Power and Control Panel with cable and earthing etc.
- xiii. Pipe line accessories i.e., Butterfly/Sluice Valves, Non-Return Valves etc.
- xiv. Dewatering pumps, one set in Water Supply Pump House shall be provided. Each set shall consist dewatering pumps of suitable capacity(1working+1Standby).

2.2 The following factors shall be taken into consideration while designing various components.

2.2.1 Wet Riser

- a) Pressure at the hydraulically remote hydrant and at the highest hydrant shall not be less than 3.5 kgf/ cm². The pressure at any hydrants shall however not exceed 7kgf/cm².
- b) The pipe line shall be designed in such away that it should be possible to get a discharge at any location. Design parameters shall be as under:-
 - (i) Maximum flow velocity: 2.5mps
 - (ii) Maximum Friction: 5m per 100m run The size of wet risers shall be 150mm.
- c) Main Fire Pumps (Both electrical as well as diesel) shall be selected for:
 - i. Discharge : 2280 lpm for Wet Riser & Sprinkler
1650 lpm Water-Curtain
 - ii. Head : As per NBC 2016 Specification
- d) Pressurization pump (Jockey Pump) shall be selected for:
 - I. Discharge: 180 lpm
 - II. Head: As per NBC 2016 Specification

Number of risers shall fulfil that, no corner of the building is farther than 30 m from the nearest riser. Horizontal distance between two risers shall not be more than 50 m. Minimum one riser shall be provided for every 1000sq.m of plinth area or part there of.
- e) However, the number of risers can be suitably increased to meet the given situation.

2.2.2 Internal Hydrant: Every riser shall be provided with the following at every floor including terrace over and above sprinkler system.

- (i) Single-headed outlet-2Nos.
- (ii) First Aid Hose Reel-1No.
[Length of pipe shall be such that nozzle of the hose can be taken into every room and within 6 m of any part of the rooms keeping in view layout and obstruction.]
- (iii) Hose Pipe 63mm dia, 15m long with male and female coupling at ends.
-2Nos.
- (iv) Branch pipe 63mm dia with 20mm nominal internal diameter nozzle and Suitable for instantaneous connection.-1Nos.

2.2.3 Yard Hydrant (External Hydrant)

- a) For connecting yard hydrants, a ring of pipe shall be laid underground around the building at a minimum distance of 2m but not more than 15m from the face of the building. All internal risers shall be connected with this ring. The yard hydrants shall be easily accessible and should normally be provided near the boundary wall/along the road. While locating yard hydrants it should be ensured that same do not become a hindrance in vehicular movement or entrance to the building. Yard hydrants should be located around the building in such a way that it should be possible to fight the fire on any face of the building from the nearest hydrant. At least one hydrant post shall be provided for every 45m.
- b) Fire Hydrants shall be of stand post type conforming to IS 908. All Yard hydrant outlets shall be situated 1 m above ground level. The hydrant couplings shall be of the instantaneous spring-lock (female) type of 63mm diameter and valves shall be of the screw-down type.
- c) Suitable pressure reducing devices shall be provided for the yard as well as internal hydrants where the pressure exceeds 7 kgf/cm², considering the safety of operators. All hydrants should be painted red and serially numbered.
- d) Each yard hydrant shall include the following accessories
 - I. Connection from the ring main with 80mm dia MS pipe
 - II. 63mm dia single head landing valve -1No.
 - III. Butterfly/slucie valve 80mm dia -1No.
 - IV. Hose pipe 63mm dia 15m long with male and female coupling at ends -2 Nos.
 - V. Branch pipe 63mm dia with 20mm nominal internal diameter nozzle, suitable for instantaneous connection-1No.
- e) All above Components shall be housed in a suitable size MS cabinet made from a 2 mm thick sheet with a glass panel on the front. The cabinet shall be painted red.

2.2.4 Fire Service inlet: In order to facilitate feeding of water in the system by fire service, a 3-way 63 mm diameter collecting head shall be provided and connected with each riser and the ring main with non-return valve and butterfly/slucie valve. This should be located at a place where fire brigade tender can reach.

2.2.5 Fire Service connection: It is for feeding water to underground storage tank by fire tenders. The static water storage tank shall be provided with a fire brigade collecting head with 4 number 63 mm diameter instantaneous male inlets arranged in a valve box at a suitable point at street level. If tank is not approachable for the fire engines, the fire brigade collecting head shall be connected to the static tank by a suitable fixed galvanized iron pipe not less than 150 mm in diameter to discharge water into the tank.

2.2.6 Fire Brigade draw out collecting head: Each of the static water storage tanks shall also be provided with a fire brigade draw out collecting head with 63mm diameter instantaneous male draw out arranged in a valve box at a suitable point at street level. This draw out shall be connected to a galvanized iron pipe of 100 mm diameter with foot valve arrangement in the tank.

2.2.7 Air Vessel: - To counteract the water hammer effect, air vessel shall be provided at the top of each riser.

2.2.8 Orifice Plate: - Suitable pressure reducing devices shall be provided for yard as well as internal hydrants to control pressure to desired limit especially at lower-level hydrants. The size of orifice shall be calculated as per IS/ CPWD specifications.

2.2.9 Alarm for Wet Riser System: - To indicate the flow of water in the system, turbine type alarm shall be provided at a prominent place outside the pumphouse in the mainline before any connection is taken. The alarm will indicate the healthiness of the system and shall not be silenced till the main fire pump is in operation.

2.2.10 Control system

The system shall be designed for operation automatically so that as and when water is drawn from the system through any hydrant, the pumps will operate automatically and feed water in to the system. However, once a fire pump starts working, it will be stopped only manually (except jockey pump). Facility shall also be provided for manual operation. A selector switch for auto/manual selection shall be provided for each pump.

The control system shall be designed to provide the following sequence of operation:

- i) The Pressurization Pump shall maintain pressure in the system and shall operate only on account of slow pressure loss. In case of sudden pressure loss, the Pressurization Pump shall not operate. The pump shall start when the water pressure in the system falls to a pre-set value and shutdown when the system pressure reaches the set value. Both limits shall be adjustable.
- ii) Main Electric Fire Pump shall operate on account of sudden pressure loss. As long as Main Electric Fire Pump is working, other Fire Pumps shall not operate. The pump shall start when the water pressure falls to a pre-set value in the system (about 1 kgf/cm^2).
- iii) In case, Normal Electric Supply fails while the Main Electric Fire Pump is running, the DG Set for essential supply will start within 5 seconds.
- iv) The Diesel Fire Pump shall start on sudden pressure loss, only in case supply to Main Electric Fire Pump is not available or within a pre-set time the Main Electric Fire Pump fails to start or fails during operation. No other pump shall work when Diesel Engine Fire Pump is in operation. Audio-Visual Alarm shall be available to indicate failure of Main Electric Fire Pump.
- v) Three attempts starting facility shall be provided for the diesel pump. If within a pre-set time, the stand by pump also fails to start or fails to develop pressure, the standby pump shall also be shut down and locked out. An audio-visual alarm indication shall be given at the control panel.
- vi) For sprinkler pump:
 - a) Sprinkler jockey pump shall start on pressure loss in the sprinkler header.
 - b) If Sprinkler Jockey pump does not start in preset time or fails during operation, the main electric fire pump shall start and feed water to sprinkler system.
 - c) Diesel pump will start and feed water only in case supply to Main Electric pump is not available or within a preset time the main electric pump fails to start or fails during operation. No other pump shall work when diesel pump is in operation. Audio-visual alarm shall be available to indicate failure of Main Electric pump.
- vii) Only one pump shall work at a time. In manual mode more than one Pump can be started.

- viii) Water level in UG and terrace tanks shall be monitored and in case of low water level, pumps connected with the tank shall not operate (even on manual mode) or stop operation as the case may be. An audio-visual alarm shall be given at the control panel.

2.2.11 Wet Riser: -Wet Riser shall be interconnected at terrace level to form a ring and cut-off shall be provided for each connection to enable repair/maintenance without affecting rest of the system.

2.2.12 Following provisions/spaces are required for firefighting system:

Pump House for installation of firefighting pumps (Main Electrical Pumps, Diesel Engine Driven and Pressurization Pumps) along with Electrical & Control Panel, valves, diesel tank etc., pump house is required. Following factors are to be considered:

- (i) Suitable ramp with proper slope and/or cutout in roof shall be provided for lowering the equipment in to the pump house. Stair case with entry door at ground level and locking arrangement shall be provided.
- (ii) Adequate ventilation for dissipation of heat due to operation of motors/engine shall be provided.
- (iii) Proper water proofing shall be provided. A sump of size 0.6m x 0.6m x 0.3m with 1 (Working) + 1 (Standby) dewatering pumps shall be provided in the pump house in one corner adjacent to the tank wall. The floor slope will lead towards the sump so that water leakage, if any can be pumped out.
- (iv) In order to ensure that there is no leakage of water in the pump house, no pipe/ cable shall cross the pump house below ground level. Suitable opening in wall above ground level shall be provided for crossing of pipes/cables.
- (v) Installation of negative suction arrangement and submersible pumps shall not be allowed.

2.2.13 Internal Hydrant - Internal hydrants are provided to fight fire from within the building. Following factors are considered for deciding location of internal hydrant:

- (i) Internal hydrants shall be provided at every floor at the same location and connected with risers.
- (ii) Hydrant for firefighting shall be located in the lobby in firefighting shaft. Those hydrants planned to be provided near fire exit staircase on the floor shall be within 5m from exit door in exit access.
- (iii) Numbers and location of risers shall be decided to fulfil the conditions stated earlier.
- (iv) Every wing of the building shall preferably be provided with independent hydrants. Hydrant shall be located in the center of the building so that one hydrant can cover area on both sides.
- (v) A masonry enclosure on three sides minimum 1200 mm wide and 800mm deep and 2100 mm height size shall be provided. Two Cut-outs of 200 mm x 200 mm size be provided in one corner in the slab for wet riser and sprinkler pipe. If sprinkler installations are to be provided, additional cut out of similar size for sprinkler pipe and drain pipe as the case may be, shall be provided. Steel shutter with 1250 mm glazing on top with locking arrangement shall be provided in front of the hydrant. The shutter shall be painted red.
- (vi) Internal hydrant shall be easily accessible. A clear space of at least 1.5 m should be available in front of the internal hydrant for operation. Internal hydrant shall not be provided in a lockable room.
- (vii) Internal hydrant shall be clearly marked with the inscription of "FIREHOSE CABINET" of letter size 75 mm in height and 12mm in width by luminous sign.

Suitable lighting arrangement shall be provided in front of the internal hydrant. The location of such cabinet shall be shown on floor plan and duly displayed in the landing of the respective fire exit staircase.

2.2.14 Drainage

Drain traps in pump room shall be made by the agency/ contractor only. Piping Connections from the equipment to the drain trap shall be done by the contractor.

2.2.15 Paint

The entire piping work along with fire pumps, Motors & Engines shall be painted with red color shade No. 536 of IS 5.

2.2.16 Building to be Sprinkler Protected

The sprinkler pipes are installed throughout the area to be protected. The structure shall be designed to support sprinkler pipes and the contained water. Inbuilt drainage with slope shall be provided throughout the area so that in the event of operation of sprinkler, water is drained out without spreading to other parts of the building. Storage racks/platforms shall be sufficiently raised above floor. It is essential to make provisions for avoiding water from Sprinkler/ hydrant operation entering lifts and electrical rooms.

2.3 Fire Control Room

A fire control room shall be provided on the entrance floor of the building.

Fire pumps shall be provided with positive suction and automatic starting devices capable of sequential starting of the pumps.

Insertions like flexible couplings/ connections, bellows, etc., in the suction and delivery piping shall be suitably planned and installed.

- (i) Pipe connecting pump house to ring main shall not be less than 150mm diameter. Higher size pipe shall be selected depending up on length of pipe and friction loss. Size of Ring main and Risers shall not less be than 150mm diameter.
- (ii) Fire service inlet and fire service connection shall be with pipe of size not less than 150mm diameter.
- (iii) All Tee off connections for landing valves from vertical risers and for external hydrants from ring main shall be with pipe size not less than 100mm diameter.

2.3.1 Selection of Material:-Components like landing valve, hose coupling branch pipes etc. are to be made of Gunmetal.

2.3.2 Hose Pipes/ Branch pipes: - A minimum of two number of 63 mm diameter, 15 m long hose pipes with instantaneous coupling at both ends and one number branch pipe with nozzle shall be kept with every internal and external hydrant.

- a) During Construction of under ground tank, 4 Nos. 200 mm diameter MS -C Class pipes with flanges on both sides shall be embedded for connection with suction header of the fire pumps. The pipe shall be extended at least 100mm on wall.
- b) The under ground tank and Pump house shall be tested for any leakage/seepage before start of the work. It shall be ensured that both tank and pump house are free from leakage /seepage.
- c) The work of laying of pipe for sprinkler's should be taken up in coordination with the duct installation.

- d) The sprinkler pipes should be tested area wise and capped for connection to pipes of adjoining area.
- e) The route of external pipe i.e., pipe from pump house and ring main should be decided in coordination with other building services.
- f) For laying of external pipes, excavation upto a depth of 1.25 m or more is to be carried out. External pipes shall therefore be laid in a phased manner in coordination with other agencies. The pipes shall be tested and earth filled back before excavation for next phase is taken up. Equipment for testing etc. should be made available in advance before start of under ground pipe laying work.

2.4 Fire Pumps

Pumps conforming to IS 12469 shall be used for Firefighting purposes. The pumps shall be centrifugal type direct driven with a 3 phase, 415V $\pm$ 10%, 50 Hz, A.C. motor. The standby fire pump shall be driven by diesel engine. The pumps shall be of horizontal split casing (HSC) type with operating speed not exceeding 1500rpm.

The main fire pump and terrace pump shall be suitable for continuous operation in the system. The jockey pump shall be suitable for intermittent operation to build-up pressure in the system on account of leakage, if any. The head shall be suitable for the system and shall take into consideration the pressure drops across the various components in the water circuit as well as the frictional losses.

The rated discharge of Electric Driven and Diesel Engine Driven pump for wet riser and sprinkler system shall be minimum 2280 lpm. Pump shall be capable of discharging not less than 150 percent of the rated discharge at a head of not less than 65 percent of the rated head. The shut off head shall not exceed 120 percent of the rated head in the case of horizontal Pumps.

2.4.1 Material and Construction

- a) The pump casing shall be of 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.
- b) The impeller shall be of bronze, shrouded type with machined collars. Wear rings shall be of the same material as the impeller. The impeller surface shall be smooth finished for minimum frictional loss. The impeller shall be secured to the shaft by a key.
- c) The shafts shall be of stainless-steel and shall be accurately machined. The shaft shall be balanced to avoid vibrations at any speed within the operating range of the pump.
- d) The bearings shall be suitable for the duty involved. These shall be grease lubricated and shall be provided with grease nipples/ cups. The bearings shall be effectively sealed against leakage of lubricant or entry of dust or water.
- e) The shaft seal shall be mechanical type, so as to allow minimum leakage. A drip well shall be provided beneath the seal.
- f) The pump shall be directly coupled to the motor/diesel engine shaft through a flexible coupling protected by a coupling guard.
- g) The pump and motor/diesel engine shall be mounted on a common robust bed plate fabricated from mild steel section. The bed plate shall have rigid, flat and true surfaces to receive the pump and motor/diesel engine mounting feet. The pump shall be perfectly aligned with the motor/ engine to avoid any vibration during operation at all variations of load.

2.4.2 Accessories

Each pump shall be provided with the following accessories:-

- a) Sluice valves on suction and delivery.
- b) Reducers, as may be required to match the sizes of the connected pipe work.
- c) Non-return valve at the delivery.
- d) Pressure gauge at delivery side between pump and the non-return valve.
- e) Flexible coupling/ connections shall be provided between Pump sets and Valves on suction and delivery sides of all the pump sets.
- f) No butterfly valves shall be installed inside the pump room.
- g) The size of the non-return valve and cut off (Sluice valve) shall not be less than the size of the initial delivery pipe.

2.4.3 Installation

- a) The pump and motor/engine assembly shall be mounted and arranged for ease of maintenance and to prevent transmission of vibration and noise to the building structure or to the pipe work. The pump and motor/engine assembly shall be installed on suitable RCC foundation. The length and width of the foundation shall be such that 100mm space is left all around the base frame. The height of foundation shall be so decided that the total weight of foundation block is 1.5 times the operating weight of the pump assembly. The foundation shall be isolated from the floor by vibration isolating pads. Angle iron frame of size 35 mm x 35 mm x 3 mm shall be provided on the top edges of the foundation.
- b) More than one pump and motor assembly shall not be installed on a single base or cement concrete block.
- c) The suction/discharge pipe shall be independently supported and their weight shall not be transferred to the pump. It should be possible to disconnect any pump for repairs without disturbing the connecting pipeline.
- d) A minimum clearance of 1 m around the main pumps shall be provided. For jockey pumps clearance of 75cm shall be adequate.
- e) Sufficient space is to be left in front for the radiator of diesel engine for free discharge of hot air. Arrangement for discharging hot air to outside of the pump house shall be provided, so that hot air does not stagnate in the pump house.

2.5 Diesel Engine for Fire Pump

The diesel engine shall be suitable for automatic operation complete with necessary automatic starting gear, battery system and shall be complete with all accessories. Both engine and pump shall be assembled on a common bed plate, fabricated from mild steel channel.

The pump shall be only direct driven by means of a flexible coupling. The coupling between the engine and the pump shall allow each unit to be removed without disturbing the other. Coupling guard shall be provided. The speed shall be 1500 RPM.

2.5.1 Diesel Engine

The engine shall be multi-cylinder 4 stroke cycle, water cooled, developing suitable HP at the operating speed specified to drive the fire pump. Continuous capacity available for the

load shall be exclusive of the power requirement of auxiliaries of the diesel engine, and after correction for altitude, ambient temperature and humidity for specified environment conditions. The engine rating shall be suitable to drive the pump at 150 percent of its rated discharge with at least 65 percent of rated head or 20% in excess of the maximum brake horse power required to drive the pump at its duty point, whichever is higher. The engine shall have 10% over load capacity for one hour in any period of 12 hours continuous run.

The engine shall be:

- a) Naturally aspirated, super charged or turbo-charged and rather air or water-cooled.
- b) Provided with an in-built tachometer to indicate rpm of the engine.
- c) Able to develop full load within 15 seconds from the receipt of the signal
To start.
- d) The diesel engine shall conform to BS649/IS1601/IS10002, amended upto date.

2.5.2 Engine Accessories- The engine shall be complete with 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) Air cleaner dry type
- (v) Fuel service tank with necessary pipe work
- (vi) Fuel filter
- (vii) Pump for lubricating oil and lube. Oil filter
- (viii) Electric starting battery 12V/24V.
- (ix) Exhaust silencer with necessary pipe work
- (ix) Governor
- (x) Instrument panel housing all the gauges, including tachometer, hour meter and starting switch with key (for manual starting)
- (xi) Necessary safety controls
- (xii) Winterization arrangement
- (xiii) Hand operated semi rotary pump for filling the service tank
- (xiv) A standard kit of tools (this shall be kept on hand at all times)

2.5.3 The engine shall be radiator water-cooled. The radiator assembly shall be mounted on the engine. The radiator fan shall be driven by the engine as its auxiliary with multiple fan belts. When half the belts are broken, the remaining belts shall be capable of driving the fan. Cooling water shall be circulated by means of an auxiliary pump of suitable capacity driven by the engine in a closed circuit.

2.5.4 The fuel system shall be gravity fed from the fuel tank to the engine-driven fuel pump. The engine fuel tank shall be mounted either adjacent to the engine or suitably wall mounted on brackets. The fuel filter shall be suitably located to permit easy servicing.

The fuel tank shall be of welded steel construction (3mm thick) and of capacity sufficient to allow the engine to run on full load for at least 8 hours. The tank shall be complete with necessary floor mounted supports, level indicator (protected against mechanical injury) inlet, outlet, over flow connections and drain plug and piping to the engine fuel tank. The outlet should be so located as to avoid entry of any sediments into the fuel line to the engine. Any valve in the fuel feed pipe between the fuel tank and the engine shall be placed adjacent to the tank and it shall be locked in the open position.

All fuel tubing to the engine shall be with M.S.'C' class pipe with flexible hose connections wherever required. Pipe joints shall not be soldered and plastic tubing shall not be used.

The following shall be provided:

- i) A sludge and sediment trap shall be provided.
- ii) An inspection and cleaning hole
- iii) Means to enable the entire fuel system to be bled of air (Air relief cocks are not allowed; screwed plugs are permitted)

2.5.5 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.

2.5.6 Starting System- The starting system shall comprise of necessary batteries of 12Volts /24Volts, starter motor of adequate capacity and axle type gear to match with the toothed ring on the fly wheel. Suitable protection to protect starting motor from excessively long cranking runs shall be suitably integrated with the engine protection system.

The capacity of the battery shall be suitable for meeting the needs of the starting system.

The battery capacity shall be adequate for 10 consecutive starts with out recharging with cold engine under full compression.

Three attempts starting facility shall be provided. If the engine fails to start after third attempt, the engine shall be locked out and suitable audio-visual alarm shall be given to indicate engine failure. The starter motor used for automatic starting may also be used for manual starting provided there are separate batteries for manual starting. The scope shall cover all cabling, terminals, initial charging etc.

2.5.7 Exhaust System- The exhaust system shall be complete with residential grade silencer suitable for outdoor installation and silencer piping shall be extended up to 1 m, outside pump house duly insulated with 50 mm thick glass wool and 1.0mm thick aluminum sheet cladding.

2.5.8 Retro fitted emission-control equipment shall be used having a minimum specified PM-capturing efficiency of at least 70%, type approved by one of the five CPCB recognized labs. (Recommendations of National Clean Air Program 2019 launched by Ministry of Environment, Forest and Climate Change)

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

2.5.10 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 up to full load. The governor shall be set to maintain rated pump speed at maximum pump load.

2.5.11 Engine Instrumentation- Engine instrumentation shall include the following:

- (i) Lube. Oil pressure gauge
- (ii) Lube. Oil temperature gauge
- (iii) Water temperature gauge
- (iv) Tachometer
- (v) Hour meter

The instrumentation panel shall be suitably mounted on the engine.

2.5.12 Engine protection devices-Following engine protection and automatic shutdown facilities shall be provided:-

- (i) Low lube. Oil pressure.
- (ii) High cooling water temperature.
- (iii) High lube. Oil temperature.
- (iv) Overs peed shut down

2.5.13 Pipework-All pipe lines with fittings and accessories required shall be provided for fuel oil, lube. Oil and exhaust systems.

2.5.14 Anti-vibration mounting- Suitable vibration mounting duly approved by the engineer-in-charge shall be employed for mounting the unit so as to minimize transmission of vibration to the structure.

2.5.15 Battery Charger-

Battery of diesel engine operated fire pump shall have separate charger from emergency power supply circuit. Necessary float and boost charger shall be incorporated in the control section of power and control panel with manual selection of boost charge, to keep the battery under trim condition. Voltmeter to indicate the state of charge of the batteries shall be provided. Where separate batteries are provided for automatic and manual starting, the charging equipment shall be capable of trickle charging both the batteries simultaneously. Equipment shall be provided to enable the state of charge of the batteries to be determined. The engine installation shall be approved by the representative of engine manufacturer (who shall carry out after sales service under AMC).

The following spare parts shall be supplied with the engine and kept on hand:

- a) Two sets of fuel filters, element sand seals;
- b) Two sets of lubricating oil filters, element sand seals;
- c) Two sets of belts (where used);
- d) One complete set of engine-joints, gaskets and hoses;
- e) Two inject or nozzles;
- f) One complete set of piston rings for each cylinder; and
- g) One inlet valve and one exhaust valve).

2.6 Pipe Work

2.6.1 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 contractor shall incorporate the following:-

- (i) Sluice valves shall be provided at suction and delivery sides of pumps.
 - a) External hydrant
 - b) Fire service connection/inlet.
 - c) Test valve.
 - d) Drain connections.
- (ii) For testing the system healthiness and automatic operation on daily basis, to avoid wastage of water, this pipe shall discharge water in the tank.
- (iii) Non-return valve shall be provided at the delivery of each pump and fire service inlet. This shall be of swing type.
- (iv) Air release valves with ball valve shall be provided in the piping system for venting trapped air with a size of 25mm for pipes upto 100mm and 40mm for larger pipes.

- (v) Plumbing drawings showing the sizes of pipe, 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.

2.6.2 Pipe Materials

Pipes shall be of the following materials:

- a) Mild steel heavy class(C-class) conforming to IS:1239 for sizes upto 150mm.
- b) Welded black steel pipe, Class 2, conforming to IS: 3589, for sizes greater than 150mm. These pipes shall be factory rolled and fabricated from minimum 6mm thick M.S. Sheet for pipes upto 350mm dia meter and from minimum 7mm thick M.S. sheet for pipes of 400mm dia meter and above.
- c) Cast iron double flanged pipe, Class-A conforming to IS1536 or IS:1537 (to be provided only in under ground application).

Note: For pipe work of Automatic Sprinkler System inside the building, Stainless Steel Pipes and fittings of grade AISI 304 as per JIS standard 3448 are also permitted particularly where replacement of pipes is not easy like areas above false ceiling etc., subject to the condition that these pipes with associated fittings are suitable to safely withstand the system test pressures.

- d) GI Pipe medium Class (B-class) conforming to IS:1239 (For Drain) Cadmium plated steel nuts/bolts/washers shall be used. Flex drops of stainless-steel metallic pipe with mounting accessories, frame for installation on false ceiling.

2.6.3 Pipe Joints

- a) Electric welding joints shall be provided in the MS pipe work. Flanged joints shall be provided for connections to valves, pumps, air vessels etc and also on straight lengths at suitable points to facilitate rection and subsequent maintenance.
- b) For connection of C.I. Pipe, fittings shall also be of C. I. heavy grade conforming to IS:1538. The flanges shall be smooth faced and neoprene gasket shall be provided between joints. All bolt holes in flanges shall be drilled. The drilling of each flange shall be in accordance with the relevant Indian Standards. Wherever un-avoidable to connect underground pipe with risers, MS pipe may be used in the form of distant pieces. The joint between C.I. and MS pipe shall be flanged type. MS pipe laid at such locations shall be provided With anti-corrosive treatment.
- c) Mild steel flanges shall be in accordance with IS: 6392 i.e., "Plate Flanges for Welding" and flange thickness shall be as under. Gasket thickness shall not be less than 3mm.

I.	Pipe dia meter	Flange
	Thickness 200mm	24mm
II.	150mm and 125mm	22mm
III.	100mm and 80mm	20mm
IV.	65mm	18mm
V.	40mm and below	16mm

- d) Fittings installed underground shall be of cast iron 'heavy' grade conforming to IS 1538 whereas those installed above ground shall normally be of medium grade wrought steel or mild steel conforming to IS 1239 (Part2) or malleable iron fittings conforming to IS 1879.
- e) All hard ware items such as Nuts, Bolts, Washers shall be of appropriate size. Washers shall be used on both sides of the bolt.

2.6.4 Anti-Corrosive Protectionon Under Ground MS Pipe.

Corrosion protection tape shall be wrapped on MS pipes to be buried inground. This corrosion protection tape shall comprise of coal tar/asphalt component supported on fabric of organic or inorganic fiber and minimum 4mm thick and conform to requirement of IS: 10221-Code of practice for coating and wrapping of underground mild steel pipe line. Before application of corrosion protection tape, all foreign matter on pipe shall be removed with the help of wire brush and a suitable primer shall be applied over the pipe there after. The primer shall be allowed to dry until the solvent evaporate sand the surface becomes tacky. Both primer and tape shall be furnished by the same manufacturer.

Corrosion protection tape shall then be wound around the pipe in spiral fashion and bounded completely to the pipe. There shall be no air pocket or bubble be neath the tape. The over laps shall be 15mm and 250mm shall be left uncoated on either end of pipe to permit installation and welding. This area shall be coated in-situ after the pipe line is installed. The tapes shall be wrapped in accordance with the manufacturer's recommendations. If application is done in cold weather, the surface of the pipe shall be pre-heated until it is warm to touch and traces of moisture are removed and then primer shall be applied and allowed to dry.

Holiday Testing for wrapping and coating is essential. Holiday testing may preferably be carried by flexible and detachable ring probe, which will enable the entire 360° of the surface of the pipe to be scanned.

2.6.5 Valves

Each pump shall be provided with a non-return valve and a sluice valve on the delivery side, the sluice valve being installed on the up stream side of the non- return valve. A pressure gauge shall also be provided between the pump and the non-return valve. The size of the non-return valve and cut off (sluice) valve shall not be less than the size of the initial delivery pipe and, in no case, less than the delivery outlet of the pump. No butterfly valves shall be installed inside the pump room. Sluice valve shall conform to IS:780. Butterfly valve, wherever used, shall conform to IS:13095.

All valves shall be suitable to with-stand the pressure in the system and rating shall be PN 1.6. All valves shall be right-handed (i.e., handle or key shall be rotated clock wise to close the valve), the direction of opening and closing shall be marked and an open/shunt indicator fitted.

- a) The material of valves shall be as under:
 - i. Body-Cast iron
 - ii. Disc -Cast Bronze or Stainless-Steel
 - iii. Seat -Either integral or Nitrile rubber
 - iv. O-ring -Nitrite/Silicon

- b) Non return valves shall be swing check type in horizontal run and lift check type in

vertical run of pipes.

- c) Air release valves shall be of gunmetal body.

2.6.6 Isolation Valves:

- a) Isolation valves shall be provided in the network to enable isolation of any section of the network without affecting the flow in the rest. The valves are distributed according to the general layout of the installation. The isolation valves shall be normally located near the loop junctions. Additional valves shall be provided in the segments where the length of the segment exceeds 300m.
- b) Cut-off valves shall conform to IS780 (PN1.6 rating)/ IS14846, Class3.
- c) Butterfly valves can be accepted subject to the condition that the valves of dia meter exceeding 150mm shall necessary be of gear operated.
- d) All Cut-off valves shall be of the right-hand type and enclosed in properly constructed surface boxes, at least 1 m² in area so as to allow for broken joints being easily remade. The top of the surface box shall be 80 mm above ground level, except where it is located on a road. Valve wheels shall have an arrow head engraved or cast there on showing direction for turning open and close.
- e) It is recommended that the position of the surface box be indicated by an iron plate painted fire red with distinct lettering. Such plates shall also show the open and close direction as cast or indicated on the valves and the serial number of the sluice valve.
- f) Locations where vehicles can pass shall be avoided for provision of valve below ground.
- g) In case of installations in earthquake prone zones, flexible couplings shall be used for jointing purposes at required locations.
- h) Valves in fixed firefighting installations shall have supervisory switch with its signaling to fire alarm panel or to have chain(s), pad lock(s), label and temper-proof security tag(s) with serial number to prevent tempering/unauthorized operation. These valves shall be kept in their intended 'open' position.

2.6.7 Strainers

Stainless steel strainers shall have minimum 1 mm thick screen with 3 mm perforations. Strainers shall be provided with flanges.

2.6.8 Orifice Plate

Orifice plate shall be made of 6 mm thick stainless steel and shall have an identification tag projecting beyond any flange between which it is clamped. The orifice shall be plain central hole without burs and dia meter not less than one-half of the internal dia meter of the pipe to which it is fitted.

2.6.9 Instruments

Pressure gauge of appropriate range and 150 mm diameter size shall be provided. The pressure gauge shall be duly calibrated before installation and shall be complete with shut off valve.

2.6.10 Air Vessel

Air vessel shall be provided on top of each riser and shall be fabricated out of 8mm thick

M.S. Sheet. The ends shall be dished. This shall be of 250mm diameter, 1.2 m high and installed vertically on suitable legs. The legs shall be provided with M.S. Plate of size 75 mm x 75 mm x 5 mm at the bottom so that the legs do not puncture the roof. The legs shall be grouted in CC foundation. Flange connection shall be provided for connection with wet riser pipe. Air release valve and pressure gauge with shut off valve shall be provided. The air vessel shall be tested at 25 kgf/cm² pressure before installation.

2.6.11 Installation

- a) The installation work shall be carried out in accordance with the detailed drawings prepared by the contractor and approved by the Engineer-in-charge.
- b) In pipe above ground level, expansion loops or joints shall be provided to take care of expansion or contraction of pipes due to temperature changes.
- c) 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.
- d) Open ends of piping shall be blocked as soon as the pipe is installed to avoid entrance of foreign matter.
- e) Piping installation shall be supported on or suspended from structure adequately. The contractor shall provide, clamps, hangers etc.
- f) Proper lines and levels shall be maintained while installing exposed pipes.
- g) Pipe supports in pump house shall be floor mounted and of mild steel/

- h) G. I. Spacing of pipe supports shall not be more than that specified below:

S . N o	Nominal Pipe Size (mm)	Spacing (m)
1	20 and 25	2.00
2	32 to 125	2.50
3	150 and above	3.00

Extra supports shall be provided at the bends and at heavy fittings like valves to avoid undue stress on the pipes.

- i) 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.
- j) 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.
 - (i) Vertical risers shall be parallel to walls and column lines and shall be straight and in plumb. Risers passing from floor to floor shall be supported at each floor by clamps.
 - (ii) The space in the floor cut outs around the pipework 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.

(iii) Riser shall have suitable supports at the lowest point.

- k) Wherever mild steel pipes shall have to be buried under ground, the same shall be treated before laying. The top of the pipes shall be not less than 1m below the ground level. Wherever this is not practicable, permission of the Engineer-in-charge shall be obtained for burying the pipes at lesser depth. Masonry or CC blocks shall be provided for supporting the pipes at interval. After the pipes have been laid, the trench shall be refilled with the excavated soil in layers of 20 cm and rammed and any extra soil shall be removed from the site of work by the contractor.
- l) Underground pipe shall be laid at least 2m away from the face of the building preferably along the roads and foot paths. As far as possible laying of pipes under road, pavement and large open spaces shall be avoided. Pipes shall not be laid under buildings and wherever un avoidable, these shall be laid in masonry trenches with removable covers and cut-off valves shall be provided at points of entry and exit.
- m) Pipe over ground shall be painted in red color. Suitable identification shall be provided to indicate the run of under ground pipe wherever the route of under ground pipe cannot be ascertained from the location of yard hydrant/ isolating valves.
- n) It shall be made sure that proper noiseless circulation is achieved 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.

2.6.12 Flushing Arrangement

Flushing connections with isolation valves should be provided at suitable locations in the fire watering main.

2.6.13 Pressure Testing

- (a) 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 kgf/sq.cm for a period not less than 24 hours. While Hydro Testing, inclusion of cut-off valves in the mains to be tested can be avoided. All leaks and defects in joints revealed during the testing shall be rectified to the satisfaction of the Engineer-in-Charge.
- (b) Piping repaired subsequent to the above pressure test shall be re-tested in the same manner.
- (c) System may be tested in sections and such sections shall be securely capped.
- (d) Pressure gauges may be capped off during pressure testing of the installation.

2.6.14 Pipe Supports

For installing pipes vertically or horizontally inside the building standard pipe supports of reputed make shall be used. Following supports shall be used.

- (i) Split pipe support clamps with rubber lining for vertical, horizontal and roof hanging.
- (ii) Clevis Hangers for horizontal supports to adjust varying heights.
- (iii) Sprinkler Hangers for horizontal supports for pipes from 15mm dia to 150mm dia.

Fasteners and fully threaded rods shall be used for installing the pipe supports. The sizes of

pipe supports and installation shall be in accordance with manufacturer's recommendations. For pipes of size 100 mm and above, with the prior approval of Engineer-in-Charge, 'U' clamp with dash fastener may be used for supporting horizontal pipe from ceiling.

2.7 Fire fighting Accessories

2.7.1 Landing Valve

Landing valves are provided in the system for connection of hose pipes for discharging water for fighting fire by fire brigade or trained personnel. The landing valves shall be as per IS:5290

Material of construction

I. Body, outlet and cap etc.	:Bronze
II. Spindle	:Brass
III. Hand wheel	:Mild steel or cast iron.

The weater discharge shall not be less than 900lpm for single head valves at 7kgf/cm² pressure.

2.7.2 Installation

The landing valve shall be fitted to a T-connection of the riser at the landingin such a way that the valve is in the center of the internal hydrant opening and at a height of 900 mm from floor level. The valve base shall be vertical and the valve facing outside. There should be no hindrance in operation of the handle.

2.7.3 First Aid Hose Reel

First Aid Hose Reel shall consist of 20mm (nominal internal) dia meter hose tubing length wrapped around a reel with water inlet pipe, stop valve and shut-off nozzle. The entire assembly is mounted on awall bracket and can swing 180 degrees. The water inlet shall be connected directly to the riser/ down-comer mains by means of 37mm socket and valve. The hose tube can be pulled out easily for the purpose of discharge of water on fire. First aid hose reel shall be as per IS-884. The coupling, branch pipe and nozzle shall be as per IS:8090.

2.7.4 Material Of Construction-

Huband sides	:Mild steel
Wall Bracket	:Cast iron/Mild steel.
Hose tube(20mm) (Nominal internal dia)	:Thermoplastic(Textile Reinforced) Type-2 as per IS-12585
Nozzle with branch Pipe	:Brass
Stop Valve (Ball Valve)	:Gunmetal.

The water flowrate shall be not less than 24l pm and the range of jet shall be not less than 6m.

2.7.5 Installation

First aid hose reels are installed with internal hydrant. The cabinet shall be painted red. The size of the cabinet shall be such that there is no obstruction in swinging the hose reel. The location of cabinet shall be such that it does not for man obstruction in passage/escape route.

The length of hose tube shall be such that the nozzle of the hose can be taken into every

room and within a range of 6 m from any part of the room. There shall be no obstruction in swinging the hose reel and should be installed above landing valve wherever provided. The inlet valve shall be at 900 mm above floor level. Hose reel bracket should be firmly grouted on the wall with the help of raw bolts.

2.7.6 Fire Hose Delivery Coupling, Branch Pipe and Nozzles:-

These are important accessories used for fire fighting operations.

2.7.6.1 Material of Construction: Copper Alloy

2.7.6.2 Delivery Hose Couplings

The delivery hose couplings consist of male half coupling and female half coupling. Grooves are provided on outer side on both the couplings for binding hose pipes with wires. In female coupling, spring loaded cam too this provided for holding male half coupling in position. Male half coupling and female half coupling are provided on both sides (i.e., on one side male and on other side female) of hose pipes. Two or more pipes can be joined together with the help of these couplings instantaneously.

2.7.6.3 Branch Pipe and Nozzle: -

Branch Pipes with nozzle are mounted at the end of hose pipe. Branch pipe is properly finished and free from sharp edges. One end of branch pipe is fixed with hose coupling and the other end is threaded to fit the nozzle.

- a. Nozzle is a tapered pipe with one end threaded internally and fixed on branch pipe. The size of another end i.e., nozzle shall be 20 mm (nominal internal dia meter).
- b. Spare Branch pipes and nozzles to the extent of 10 percent of the above requirements, with a minimum of two sets, shall always be kept readily available in fire control room/pump room.

2.7.7 Fire Service Inlet and Fire Service Connection

These are provided for connection of fire service hose pipes for either directly pressurizing the system with their pumps or filling water in the tank from a distance. Non-return valve with butterfly valve shall be provided for holding water pressure. Fire service inlet shall be provided with each wet riser/down comer and the ring main. These are fixed to 150 mm dia meter pipe and located in MS Box made of 2 mm thick mild steel sheet with openable glass cover. These shall be as per IS:904.

Material of Construction: Copper Alloy.

2.7.8 Hose Pipes

Hose pipes shall be rubber lined woven jacketed and 63 mm in diameter. They shall conform to Type A (Re-in forced rubber lined) of IS:636. They shall be flexible and capable of being rolled. Length of hose pipe will be 15m. The hose pipe shall be complete with male and female coupling at the end. Be sides keeping hose pipe with internal hydrant and yard hydrant, spare hose pipes to the extent of 10 percent of the above requirements, with a minimum quantity of 30m shall always be kept readily available in fire control room/pump room. Such spare hose shall be in 15 m lengths, readily attached to couplings.

2.8 Automatic Sprinkler System

2.8.1 The following standards shall be followed for Automatic Sprinkler system.

- (i) IS: 15105: - Design, Installation and Maintenance of Fixed Automatic Sprinkler Fire Extinguishing Systems-Code of Practice

(ii) IS:9972:- Specification for Automatic Sprinkler Heads for Fire Protection Service

2.8.2 Planning

Pressure in the sprinkler installation piping shall not exceed 7 bar and pressure at the most remote sprinkler at any level shall not be less than 0.5 bar and also not more than 5 bar.

2.8.3 Extent of Sprinkler Protection:-

Sprinklers shall be provided, except in the but for following are as:

- (a) Areas, rooms or places where the water discharged from a sprinkler may pose a fire or explosion or toxic hazard. In such areas alternative arrangement shall be made.
- (b) Stairs, spaces below stair headings (but not rooms above a stair) and lift wells. Any part of the building not provided with sprinkler protection shall be fire separated by walls. Fire doors not less than 1 hour in fire resistance shall be provided in the opening of such walls.
- (c) Wash rooms, toilets and WCs (but not cloak rooms) of area less than 5m^2 . If area of these rooms exceeds 5m^2 , these shall be provided with sprinkler protection unless fire separated by walls and all openings in the walls are protected.
- (d) Sprinklers shall not be required in electrical equipment rooms where all of the following conditions are met:
 - i) The room is dedicated to electrical equipment only.
 - ii) Only dry-type electrical equipment is used.
 - iii) Equipment is installed in a 120 minutes fire-rated enclosure including protection for penetration in walls.
- (e) Rooms like server room or electrical control room where alternate protection by other automatic extinguishing systems shall be provided.
- (f) In areas having height 17m or above such as in atria, sprinklers installations may be rendered ineffective and hence may be avoided.
- (g) The area to be protected by sprinkler is divided into various zones. For detecting operation of sprinkler in a zone, flow switches are provided which are wired to an annunciation panel installed in the Fire Control Room. In the event of operation of sprinkler (s) in an affected area. The annunciation panel will give audio-visual alarm and indicate the affected zone. This arrangement will be independent of fire alarm system.
- (h) For moderate hazard, water discharge shall be at least 5 liter/min/m² over an assumed area of operation covering 360m².
- (i) Sprinkler Spacing, Arrangement, Distribution and Locations:- Sprinkler heads may be installed on ceiling and or side walls.
 - (i) Minimum Distance between Sprinklers is 1.8 m (for Ceiling as well as Side wall sprinklers)
 - (ii) Maximum distance of sprinkler (For ceiling & side wall sprinklers) :it shall not exceed from end walls: half of the allowable distance between sprinklers Note: For ceiling sprinklers:

- a) where the external walls are combustible or built with metallic or otherwise or open sided; and in case of open joisted ceilings or where the roof has the rafters exposed, the distance between the boundary and the sprinklers shall not exceed 1.5m.
 - b) Distance shall be measured perpendicular to the wall.
- (iii) Sprinklers shall not be located at a distance less than 100 mm from the wall (for ceiling sprinklers).
- a) Sprinklers shall not be located at a distance less than 100 mm from the end wall (for side wall sprinklers)
 - b) While designing and installation of the sprinklers, the commendation of sprinkler manufacturer shall be considered.

2.8.4 Spacing below Sprinkler Heads:- Clear minimum space of 0.5m shall be maintained below the deflector of sprinkler head.

2.8.5 Sidewall Sprinkler Deflector Location and Orientation in relation to building structure:

- i) Distance between sprinklers and the ceiling shall not exceed 150mm. If specifically approved for use and listed so, the distances between ceilings and the sprinkler scan be increased upto 450mm.
- ii) Vertical side wall sprinkler deflectors shall be located not more than 150mm or less than 100 mm from the wall from which they are projecting.
- iii) Sprinklers shall be so located to minimize obstructions (to discharge) either on parallel or perpendicular sides thereof. If required, additional sprinklers shall be provided to obviate the obstructions.

2.8.6 Sidewall Sprinkler Obstruction: Sprinklers shall be located at least 1.2 m away from any lighting, fan and similar fixtures either in front of or on the same wall where the sprinklers are mounted. For any obstruction (to discharge) including lighting, fan etc., shall be beyond 1.2m, distances A and B shall be maintained as per the Tables given below. In case these distances cannot be maintained, the sprinkler shall not be allowed at such location. Clearance between the top of storage if any to the deflector shall not be less than 450mm.

- a) Side wall sprinklers in rooms shall neither be installed above the grills of air conditioner nor within 450 mm thereof on the same wall. Horizontal side wall sprinkler shall be located not more than 100mm and are allowed to be located with their deflectors less than 100mm from the wall on which they are mounted.
- b) Deflectors of the sprinklers shall be aligned parallel to the ceilings or roofs.
- c) When installed under a sloped ceiling (1 in 6), side wall sprinklers shall be located at the high point of slope and positioned so as to discharge down the slope.
- d) Where vertical side of a beam/projection from a wall is used for installing a sidewall sprinkler, additional sprinklers shall be installed below the of fit if the width of beam or projection from the wall exceeds 200mm.
- e) When soffits used are within 200 mm in width or projection from the wall, additional sprinklers shall not be required subject to the deflector of the sprinklers falling within prescribed distance.

2.8.7 Concealed Spaces:-

If the height of the concealed space at roof and floor is not greater than 0.8m, the spaces shall be sprinkler protected only if they contain combustible materials or are constructed with combustible materials. Spaces between roofs and ceiling more than 0.8 m deep shall be sprinkler protected as follows:-

- a) Concealed spaces less than 5m² in area shall not require sprinkler protection.
- b) Sprinkler heads shall be provided considering the space as any other area in the building.
- c) Sprinkler heads may be connected individually with the range/distribution pipes below, which shall be sized by taking the room and concealed space sprinklers cumulatively.
- d) Sprinkler heads for concealed space and for the room may be connected with separate range/ distribution pipes connected, with common feed pipe. The common feed pipes shall be not less than 65mm diameter.

2.8.8 Pipe Sizing and Design: - Sprinkler heads shall be connected with pipe lines permanently charged with water. Depending upon location of sprinkler heads and site conditions, sprinkler heads may be connected with range and distribution pipes.

The pipes connecting the sprinkler heads are to be sized depending upon number of sprinkler heads and arrangement of their connection. Range Sizes of pipes are to be calculated from various tables and hydraulic calculations given in IS:15105.

Pipe sizes shall be determined using one of the following methods:

- a) Pre-calculated system: applicable only where light and ordinary occupancies where the aggregate floor plate area (in one or more floors combined) is 5000 m² or less (except where gridded or looped layouts are used).
- b) Pre-calculated pipework is applicable only to the extensions of old pre-calculated systems.
- c) Fully calculated system: applicable for
 - i) Light and ordinary occupancies where the aggregate floor plate area (in one or more floors combined) exceeds 5000m².
 - ii) High hazard occupancies,
 - iii) Storage occupancies, and All occupancies where conventional and special sprinklers are used like ESFR, LD, EC, intermediate, etc.
- d) Some guidelines relating to pre-calculated system are given below:
 - i) Pipe less than 25mm diameter is not to be used.
 - ii) There shall not be more than 6 (Six) sprinklers in any range.
 - iii) Range and distribution pipe nominal sizes shall be selected from Tables given below respectively.

2.8.9 Range Pipe Nominal Sizes for Various Pipe Layouts in Moderate/ Ordinary Hazard Installations.

	Range Pipe Layout	Pipe Nominal Bore (mm)	Maximum Number of Sprinklers to be fed by Pipe of size listed
(a)	(1) Range(s) at remote end of each distribution pipes		
	End feed layout:		
	(i) Last two ranges in two end-side layouts	25	1
		32	2
	(ii) Last three ranges in three end-side layouts	25	2
		32	3
	(2) Last range in all other layouts.	25	2
		32	3
		40	4
	(b)	25	3
		32	4
		40	6

2.8.10 Distribution Pipe Nominal Size in Moderate/Ordinary Hazard Installations and Maximum Number of Sprinklers

Distribution Pipes	Type of Layout	Distribution Pipe Nominal (mm)	Maximum Number of Sprinklers to be fed by Pipe size listed
At extremities of the installation	Two end side layouts	32	2
		40	4
		50	8
		65	16

Last three ranges	All other layouts	32	3
		40	6
		50	9
		65	18
Between design points and the Installation Control Valve	All	To be calculated as per 10.4.4 (b) of IS 15105	

2.8.11 Components of sprinkler system:- Following types of valves are used in the installations:

1. Test Valve:- For testing hydraulical alarm electric alarm by drawing water from down streamside, test valve shall be connected with down stream of the water flow alarm.
2. Drain Valve:- For drainage of system, drain valve of 50mm dia meter shall be provided down stream of Installation Control Valve or any subsidiary stop valve.

A common valve can perform the functions of test and drain. The outlet shall be connected with a 50 mm dia meter G.I. drain pipe along with riser pipes.

3. Flushing Valve:- If the water used for sprinkler is not potable, flushing valves shall be provided at the end of a distribution pipe. The valve size shall be same as distribution pipe. Valve outlet shall be fitted with a brass plug and extended to not more than 3m above floor.
4. Check Valve: - Check valve shall be provided where more than one water supply is available and same shall be fitted on each water supply pipe.
5. Subsidiary Stop Valve: - Subsidiary stop valve which shall be of the same diameter as the pipe line in which they are fitted and shall be provided to control water supply to sprinklers of highly sensitive areas like computer rooms.
6. Installation Control Valve (ICV): - A sprinkler installation shall be fitted with a suitable Installation Control Valve to control the water supply to the installation. The valve set shall comprise of:
 - (a) A main stop valve.
 - (b) An alarm valve.
 - (c) A water motor alarm.

The alarm valve shall be fitted immediately downstream of the main stop valve of each building/block and before any connection is taken off to supply any part of the installation. The Installation Control Valve shall be placed externally in the vicinity of the main entrance of the building protected at an easily accessible place so that the alarm bell sound is heard by the inhabitants/passers-by. The valve shall be secured open by a pad locked or rivetted strap and protected against impact damage.

If there are genuine constraints in locating the Installation Control Valve outside the buildings, this may be located inside the building in the vicinity of main entrance (subject to approval of authorities concerned). Installation Control Valve in such cases, shall be located away from any exposure to damage and personnel shall be normally available in the vicinity of the location to get alerted by alarm operation. Also, electrically operated sirens interfaced with the opening of the alarm valve of ICV, shall be provided outside the building. In no

case, Installation Control Valve shall be provided inside pumproom.

A plan of the risk with the position of Installation Control Valve shall be placed in a conspicuous location. A location plate shall be fixed near the Installation Control Valve bearing the following words in raised letters:

SPRINKLER ALARM VALVE

7. Water motor alarm: Water motor alarm shall be provided very close to the alarm valve. Strainer shall be fitted between the alarm valve and the motor nozzle connection. The water outlet shall be positioned so that any flow of water can be seen. The alarm device shall provide audibility level of 85 dB above the background noise level.

8. Pressure Gauges: Pressure gauges shall be provided immediately above and below each alarm valve. Stop cock shall be provided before pressure gauges for removal without interruption of water supply of the installation. Pressure gauges shall be as per IS:3624.

2.8.12 Selection of Temperature Rating

Temperature rating of a sprinkler should not be less than 30° C more than the highest anticipated temperature of the location of installation. Under glazed roofs or where there are roof sheets of PVC or similar plastic material, sprinkler shall be rated 73°C to 100°C.

2.8.13 Orifice Size

Sprinklers orifice size of minimum 15mm shall be used.

2.8.14 Size of Installations

The protected floor area to be controlled by any one Installation Control Valve shall not exceed 12000m². As far as possible one area shall be controlled by one Installation Control Valve. If the area is quite large, more than one Installation Control Valve should be planned. Details of area controlled by an Installation Control valve shall be exhibited near it. If there are more than one block in a campus, each block shall be provided with different Installation Control valve.

2.8.15 Protection of Sprinklers

Any sprinkler installed in a position of risk or accidental damage, shall be fitted with a metal guard suitable for sprinkler service.

2.8.16 Sprinkler Annunciation Panel and Alarm

Electrically operated alarm shall be provided for indication of operation of sprinkler in an area. Water flow switches shall be installed in main distribution pipes which shall be wired to sprinkler annunciation panel. In the event of operation of a sprinkler, the flow switch will operate and give signal to the annunciation panel to indicate operation of sprinkler in the area. This will initiate an electrically operated alarm. The system shall be independent of fire alarm system and compatible with. Necessary potential free contacts for use in, should be provided.

2.8.16.1 Construction Details

- a) The Panel shall be fabricated out of not less than 2 mm thick MS sheet and powder coated after 7 tank treatment process and shall be totally enclosed dust damp and

vermin proof. Suitable knockout shall be provided for the entry of cables. The panel shall be designed such that the equipment for power supply and battery charging are housed in

Independent compartments. Sealed maintenance free batteries shall also be accommodated inside the panel.

- b) Indicating lamps control switches, buttons and fuses shall be suitably located in the front and properly labeled.
- c) The indicating lamps shall be LED type of following colors. The flow switch operation conditions shall be indicated by twin lamps.
 - I. Red to indicate flow switch operation.
 - II. Amber to indicate fault condition.
 - III. Green to indicate healthy condition.
- d) The test buttons to test the indication lamps shall be provided.
- e) The panel control shall be microprocessor type.
- f) The primary function of the panel shall be to respond automatically to the operation of one or more flow switches to give alarm and to indicate area/areas where the device has been activated. The operation of one or more flow switches shall result in simultaneous alarm given by the following:-
 - I. External alarm hooter(s) (provided outside the building to be protected).
 - II. A visible indication on panel.
 - III. Audible alarm on panel itself (common for all zones)
- g) The panel shall indicate the fault within the system and immediate fault warning shall be given by an audible and visible signal on the panel in case of open circuit, short circuit and earth fault in cable between flow switch and annunciation panel.
- h) The panel shall be complete with mimic diagram for the areas covered by different flow switches. The layout of mimic diagram shall be got approved from Engineer-in-Charge.
- i) Battery backup with trickle cum boost charger shall be provided for operation of the system. Indication of mains failure and the state of charge of the batteries shall be provided. The batteries shall be sealed & maintenance free. The capacity of the battery shall be 12 Volt, 2 Nos. 24 Ah each. All standard accessories shall be provided.

2.8.16.2 Installation

Following points in addition general installation guidelines, are to be taken care for sprinkler installations:

- a) For fixing sprinkler heads, 15 mm diameter M.S. Socket is to be welded to range pipes at the locations as per drawings. Dead plug shall be fixed in the socket.
- b) If sprinkler head is to be provided away from range pipe, M.S. Pipe nipple of suitable size be used to extend the sprinkler head and socket is welded at desired location.
- c) After completion of work in sections, pressure testing at 7.5kgf/cm² Pressure shall be carried out for 24hrs.
- d) After completion of the entire work, pressure testing of entire pipe work shall be carried out for 24 hrs. at a pressure of 7.5kgf/cm². The drop of pressure upto 0.5kgf/cm² shall be accepted.
- e) The lines shall be flushed before completion of building work so that any foreign matter

which might have entered the system is taken out. The pressurization pump (Jockey Pump) be operated and valves opened at different locations.

- f) During occupation of the building, sprinkler heads shall be provided in place of dead plugs. Teflon tape shall be used on threaded portion. The sprinkler heads shall be properly tightened in the socket.
- g) When all sprinklers' heads are installed, pressure is built up in the system by pressurization pump slowly and in case no leak is found, desired pressure is developed and maintained. In case any leak is detected, the same shall be attended before pressurizing the system further.

2.8.17 Spare Sprinklers to be Kept in Stock:

A stock of spare sprinklers shall be maintained in the premises so that prompt replacement is possible after the operation/ damage of sprinkler heads. The spares shall be kept in an easily accessible location under conditions where the temperature does not exceed 38°C. Minimum 50 Sprinklers of each type shall be supplied to the department at the time of Handover.

2.9 Water Curtain Sprinkler:-

For basement car parking, compartmentation can be achieved, with fire barrier or with water curtain nozzle (K-23) or with a combination thereof. Automatic deluge system comprising deluge valve, piping, nozzles etc. shall be used to zone the compartment in case of water curtain system. In case of water curtain, existing water storage shall be supplemented by water demand for water curtain nozzles for 60min considering the largest compartment's perimeter out of all compartments of car parking in any of the basements. The water supply for the water curtain nozzles shall be through an independent electric pump of adequate capacity (flow and head) with piping/riser for the water supply to the nozzles. The water curtain shall be operated by the actuation of flow switch actuating sprinkler system.

2.9.1 Installation

The spray nozzle must be handled with due care. Nozzle which is visibly damaged should not be installed. Use Teflon tape or soft thread sealant on male thread of the nozzle. The nozzles must be tightened into the fitting. Excessive tightening torque may result in serious damage to nozzle arms and the deflector which may affect the spray pattern of the nozzle and its performance. Spray nozzles are to be installed in accordance with the latest published standards of NFPA or similar organizations and also with the provisional governmental code, ordinance and standards whenever applicable. The use of these nozzles may be limited due to occupancy and hazard, Refer to Authority having jurisdiction prior to installation.

2.9.2 Inspection, tests & maintenance

It is recommended that the window spray system be inspected regularly by authorized technical personnel. The nozzle must be checked for atmospheric effects, external and internal obstruction, blockage if any. The nozzles should be cleaned or replaced if required. The system must be operated with optimum water flow at least twice in a year or as per the provisions of NFPA or local authority having jurisdiction. The owner is solely responsible for maintaining the water spray system and the components there in so that it performs properly when required.

2.10 Electrical Work

- a) Unless otherwise specified in the tender specifications, all equipment and materials for electrical works shall be suitable for operations on 415V/240V+10% (3 phase /single phase), 50HzAC system.
- b) All electrical works shall be carried out complying Central Electricity Authority (Measures Relating to Safety and Electric Supply) Regulations, 2010 and NEC 2011, as amended upto date. All parts of electrical works shall be carried out as per appropriate CPWD General Specifications for Electrical works, namely, Part I (Internal) 2023, Part II (External) 2023 work, and Part IV (Sub-station) -2013 all as amended upto date.
- c) All materials and components used shall conform to the relevant IS specifications amended upto date.

2.10.1 Power Supply

- a) Power supply to following systems and equipment, where provided, shall be from normal and emergency (stand by generator) power sources with change over facility:
 - I. Fire pumps
 - II. Pressurization and smoke venting; including its ancillary systems such as dampers and actuators.
 - III. Fireman's lifts (including all lifts).
 - IV. Exit signage lighting.
 - V. Emergency lighting.
 - VI. Fire alarm system.
 - VII. Public address (PA) system (relating to emergency voice evacuation and annunciation).
 - VIII. Lighting in fire command center and security room.
- b) The generator shall be capable of taking starting current of all the fire and life safety systems and equipment as above.
- c) The electric supply to the pumping set(s) shall be entirely independent of all other equipment in the premises that is even when the power through out the entire premises is switched off, the supply to the pump shall continue to be available un-interrupted.
- d) The power supply to the panel/distribution board of these fire and life safety systems shall be through fire proof enclosures or circuit integrity cables or through alternate route in the adjoining fire compartment to ensure supply of power is reliable to these systems and equipment. It shall be ensured that the cabling from the adjoining fire compartment is protected within the compartment of vulnerability. The location of the panel/ distribution board feeding the fire and life safety system shall be in fire safe zone ensuring supply of power to these systems.
- e) Circuits of such emergency system shall be protected at origin by an automatic circuit breaker so set as to permit the motor to be over loaded during an emergency to the maximum limit permissible by the manufacturer. Further, the no volt coil/the under-voltage release of that circuit breaker shall be removed. Master switches controlling

essential service circuits shall be clearly labelled.

- f) Independent supply shall be provided for water supply pumps if installed in the same pump house. If the fire pump house is away from the sub-station building, the route of the cable shall not pass under the building or permanent structure. Cable shall be laid along the route which is safe from fire.
- g) Sufficient spare power shall always be available to drive pumping sets at all times through out the year. Suitable capacity ACBs /MCCBS/ SDFUs shall be provided in the electrical panel for extending supplies to fire pumps. Such switches shall be suitably marked "FIRE SWITCH" and shall not be switched-off without permission/ intimation to appropriate authority. In case any maintenance /repair work is to be carried out on the electrical panel where from supplies to fire pumps have been extended, alternative arrangement shall be made to ensure that power supply to fire pumps continue to be available for operation any time.

2.10.2 Motors

The motors shall be squirrel cage AC induction type. The motors shall be suitable for continuous duty and rating necessary to drive the pump at 150percent of its rated discharge with at least 65 percent rated head. The motor shall be totally enclosed fan cooled type confirming to protection clause IP21 of IS:4691. The class of insulation shall be 'F'. The synchronous speed shall be 1500/3000 rpm as per requirement of the pump. The motor shall conform to IS:325.

2.10.3 Motor Starter

- a) The motor starter shall conform to IS:1822 "Motor starters of voltage not exceeding 1000 volts" and shall be air insulated and suitable for 415V,+ 10%,50 Hz, 3phase AC supply and shall be integrated in the panel.
- b) 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 type for motors of higher ratings unless otherwise specified in the tender specifications. However, for main Fire Pump & Sprinkler Pump Soft Starters may be used.
- c) Each starter shall be provided with the following protections:-
 - 1. Thermal overload on all the three phases with adjustable settings,
 - 2. Independent single-phase preventer. (Current sensing type).
- d) Adequate number of extra NO/NC contacts for inter locks, indicating lamps, remote operation etc. shall be provided on the starter/contactors.
- e) Under voltage /No volt trip shall not be provided.

2.10.4 Panel Boards

- a) The main panel board shall be floor mounted, free standing or wall mounted cubical type and shall be factory built fabricated by one of the approved manufacturers. Shall be fabricated from 2.0 mm thick CRCA sheet and powder coated after 7 tank treatment process, fabricated with IP 42 degree of protection. It shall be suitable for termination of the incoming cables from bottom.
- b) The capacity of switch gear shall be suitable for the requirements of motor fed/controlled. Starting currents shall be duly considered. SDFUS/ MCCBs shall be used upto 630A. ACB shall be used for 630A and above ratings. All Switch fuse units

/SDFUs shall be of AC23 duty as per IS:4064-1978 as amended upto date. They shall be complete with suitable HRC cartridge type fuses.

- c) Panel boards shall house starters for motors with independent current sensing type single phase preventor for each starter. Volt meter with selector switch, a set of indicating lamps and fuses for voltmeter and lamps shall be provided. Ammeter with CTs, and selector switch shall be provided with each motor starter. Instruments shall be flush mounted with the panel and have a class index not higher than 1.0. 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.
- d) The layout shall be designed for convenient connections and inter-connections with the various switchgear. Connections from individual compartments to cable alleys shall be such as not to shut down healthy circuits in the even to maintenance work becoming necessary on a defective circuit. Care shall be taken to provide adequate clearances between phase bus bars as well as between phase bus bars, neutral and earth.
- e) Where terminations are done on the bus bars by drilling holes there in, extra cross section shall be provided for the bus bars. Alternatively, terminations may be made by clamping. 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 uppertiers shall be duly clamped with in the panel board.
- f) Identification labels shall be provided against each switch gear and starter compartment, using plastic/aluminum engraved labels. Metallic danger board conforming to relevant IS shall be fixed on each electrical panel board.

2.10.5 System Controller

For controlling operation of pumps and indicating fault, system controller shall be provided. The system controller shall consist of relays, timer, contactors etc. and shall be designed to operate the fire pumps with inter locking and fault indication. Annunciation window shall be provided to indicate following faults:

- a) Low water level in UG tank
- b) Low water level inter race tank.
- c) Main pump failed to start.
- d) Main pump failed during operation.
- e) Diesel pump failed to start.
- f) Diesel pump failed during operation
- g) Supply to Main Pump failed
- h) Supply to Pressurization Pump failed
- i) Supply to Terrace Pump failed.

Suitable sensors, differential pressure switches, monitors shall be provided at respective locations. The control system shall be operational on 12V/24V DC starting batteries of engine. Battery chargers shall be provided to ensure that the batteries remain charged. Batteries shall be sealed maintenance free type.

2.10.6 Remote Indicating Panel

There mote indicating panel shall be provided in the fire control room. This panel shall have necessary status indication of all electric motors. Back indication to show the status of operation of all the motors, pressure in the system, water level in under ground and over head tank etc. Shall be provided. Panel shall be fabricated from not less than 1.6mm thick

CRCA sheet and powder coated after 7 tank treatment process. The panel shall be dust, damp and vermin proof. This shall be of wall mounting type. This shall be complete with necessary termination arrangements, multicore cables, tag blocks, control transformer, designation plastic labels, double earth studs etc. as required.

2.10.7 Power Cabling

- a) Power cables shall be XLPE insulated, PVC sheathed aluminum /Copper conductor, armoured cables of 1100 V grade.
- b) Power cables shall be of sizes to meet the starting and running current of motors fed and shall be as approved by the Engineer-in-Charge, after taking into consideration the load, the length of cabling.
- c) Cables shall be laid in suitable metallic trays suspended from ceiling, or mounted on walls. Cable ducts shall not be provided in pumprooms.
Cable trays shall be of perforated steel sheet with adequate structural strength and rigidity. Necessary supports and suspenders for cable trays shall be provided as required.

2.10.8 Control Wiring

- a) Control wiring shall be done using PVC insulated and PVC sheathed, 2.5 sq.mm, armoured multi-core copper conductor cable. The control cable shall also be laid in the same manner as power cable. The number and size of the control cables shall be such as to suit the control system design adopted by the contractor.
- b) 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.

2.10.9 Earthing

- a) Metallic body of all motors, medium voltage equipment and switchboards shall be properly earthed. Number of earth tapping points shall be intimated well in advance to the Structural earthing agency and shall connect to the points being provided.
- b) Armoring of cables shall be connected to the body of the equipment/ switch board at both the ends. Compression type glands shall be used for all such terminations in the case of PVC/ XLPE cables.

2.10.10 Painting

All panels shall be supplied with the manufacturer's standard finish painting.

2.11 Installation, Testing and Commissioning

2.11.1 Preparation And Approval of Drawing

Following points are to be taken care while preparing the drawings.

The location of yard hydrants, fire service inlet and fire service connection are to be decided based on considerations stated earlier. However necessary adjustments are to be made so that these components do not become hindrance in vehicular movement and entrance to the building. Requirement of other building services are also to be given due consideration. Symmetry should be maintained for aesthetic considerations.

- 2.11.2 Pump House:- The layout of equipment in pump house is very important from operation and maintenance considerations in case of the equipment i.e., water supply pumps etc. Are to be installed in the same pump house, sufficient space shall be left for them as well. The dimensioned foundation drawing of pumps should be available for marking in the pump

room layout. The layout is to be prepared in such a way that it should be possible to maintain any equipment without disturbing head joining equipment. Electrical panels are to be installed at a location which is easily accessible near the entrance to the pump house and there should be no possibility of water dripping over or near the electrical panel.

2.11.3 Electrical Panel: -Complete wiring drawing, layout etc. are to be examined to ensure that provisions of agreement are incorporated in the drawing. Sizes of various panel and mounting arrangement may be decided keeping in view ease of operation and aesthetic consideration as well.

2.11.4 Installation:-

- a) The pump and motor/engine are to be perfectly aligned on the base plate so that there is no vibration during operation. All nuts, bolts, washers shall be of adequate size and galvanized.
- b) The pipe supports should be decided in a way that the weight of pipes and valves are not transferred to the pumps and supports do not cause hindrance in movement inside the pump house. As far as possible, floor supports may be provided in pump house.
- c) All valves shall be installed at a height and in apposition that the operation by right hand is conveniently possible.
- d) All pressure gauges should be installed so that the dial is vertical and is visible while entering the pump house.
- e) Electrical panels should not be installed at floor level. The panels shall be sufficiently raised above ground level. If panels are to be mounted on wall, An angle iron frame shall be provided so that at least 75mm space is left behind the panels. The panels shall be easily approachable.
- f) Drain pump shall be installed in the sump provided. The pump shall operate automatically for which water level sensor shall be provided.
- g) In no case, any structural member i.e., RCC wall, column, beam and floor are to be damaged during installation. Mechanical fasteners are to be used for grouting support.
- h) U.G. tank wall is not to be used for any support. No pipe/cable is to cross the pump house below ground level. Openings above ground level are only to be used for this purpose.
- i) The engine installation work shall be carried out in accordance with the requirement of engine manufacturer and be got approved by the manufacturer or their authorized service center. The exhaust pipe should be suitably extended outside the pump house so that smoke does not affect nearby structure. Fuel tank shall be properly supported and located in a way that the same does not cause hindrance in movement in the pump house.
- j) While excavating for laying of external pipes, suitable signboard/barricading shall be provided to ensure that no person falls in the trench.
- k) No earth or any other matter is to be allowed to enter the pipes. The ends shall be kept closed always.
- l) Pressure testing is to be carried out in sections before filling the earth back in the trench.

- m) The earth filling is to be done in layers of 20 cm each and properly rammed so as to avoid possibility of settlement. Surplus earth/ malba shall be removed from the site by the contractor.
- n) Where pipe crossing road likely to have heavy traffic, additional protection over pipe shall be provided to ensure that pipe is not damaged. However, semi-circular RCC Pipes shall be provided overcast iron pipes at road crossings.
- o) External hydrants and fire service connection/in let shall be located parallel to the nearby road/ foot path so as to give proper appearance. Foundation shall be raised from below ground level and shall be properly plastered in plumb. The hydrants shall be facing the road/approach. There shall be no obstruction in approaching the hydrants for operation.
- p) Risers shall be parallel to the wall and in plumb. Adequate supports shall be provided from the wall. Opening around the pipe in slab shall be filled with CC and finished with plaster.
- q) Internal hydrant shall be provided in the center and facing outside for ease of operation. Sufficient space shall be provided around the handle for operation. There shall be no hindrance in moving the first aid hose reel.
- r) Terrace pipes shall be supported on CC pedestals of adequate height. The pipe route shall be such as no hindrance is created in movement at the terrace. Pipes shall be sufficiently raised above terrace. It is to be ensured that waterproofing is not damaged during laying of pipes.

2.11.5 Testing

- a) During laying of pipes, the same shall be subjected to 10 kgf/cm^2 hydraulic pressure for a period of 24 hours, in sections. After completion of the work, all valves / fittings shall be installed in position and entire system shall be tested for 24 hours at a pressure of 10 kgf/cm^2 . The drop of pressure upto 0.5 kgf/cm^2 shall be accepted.
- b) After completion, all operation checks shall be carried out for automatic operation of the systems. For this purpose, landing valves may be opened at different locations. The exercise shall be repeated couple of times to ensure trouble free operation of the system.
- c) The design flow of pumps shall be checked. The pump shall be operated after opening a number of landing valves at different locations. Design pressure is to be maintained in the pump house. Water discharge is to be measured by drop in level in UG tank for a certain period. All pumps shall be tested one by one. The flow rate shall be not less than as specified while maintaining the design pressure in pump house.

2.11.6 Inspection By Local Fire Officer

After completion of the work and testing to the entire satisfaction of Engineer-in-Charge, the installation shall be offered for inspection by Chief Fire Officer or his representative. Testing as desired by the Fire Officer shall be carried out. The contractor shall extend all help including manpower during testing. Rectification of observations of Fire Officer shall be attended by the contractor. The installation will be accepted by the department only after clearance by Fire officer.

2.11.7 Commissioning

- a) Flushing the System: Before commissioning, the entire system shall be flushed to ensure that any earth/foreign matters which might have entered during installation are taken out. For this, pump may be operated and valves opened at different locations.
- b) As soon as the work is complete, the system shall be commissioned and made available for use. Requirement of fire fighting installations is equally important during occupation of the building. If the building is to be occupied in part, fire fighting system of building completed shall be commissioned by isolating the system of under construction portion of the building.
- c) The fire fighting system shall be maintained and manned from the very first day of its commissioning.
- d) Any defects noticed during the warranty period shall be promptly attended and availability of the system at all times is to be ensured.

2.11.8 List Of Relevant Indian Standards

S.No	ISNo.	Title
1.	IS-884	Specification for first-aid hose reel for fire fighting
2.	IS-901	Specification for couplings, double male and double female instantaneous pattern for fire fighting,
3.	IS-902	Specification (for suction hose couplings for fire fighting Purposes (third revision))
4.	IS-903	Specification for fire hose delivery couplings, branch pipe, nozzles and nozzle spanner. (Fourth revision)
5.	IS-904	Specification for two and three-way suction collecting heads for fire fighting purposes.
6.	IS-907	Specification for suction strainers, cylindrical type for fire fighting purpose. (Second revision)
7.	IS-908	Specification for fire hydrant, stand post type. (Second revision)
8.	IS-909	Specification for underground fire hydrant. Sluice valve type
9.	IS-937	Specification for washers for water fittings for fire fighting purposes.
10.	IS-1643, IS-1646	Code of practice for fire safety of buildings (general)
11.	IS-2871	Specification for branch pipe, universal for fire fighting purposes.
12.	IS-5290	Specification for landing valves.
13.	IS-8090	Specification for couplings, branch pipe, nozzle, used in hose reel tubing for fire fighting.

14.	IS-8442	Specification for stand post type water and foam monitor for fire fighting (first revision)
15.	IS-9972	Specification for automatic sprinkler heads. (First revision)
16.	IS-11101	Specification for extended branch pipe for fire brigade use
17.	IS-9668	Code of practice for provision and maintenance of water supplies and fire fighting.
18.	IS-3844	Code of practice for installation and maintenance of internal fire hydrants and hose reel on premises.
19.	IS12469	Specification for Pumps for Fire Fighting System
20.	IS-10221	Code of practice for coating and wrapping of underground mild steel pipelines.(First revision)
21.	IS-15105	Design and installation of fixed automatic sprinkler fire extinguisher system-Code of Practice.
22.	IS-1239	Mild steel tubes, tubulars and other wrought steel fittings.
23.	IS-3589	Specification for Steel pipes for water, and sewage
24.	IS-2592	Recommendation for methods of measurement or fluid flow by means of orifice plates and nozzles.
25.	IS:1536	Specification for Centrifugally Cast (Spun) Iron Pressure pipes for water, gas & sewage (first revision)
26.	IS1537	Specification for Vertically Cast-Iron pressure pipes for water, gas & sewage (first revision)
27.	IS:13039	Code of practice for provision and maintenance of External Hydrant System (first revision)
28.	IS:15496: 2004	Inspection and Maintenance of Gaseous Fire Extinguishing system.

2.12 Technical Specifications for Fire Suppression System

2.12.1 The scope of work shall include Design, Supply, Installation, Testing and Commissioning of Total Flooding Clean Gas Fire Suppression System with HFC 227ea/ HFC 236/ NOVEC-1230 or equivalent gas Suppression system and related accessories as per NFPA2001-2015 at Electrical Substation, Server Rooms, UPS room, Medical gas pipeline system, LPG Manifold in kitchen etc., as required.

- a) Total flooding clean gas fire suppression system cylinders, Relays, Valve assembly, Solenoid valves and other accessories like NRVs, flexible hoses, pressure gauges, Safety devices, Directional control valves etc. shall be as per UL/VDS/LPCB/FM approvals and relevant standards.
- b) Installation of Control panels and laying of cables necessary for Total Flooding Clean Gas Fire Suppression systems (All the cables are to be provided with casing cabinets)

for aesthetic look).

- c) Necessary interfaces are to be provided for Fire Alarm Panel with Total Flooding Clean Gas Fire Suppression system.
- d) Installation of Total Flooding Clean Gas Fire Suppression system cylinders in prefabricated enclosures. Fabrication and erection of piping necessary for Total Flooding Clean Gas Fire Suppression system with proper supports.
- e) Training for operation and maintenance of Total Flooding Clean Gas Fire Suppression system.
- f) Submission of Design calculations, Drawings, Technical specifications, Supply, Installation, Testing and commissioning procedure for Total Flooding Clean Gas Fire Suppression systems.
- g) Implementation of safety at different stages of installation and commissioning.
- h) Submission of warranty for efficient and specified performance of the Total Flooding Clean Gas Fire Suppression system. In case, any item is found to mal-operate or fails to provide specified performance during inspection/ testing or during commissioning/ trial runs of the system or during warranty period, the Contractor shall attend to the faulty/defective item and make necessary repairs/ replacements to the satisfaction of the Department, without any extra cost.
- i) Total Flooding Clean Gas Fire Suppression systems shall be installed as per the approved installation drawing.

2.12.2 Submission Of Technical Documents

- a) Contractor shall submit for approval, The following documents and drawings:
- b) Technical literature & data sheets of Total Flooding Clean Gas Fire Suppression systems and related accessories.
- c) Design of Total Flooding Clean Gas Fire Suppression systems.
- d) General sensor, panel location, cable routing & cylinder module location and pipe line routing drawings and execution plan.
- e) Total Flooding Clean Gas Fire Suppression systems, piping fabrication drawings and isometric drawings.
- f) Installation sequence schedule along with installation drawings, interface study details.

2.12.3 Fabrication, Installation & Testing

- a) Contractor shall depute competent engineers with experience on similar works to supervise installation works and sufficient skilled labour to ensure completion of work in time.
- b) Anaesthetic cabin housing for Total Flooding Clean Gas Fire Suppression system cylinder modules, Gas release panel site location is also in the scope of work. The scope also includes civil works required for completion of the job.
- c) After commissioning the system, all panel Keys, Passwords and software required for programming devices shall be handed over to department in order to ensure smooth functioning of the system.

- d) Proper cable management system shall be used to route the cable in all the locations.

2.12.4 Instruction to the Contractor

- a) The item covered in this specification shall conform to technical specifications, latest revision of relevant standards and requirements in respect of accuracy, performance, dimensions, materials of construction, manufacturing, safety, reliability & quality assurance.
- b) Total Flooding of Clean Gas Fire Suppression system and accessories to be supplied under this package shall be new.
- c) All necessary facilities including tools, testing equipment, instruments, accessories, manpower assistance etc. shall be provided by the Contractor to enable inspection by CPWD during its manufacture/fabrication/assembly.
- d) The Contractor shall be responsible for adherence to all the applicable rules, regulations & requirements of statutory bodies as required.

2.12.5 Compliance to Standards

All the items supplied or used shall be manufactured/ fabricated and tested in accordance with the relevant Indian/International standards.

NFPA2001	Standard on clean agent fire extinguishing system
UL521	UL Standard for Heat Detectors for Fire Protective Signaling Systems
LPS1666	Direct Low-Pressure application for fixed fire suppression
GCR2016	Gas Cylinder Rules 2016

2.12.6 System design

- a) Design of system shall be as per NFPA 2001-2015. The clean gas agent shall be stored in a pressure not more than 50 bar. Design temperature shall be taken as 21 Deg C (70 Deg Fahrenheit). All items like valves, actuators, Hoses, cylinders, and piping manifolds, pressure switches, Arrangement for supervisory switch connection for monitoring the cylinder pressure, nozzles, Annunciators, evacuation sign boards, gas release panels etc., shall be UL/VDS/FM/LCPB listed.
- b) Piping network and nozzles shall be designed for minimum piping inside room and effective distribution of extinguisher agent.
- c) The clean gas fire suppression system of each room shall be interfaced with the Fire Alarm system of the room. The system shall be operable automatically from fire alarm panel upon detection of fire signal from two detectors simultaneously of that location when the confirmed fire signal (Two detectors simultaneous activation Logic) is received from fire detection & alarm system, automatic clean gas total flooding system shall be triggered. Then complete premises, shall be filled with gas and the fire

shall be extinguished. High Sensitivity Laser Smoke Detector shall be provided in these areas wherever Fire Suppression is Provided.

- d) The total flooding clean gas fire suppression system shall also be manually operable from local gas release control panel located near each room to be protected. Necessary hardware interfaces with necessary relay logics and the status are to be provided.
- e) To avoid possibility of inadvertent manual triggering, the system shall be latched with safety key switch.
- f) The control panel shall also have status monitoring of gas discharge actuator and audio-visual annunciation of gas discharge.
- g) Clean gas cylinders, associated instruments including control panel and pipe manifold shall be located inside suitable enclosure with door near protected area entrance.
- h) Clean gas total flooding system shall be actuated on receipt of confirmed Fire Detection Signal by FDA system.
- i) AHU related to this room shall be tripped as receipt of confirmed fire signal from FDA panel via interface modules.

2.12.7 Equipment Schedule & Specification:

Each system shall consist of following main items/accessories:

- a) Gas cylinder with gas and control valves (Cylinders shall have PESO approval).
 - b) Actuators: Electrical, Pneumatic
 - c) Flow switch
 - d) Supervisory switch for monitoring cylinder pressure.
 - e) Cylinder manifold along with interface Hoses and check valves.
 - f) Gas nozzles
 - g) Discharge hose
 - h) Pressure Gauge
 - i) Evacuation board
 - j) Cylinder trolley—one only for all systems
 - k) MRPS (Manually Release Push Switch)
 - l) Inhibitor
 - m) CS Seamless pipes: ASTM A106 Gr. B (Schedule of pipe as per Design calculations)
 - n) CS Pipe Fittings-Forged: ASTM A234 WPB (Above 40 NB Sizes: Buttwelded type, below 40 NB Size: Socket welding type)
 - o) CS Flanges: ASTM A 105 Raised face with serrations. (Classification of Flanges as per Design calculations)
 - p) Control panel and related electrical/electronic hardware.
 - q) 24VDC regulated linear power supply and test facility.
 - r) Enclosure for housing cylinder bank, manifold and gas release panel for each location.
- In addition to above, Any other items/ accessories which are required for completion of the work and commissioning of the system are also in the scope of work.

2.12.8 Cylinders:

Cylinders shall be seamless construction in accordance with the requirements of NFPA / Relevant BIS standards. Cylinder neck shall be threaded to suit the type of valves.

2.12.9 Actuators:

Electrical / Pneumatic actuators, manual actuators, all actuators shall be as per NFPA.

2.12.10 Flow Switch

Flow switch is provided on discharge pipe and is connected to the control panel to provide indication of "GAS DISCHARGED". Necessary logic circuit shall be built to derive the status to local control panel and also remote-control panel.

2.12.11 Cylinder Manifold:

Manifold is a high-pressure common line. The outlet of each gas cylinder Valve is connected by means of high-pressure hoses to the manifold, where a non-return valve is provided for each connection.

2.12.12 Gas Nozzles:

Type: Pendent Nozzles, Suitable for Uniform Agent Distribution. Material: Brass.

2.12.13 Discharge Hose:

Connection of individual gas cylinder with Manifold is by means of High-pressure discharge hose. This enables the leakage free connection of individual cylinder to the manifold.

2.12.14 Pressure Gauges:

The gas cylinders are pressurized with the help of Nitrogen. Due to various reasons, there could be minor leakage from the cylinder, Pressure gauges as per IS 3624-1987 are provided to monitor the pressure.

2.12.15 Evacuation Board:

One evacuation board in each premises, shall be provided. As soon as fire is detected by detector, Control panel shall initiate an audio-visual alarm and shall switch on the signal of evacuation board with the warning "EVACUATE IMMEDIATELY, GAS UNDER RELEASE".

2.12.16 Manually Release Push Switch (MRPS):

Manually Release Push Switch is also to be provided for the system. This consists of break glass type emergency push button unit. The depression of Push button shall initiate the system into fire condition with the audio-visual alarms at the control panel and separate indications of MRPS. In this operation, however time lag and electrical interlocking shall automatically override and the discharge of gas shall be immediate.

2.12.17 Inhibitor:

Auto gas system can be operated in Auto mode or in Manual mode. When a confirmed fire signal is received by the control panel, it initiates the signal for release of gas into the affected premise. Since the discharge of gas is purposefully delayed say up to 60 seconds, the persons present in the premise may decide to stop the release of gas, if fire is of minor nature or due to any other reason. This is done with the help of Inhibitor.

2.12.18 Inter connecting Cable

2CX1.5 Sq. mm FRLS, PVC insulated copper conduct or, shielded, armoured cable with cable management system shall be used. The colour of the cable shall preferably be RED and shall have Tags at regular intervals. Hooters, Junction Boxes and Other accessories

required as per relevant standards/codes.

2.12.19 Pipes, Fittings, Flanges, Check Valves etc.

- a) Pipes to be used for clean gas fire suppression system network shall be of seamless type, schedule to suit the system requirement. (ASTM A106 Gr. B)
- b) All Fittings shall be as per ASTM A 234 WPB, class rating to suit the system requirement. Flanges shall be forged, as per ASTM A 105, class rating to suit the system requirement.

2.12.20 Control Panel:

- a) In the automatic operation, the control panel shall provide a 24V DC output to the electrical/pneumatic actuator of the first cylinder. Subsequently all cylinders in manifold will be activated by pilot. The automatic system shall be initiated by simultaneous activation of two detectors provided in the area to be protected, the control panel, which provides an audiovisual alarm in case of receipt of a signal from any of the detectors in areas to be protected.
- b) Control panel audible alarm may be silenced at the panel, though the condition of fire continues. When silenced the control panel provides a low intensity audible alarm but serving to indicate the cancellation of the intermittent fire alarm. Control Panel shall provide an adjustable time lag from 0 to 60 seconds from the receipt of signal to the actual discharge of gas. All the necessary cabling and interfaces are to be done as per standard. The control panel shall have control and status of actuator and status of gas discharge. The necessary provision shall be available for extending the status to remote control room.
- c) The Gas release panel shall be interfaced with fire alarm panel.
- d) The scope of contract includes supply of required cable for interfacing Gas release panel with Main fire alarm panel, laying, casing cabinets for routing the cables, termination junction boxes and other required items/accessories required for completion of the installation.

2.12.21 Integrated system testing:

- a) Commissioning of the entire installation like integrated testing with Fire Alarm system, Gas release panel testing in Auto mode/Manual mode, Gas Abort station operation, Manual call point operation, Solenoid operation etc. shall be done in the presence of the Engineer-in-charge or his representative.
- b) Flow test shall be carried with Compressed air/Nitrogen gas to ensure that there is no blockage of nozzles.
- c) All necessary instrumentation, equipment, material and manpower required for testing shall be provided by the Contractor.
- d) The Contractor shall record all tests and system calibrations and a copy of these results shall be retained in Log Book.

2.12.22 Specifications for Maintenance of Clean Gas Fire Suppression System During Three years defect liability period.

- a) Servicing and undertaking preventive maintenance for a period of One year for the clean gas fire suppression system panel and alarm signals.

- b) Necessary manpower, tools, consumables like smoke generator for testing detectors, and test instruments etc. for maintenance of the system is in the scope of Contractor.
- c) During the period, quarterly visits shall be made by the OEM. During the defect liability period, false alarms/emergency calls should be attended immediately on receipt of information either from CPWD/ESIC.
- d) During every quarterly visit, scope of work shall include but not limited to the following:
 - i. Check the health of Local control panel.
 - ii. Complete check-up of wiring, local control panel, Simulation checks of detectors, remote indicators, junction box, Solenoid valve of total flooding clean gas fire suppression system etc.
 - iii. Simulation checks of safety interlocks of clean gas fire suppression system solenoids including AHU tripping from local control panels.
 - iv. Functional checks of Main/Redundant UPS and DC regulated power supply changeover circuit. End to end functional checks. Testing/Simulation checks of alarms at Gas discharge Panels and repeater panels if any.
 - v. Checking the condition of the Piping manifolds, Hoses, clean gas Cylinders, monitoring of cylinder pressure, safety burst disc, electronic control head / Solenoid, pressure operated control head, flexible hose, strap, non-return valve (NRV) and safety cap etc.

2.13 Automatic Fire Suppression system for Electrical Panels (With Heat Detection Tube)

This section is for an Automatic Fire Detection and Clean Agent Fire Suppression Systems by use of Linear Pneumatic Heat Detection Tube as 'Direct' Gas Flooding System for Electric Panels. The scope of work includes design, supply, installation, testing and commissioning of Automatic Clean Agent fire suppression System for All electrical panels complete with fire detection tube, cylinder, valves, integration with Main Fire Alarm Control Panel for status monitoring etc.

- a) Arrangement of Clean Gas Agent for flooding inside the panels.
- b) Audio-visual annunciation devices for indicating the incidence of fire.
- c) The electrical panel fire suppression system shall be complete with Direct 'Clean' Gas storage cylinders of required capacities, linear fire detection tubing, filling of gas, end-of-line adaptors, pressure switches, control equipment and all necessary accessories and push in fittings to form a complete and working installation to protect all-Electrical panels in case of fire.
- d) The system so provided shall have an interface with the Fire Alarm Control Panel. In case of fire in the concerned Panel, indication of Fire detection and Gas discharge status should be available in the Fire Alarm Control Panel.
- e) All installations shall conform to BIS requirements wherever applicable. Wherever relevant BIS standards are not available, then the NFP A requirements shall be met.

- f) The clean agent used should be eco-friendly like HFC227ea/ HFC236 /NOVEC1230.
- g) Each Clean Agent extinguishing unit, when installed, shall be a self-contained system, equipped with its own automatic (non-electric) detection system, which when actuated, automatically shall release the suppression agent into the Electric panel.
- h) The Clean Agent Automatic Direct System shall consist of the following major components: Clean Agent Cylinder, Valve Assembly, Cylinder Mounting Bracket; Fire Detector, Actuation and Discharge Fire Tubing, Fittings and Pressure Switch.
- i) The Clean Agent Automatic Direct System shall utilize flexible tubing that shall be attached to the top of the cylinder valve. This tubing shall be pressurized with dry nitrogen, which is temperature sensitive, and it shall act as a continuous line or thermal detector that ruptures upon flame impingement. Once the detector or tubing is ruptured, forming a nozzle at the rupture point, the Clean Agent flows through, distributing the extinguishing agent only into the protected area. Upon system actuation, the pressure switch shall be used to indicate system discharge, shut down ventilation, or shut-off electrical power etc.
- j) The Clean Agent Automatic Direct System shall be designed and listed as an Automatic unit. No manual or electric means is to be required for simultaneous actuation of multiple systems. Only 1 unit shall be used to protect one hazard and shall not be combined to protect a larger size hazard.
- k) The Clean Agent shall be stored in pressurized cylinders and the ambient operating temperature range for all the cylinders and all other system components shall be from 10 DegC to 50 DegC.
- l) Each container shall be equipped with a nickel-plated brass valve, a pressure gauge to monitor container pressure, and a quarter-turn ball valve for connection to the Detection Tubing. In addition, the container valves shall be equipped with a pressure relief (rupture disc) device complying to Indian Standards.
- m) A wall-mounted bracket shall be used to mount the container/valve assembly in a vertical (upright) position and each bracket shall be with two integral quick-clamps.
- n) The tubing shall perform the three functions of heat detection, System Activation, and Clean Agent discharge. The tubing shall be installed throughout the Electrical Panel volume, with one end connected to the top of the Clean Agent container valve.
- o) A pressure switch shall be connected at the end of line of the Detection Tubing to monitor system pressure, system actuation and/or to energize / de-energize electrically operated equipment. There shall be provision to connect the pressure switch to some other device(s) to alert personnel in the event of a system discharge.

2.13.1 The following shall be the design requirement

A sufficient amount of Clean Agent liquid to convert into Clean Agent HFC227ea/HFC226/NOVEC1230 shall be provided.

The contractor shall submit the calculations to verify suitability of the volume of the clean agent. The following shall be considered during the design calculations:

- a) Volume of hazard area.
- b) Specific volume of Clean Agent.
- c) Discharge time and flow rates.

- d) Design concentration and design factors.
- e) Detector/discharge tubing placement.
- f) Interface system with main control fire alarm system and, shall be provided.
- g) Provide total flooding of Clean Agent concentration by volume as per NFPA-2001.
- h) When the additional limitations of hazard volume, area coverage, maximum height, design concentration, agent quantity, detection tubing arrangement etc. are also met, the system installation shall comply with the design requirements, NFPA-2001.
- i) All doors and holes in the enclosed/equipment shall be closed or sealed to maintain the tightness of enclosure.
- j) The system shall have means to close the exhaust fans if installed in the panel at the time of system activation.
- k) The main supply of panel can be shut off with the system, if so, required by the Engineer-in-Charge.

2.13.2 Detection Tubing

- a) The automatic system shall become a self-contained, self-actuating unit and shall not require an external source of power or electricity.
- b) The system shall utilize flexible tubing that shall be attached to the container valve. This tubing shall be pressurized with Dry Nitrogen to 150 psi at 70 Deg F. The tubing shall be temperature sensitive and shall act as a continuous linear thermal detector that shall rupture upon flame impingement.
- c) Once the detection tubing is ruptured, forming a nozzle at the rupture point, it shall allow the Clean Agent through the Nozzle into the protected area.

2.13.3 System Components

- a) PESO approved Cylinder of steel construction with standard red epoxy paint finish. Cylinders shall be accompanied by original manufacturers test certificate confirming the contents of the cylinder and filled in PESO approved plant.
- b) Each cylinder shall have pressure gauge and integrated low-pressure switch to provide visual and electrical supervision of the cylinder pressure. The low-pressure switch shall be wired to the Audio-Visual Alarm to provide audible and visual trouble alarm in the event of drop of pressure. The pressure gauge shall be color coded to provide an easy, visual indication of cylinder pressure.
- c) The cylinder shall be equipped with brass valve, pressure gauge (to monitor agent pressure) and isolation valve for maintenance purposes. The cylinder valve shall be with a safety burst disc of 28 Bar rupture pressure.
- d) Furnish a welded steel bracket with each cylinder assembly for holding the cylinders in as well with a front bracket piece that secures the cylinders. Cylinder shall be provided with a certificate provided by the company who charge with the gas mixture.
- e) The Detection Tube shall be UL approved red/black in Colour and pressurized as per system design requirement. The integrated Pressure Switch (CE/UL/LPCB marked) should be integral part of valve having NO/NC contact.
- f) The control box enclosure shall be at least IP 54 rated from OEM of gas suppression system provider complying standard. The unit shall have LED indication for system Healthy, Mains Healthy and Gas Release. The unit shall also have signal silence button. Third Party test reports for IP and Functionality of the system to be submitted for approval complete as required.

2.13.4 Installation

- a) The system shall be installed as per approved shop drawings. The installation /final connections shall be carried out under indirect supervision of representative of Manufacturer/specialized agency. Cylinder shall be located so that they are not subjected to mechanical, chemical or other damage.
- b) All system components shall be capable of withstanding heat of fire and severe weather conditions. Detection Tube to be properly secured inside the panel by Clips/Tie etc. The Detection Tube outside the panel should be protected in flexible conduit.
- c) Inspection certificate should be pasted on cylinder clearly marking next due date of inspection.

2.13.5 Testing & acceptance

Testing of the system shall be done at site by holding the Nitrogen Pressure at 14 Bar into the detection tube for 24 hrs. to check for any pressure leakage in the system. If there is no pressure leakage of the system, then the installed system is accepted as healthy and the isolation valve shall be opened.

2.13.6 Documentations

Contractor shall prepare shop drawings of automatic Linear Pneumatic Heat Detection tube fire suppression system for approval of EIC before commencement of work/procurement of any items.

- a) General arrangement (GA) drawing clearly show routing of tube inside the panel as well as in equipment compartments as per system design requirements, location & fixing arrangement of cylinder & its system components, cutout details in panels etc.
- b) Technical leaflets / specifications. On completion of work, the contractor shall submit as built drawings. The drawings shall be Computer aided design drawings (CADD).

Indicative Fire Fighting System requirement to be provided in the building shall be as given below. Final design shall be made by the contractor as per NBC 2016 which shall be not on lesser provision of below mentioned requirement.

Sr. No	Building	Fire Extinguisher	First aid Hose reel	Yard Hydrant	Down comer	Automatic Sprinkler System	Under-ground static water tank combined capacity for wet riser, Yard Hydrant and Sprinklers per set of Pumps (litres)	Terrace tank over respective tower terrace (litres)	Terrace pump (1 working + 1 standby), Control Panel
1	Admin cum Laboratories Bldg	R	R	R	NR	R	20000	NR	NR
2	Farmer Training Hostel	R	R	NR	R	NR	NR	10000 Litres	450 LP M/35m head

C-3 Fire alarm system & PA System

3.0 Technical Specifications for Intelligent Addressable Fire Alarm System

- 3.1 The scope of work shall include designing , supplying and installing of **Intelligent Addressable Fire Alarm System and Public Address System for Admin cum Laboratories Building and Manual fire Alarm System for Farmers Training Hostel as per NBC 2016**. The work under this system shall consist of furnishing all materials, equipment, appliances and labour necessary to install the complete Fire Alarm System, complete with Main Fire Alarm Control Panel, Sensors, Sounders, Strobes, Manual Call Stations, Relays etc. for interfacing with other systems in Admin cum Laboratories building and other service areas as required. These technical specifications shall be read along with the General Conditions for all E&M works given under subhead C-B.
- 3.1.1 The facility shall have an emergency voice alarm communication system. Digitally stored message sequences shall notify the building occupants that a fire or life safety condition has been reported. Message generator(s) shall be capable of automatically distributing up to eight (8) simultaneous ,unique messages to appropriate audio zones within the facility based on the type and location of the initiating event. The Fire Command Centre (FCC) shall also support Emergency manual voice announcement capability for both system-wide or selected audio zones, and shall include provisions for the system operator to override automatic message system-wide or in selected zones.
- 3.1.2 The system shall support additional, alternate Fire Command Centers, which shall be capable of simultaneous monitoring of all system events. Alternate Fire Command Centers shall also support an approved method of transferring the control functions to an alternate Fire Command Centre when necessary. All Fire Command Centers shall be individually capable of assuming Audio Command functions such as Emergency Paging, audio zone control functions, and Firefighter's Telephone communication functions.
- a) Each designated zone shall transmit separate and different alarm, supervisory and trouble signals to the Fire Command Center (FCC) and designated personnel in other buildings at the site via a multiplex communication network. Any opening/ chasing in the wall/ceiling required for the installation shall be made good in appropriate manner.
 - b) The Contractor shall also undertake to control and monitor the ventilation and other systems from the Fire Alarm Panel through the use of Addressable Output / Input Modules.
 - c) The building shall be designated as multiple fire zones with each area forming one or more programmed zones. All wiring shall be done using 2x1.5mm² Fire Survival armoured copper conductor cable.
 - d) Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on NFPA Class A Signaling Line Circuits (SLC). Initiating Device Circuits (IDC), Notification Appliance Circuits (NAC) shall be wired in NFPA Class A.

- e) Alarm signals arriving at the FACP shall not be lost following power failure (or outage) until the alarm signal is processed and recorded.
- f) Two-way emergency telephone communication circuits shall be supervised for open and short circuit conditions.
 - i. Two-way emergency telephone (Fire Fighter Telephone) communication shall be supported between the Audio Command Center and up to thirty (30) remote Fire Fighter's Telephone locations simultaneously on a conference in multiple FFT Risers.
 - ii. Means shall be provided to connect FFT voice communications to the speaker circuits in order to allow voice paging over the speaker circuit from a telephone handset.
 - iii. The digital audio message generator shall be of reliable, non-moving parts, and support the digital storage up to 32 minutes of tones and emergency messages, shall support programming options to string audio segments together to create up to 1000 messages, or to loop messages and parts of messages to repeat for pre-determined cycles indefinitely.

3.1.3 Basis Of Design

Intelligent Fire Alarm System (IFAS) shall be provided to effect total control over the life safety services required in the building. The IFAS shall be of the digital, distributed processing, real-time, multi-tasking, multi-user and multi-location type.

The IFAS provided shall be able to tie up the following Mechanical, Electrical & Low Voltage Services into an integrated system.

- a) Air Handling Units, Fire Dampers.
- b) Staircase pressurization fans, Liftshafts and lift lobbies pressurization fans.
- c) Public address system.
- d) Lifts
- e) Smoke evacuation system
- f) Firefighting/Fire Suppression system

The system shall be provided with Addressable fire alarm initiating, annunciating and control devices. The addressable and intelligent system shall be such that smoke detectors, thermal sensors, manual call points, etc., can be identified with point address.

In the event of a fire alarm, but not in a fault condition, the following action shall be performed automatically.

- a. The System Alarm LED on the main fire alarm control panel shall flash.
- b. A local sounder in the control panel shall be sounded.
- c. The LCD display on the main fire alarm control panel shall indicate all information associated with Fire Alarm conditions including the type of alarm point and its location within the premises.
- d. History storage equipment shall log the information associated with the Fire Alarm

Control Panel condition, along with the time and date of occurrence.

- e. All system output programs assigned via control-by-event programs that are to be activated by a particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.
- f. The audio portion of the system shall direct the proper signal (tone or voice) to the appropriate speaker circuit.
- g. All lifts initiated through the system shall automatically be returned to Ground Floor.
- h. Air handling units on affected floors shall automatically be switched OFF and simultaneously respective fired ampers shall also be closed.
- j. Staircase/Lift Lobby pressurization fans shall be put on.
- k. Toilet exhaust fans on affected floors shall be put off.
- l. Pre-recorded alarm messages shall be played through the interface with Public Address system.
- m. Start smoke evacuation system.

3.1.4 General Instructions

Fire Alarm System shall be

- i. Protected from moisture by using appropriate coverings.
- ii. Sequence work to avoid interferences with building finishes and installation of other products.
- iii. For ease of service, all panel I/O wiring terminal blocks shall be removable, plug-in types and have sufficient capacity wire. Terminal blocks that are permanently fixed are not acceptable.

3.1.5 Standards

The design, supply and installation and testing of the entire fire alarm system shall conform to EN 54 / BS: 5839 or NFPA 71 and 72. The detectors shall conform to relevant IS codes for Fire Alarm Systems, Local Bye-laws and National Building Code, CPWD Specifications Part-VI (Fire Alarm System).

All components of AFAS shall be new and suitable for the environment of installation at site. These shall be satisfactory in operation at voltage Deviated by $\pm 10\%$ from the nominal value.

3.1.6 Works to be done by the Contractor:

In addition to supply, installation, testing and commissioning of all the equipment and materials, the following works shall be deemed to be included within the scope of work to be executed by the contractor.

- (i) Loop earthing as required.
- (ii) All minor building work such as cutting and making good the damages.
- (iii) Necessary testing equipment.

- (iv) Approval from the concerned fire authorities as may be required as per the local Fire Regulations and bye laws.

3.1.7 Painting and protection:

Metal work of all equipment to be supplied (except the detectors) shall be given the final coat of paint over the primer after necessary treatment at the works before dispatch. All damages to painting during transport and installation shall be set right or repainted to the entire satisfaction of the Engineer-in-Charge before handing over.

3.1.8 Guarantee:

The contractor shall guarantee the entire AFAS installation as per specifications both for components and for system as a whole. All equipment shall be guaranteed for Three years from the date of acceptance against performance or breakdown due to defective design, manufacture and/or installation. The installation shall be covered by the condition that the whole installation or any part thereof found defective within the years from the date of taking over shall be replaced or repaired by the contractor free of charge to the entire satisfaction of 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 warranty shall cover the following:-

- (i) Quality strength and performance of materials used.
- (ii) Safe mechanical and electrical stress on all parts under all specified conditions of operation.
- (iii) Satisfactory operation during the DLP period.
- (iv) Performance figures and other particulars as specified by the tenderer under schedule of guaranteed technical particulars.

3.1.9 After sales service:

The contractor shall ensure adequate and prompt after sales services in the form of maintenance personnel and spares as and when required with a view

To minimize the breakdown period. Particular attention shall be given to ensure that all spares are easily available during the normal life of the installation.

3.2 Fire Alarm System

- a) The Fire Alarm System shall conform to EN54, BS: 5839 or NFPA 71/72 in respect of design and installation, and it shall give Audio/Visual Alarm Signals when there is rise in temperature in case of Heat Detector or while measuring Smoke Density in case of Smoke Detector, while it exceeds the pre-set limit. The system shall give pinpoint location of fire with warning system and voice communication for commands and instruction if required.
- b) The system shall have a microprocessor-based control and monitoring facility. The basic function of the system shall be able to achieve pinpoint location of alarm indication.
- c) It shall be possible to program each loop with up to 99 Detectors & 99 Modules in a circuit.
- d) Annunciation facility shall also be inbuilt into the FACP, the panel being able to initiate

alarm signal for any particular zone.

- e) The system shall be fully supervised for all fault conditions with distinctive alarm operated for fault and fire conditions. Test buttons and software features shall be provided to test the electronic circuits and Detector health.
- f) The FACP shall be so programmed that when a particular Detector or group of detectors gives a fire signal the FACP should be able to trip an individual AHU automatically. In case of Fire in an area handled by an AHU the FACP shall be able to trigger a Relay that shall shut off the AHU through an additional contact provided in the AHU panel by the contractor.
- g) The FACP shall also be able to operate the fire suppression system in high-risk areas automatically upon receiving input warnings from one or more VESDA (very early smoke detection and alarm) units located in that area.
- h) The FACP shall have facility to connect addressable Input/Output Devices in the peripheral RS 485 bus. These may be input card, relay card, sounder card, passive/active repeater panels and mimic driver cards.
- i) The system shall be based on an "Open Protocol" to ensure flexibility of using Sensors / Detectors of an alternate manufacturer, in case the user requires such an option at a later date.

3.2.1 Inventory

Inventory of Fire Alarm system is prepared by Contractor & Shall be design, prepare drawings and layouts for Fire Alarm System and get it approved by the Engineer-in-charge.

3.2.2 Fire Alarm Control Panel (FACP)

This refers to the microprocessor-based panel that shall be connected to the various sensors/devices by means of 2 wire loops. The FACP shall be able to supervise individual detectors for proper performance as well as to give pinpoint location of Fire or Fault Alarm and initiate Alarms as well as facility for cutting off of AHU's and Electrical Power is also to be included. The Fire Alarm Control Panel shall be microprocessor based Addressable, Control Unit which shall control all Analogue Addressable Detectors, Manual Call Stations and Switching Systems (for disconnecting AHU and power supply to Lifts etc.) connected to it.

- a) The panel should work on degrade mode i.e if the main panel experiences a critical system fault, it shall work in a degrade mode. If the mains incoming supply fails, an internal feeder selector card switches to a backup mains supply..
- b) All addressable units shall be connected to the FACP through the Loop Cards and shall be addressed through individual numbers. The FACP shall be able to obtain analogue value for all detectors in the circuit through a pulsed digitalized current data. The FACP shall be able to analyze all analogue inputs from all addressable units, and through its own software and ambient level screening the FACP shall be able to identify fire, possible fire or fault conditions. The unit supervision shall be dynamic and continuous.
- c) The FACP shall itself have loop card built in. The capacity of the Panel and number of loops shall be designed by the contractor based on the total detectors and devices. All the networked panels shall display all the events occurring anywhere in the system. Each FACP on the network shall effectively function as a repeater panel as well.

- d) The FACP shall also give adequate warning signal whenever there is dust accumulation in detectors, and up to the point of its replacement it should be possible to change the level of ambient alarm calibration condition either by the use of software program operable by the owner or by resetting the detector.
- e) Short / Open circuit units shall also be reported at the FACP. In such cases, the system through the use of fault isolators shall be able to isolate that segment between the two fault isolators. The missing Detectors/Devices shall also be reported at the FACP with identification of the location.
- f) When an alarm condition is sensed at the FACP from a smoke or heat detector, a delay time/alarm verification period shall be started. If the sensor is still in alarm after the delay time expires, an alarm condition is reported. The delay time shall be adjustable from 0 to 990 secs.
- g) The FACP shall have the facility to perform walk test such that an operation can be periodically checked out for all initiating devices. As each device is placed into alarm, the FACP shall print the condition and automatically reset the device. Audible devices shall be initiated, if required, at a pre-programmed time. If a zone is inadvertently left in walk test mode, it shall automatically reset to normal after the idle time is exceeded. During the walk test, the zones other than the programmed zones shall be under continuous supervision (normal mode). In case of any alarm initiated by detector/devices, the walk test shall get terminated automatically.
- h) Programming functions shall include alarm /trouble type assignment, point descriptor assignment, alarm message assignment, etc.
- i) Programming may be carried out from the FACP keyboard or utilizing the approved PC setup software via laptop/desktop computer.
- j) The FACP shall have a minimum 300-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 $\pm$ 5%V, 50 Hz), 48 hrs back-up with 24-volt sealed maintenance free batteries with automatic charger. In case of testing of the system from the FACP the Display shall be able to give readouts of analogue value of all detectors being tested. The FACP shall also be able to carry out continuous self-monitoring when in normal condition.
- k) The FACP shall have facility for in-built or external printer coupled to the FACP, which shall log all events with time. The printout shall clearly indicate the event - Fire/Pre-Alarm/Fault etc. with the unit address and time.
- l) The FACP shall also be able to discriminate between false alarms and fire conditions, as well as priority selection of alarm in case alarm activates in two or more remotely located units simultaneously. In such cases, the Manual Call stations shall have the highest priority.
- m) The FACP also is able to actuate switching systems automatically in case of Fire condition that of AHU's and power supply or other systems such as Fire Suppression Systems.
- n) The System shall be fail safe and adequate safe guards should be undertaken that in the event of a failure of a part of the System, it shall not handicap the complete System. The

Loop Cards shall be of Modular Construction.

- o) The Contractor shall undertake the responsibility of the complete installation, commissioning, user trials, training and maintenance of the System, installation of System Software into the FACP. The Software shall be such so as to be easily operated by the Client's Personnel and secured against Software errors, ability to be upgraded so as to incorporate more features at a later date.
- p) The FACP shall have its own Battery Backup of a minimum of 24 hours in normal condition and then half an hour in alarm condition. The backup time calculation shall be done as per IS 2189 standards. The Battery shall be 2*12V (24V) DC with required AH capacity and of sealed lead acid rechargeable maintenance free type, housed inside the FACP.
- q) It shall be able to withstand temperature variations from 0° centigrade to 50° centigrade. Further, Relative Humidity (non-condensing type) 10 to 90% shall not hamper its performance.
- r) The FACP shall be totally enclosed dust and vermin proof type made of minimum 16-gauge dust inhibited sheet with even baked finish. The FACP shall be of completely solid stage design.
- s) The FACP shall have any one of these approvals: EN/UL/FM.
- t) The system shall be designed such that it shall be possible to add at least 20% of the Detectors for future expansion without extra cost on the panel.
- u) The FACP shall be capable of being networked (future expansion) with other similar FACPs located at different parts of the premises through a single RS485 bus.
- v) The FACP shall have provision for interfacing with the Public Address System.
- w) The panel should have the facility to interface with an automatic two-channel programmable speech dialer for verbal reporting of fire. It shall be able to call four telephone numbers per channel. The programmable speech dialer shall have two alarm inputs and shall provide listen-in capabilities through the built-in microphone. The dialer shall have a built-in keypad for easy operation, programming and voice recording.
- x) The panel shall have facility to connect printer to print out log and facility to have seamless integration with analog/digital voice evacuation system and shall be complete with all accessories. The panel shall be compatible with open protocol BACnet/ Modbus over IP complete as per specifications

3.2.3 Loop

A loop shall be capable of supporting not less than 240 devices (including detectors) and minimum 120 detectors per loop and loop length upto 2km, network communication card. The loop card shall have built-in short circuit isolators to accommodate Class A wiring.

3.2.4 Addressable Detectors

The Detectors shall be Analogue Addressable type. The chamber should be easily removable for the purpose of easy maintenance. The address programming shall be done through the decade switch in the Detector/Soft programming through panel or handheld programmer. The Detectors shall have a common base to allow easy interchange of various types of Detectors. Address setting by DIL Switch or through Hand Held Programmer shall not be acceptable.

A. Optical Thermal/Multicriteria detector

- a) All detectors are fitted with plug-in system type connections, from the maintenance and compatibility point of views. An alarm release will not affect a detector's good functioning. After resetting the alarm, the detector will resume operations without readjustment of any kind.
- b) The detector shall be able to sense incipient fire by detecting the presence of visible and invisible products of combustion. The detector shall be suitable for low voltage (15 to 32 V DC) two wires supply. The sensitivity of the detector shall not vary with change in ambient temperature, humidity, pressure or voltage variation.
- c) The detector shall be suitably protected against dust accumulation/ingress and it shall be free from maintenance and functionally tested at intervals. All detectors shall be identical in construction design and characteristic of facilitate easy replacement.
- d) The coverage per smoke detector shall strictly follow IS2189 standards. It shall be possible to connect Smoke Detector with Heat Detector or Manual Push Button in the same circuit. The sensitivity of detector shall be set from the FACP to suit the site requirement.
- e) It shall have in-built locking mechanism to check the removal and pilferage of the detector.
- f) The Photo electric type Smoke Detector shall be Analogue Addressable type and be able to send analogue output to the FACP regarding its condition. It shall be able to communicate with the FACP by the pulses emitted from the FACP. The detector should be programmed using decade or rotary switch/ soft programming.
- g) The base of the Detector shall be electronics free and interchangeable with other smoke or heat detectors. It shall be able to withstand temperature variations from 0 degree centigrade to 60 degrees centigrade. Further, Relative Humidity (non-condensing type) 10 to 90% shall not hamper its performance.
- h) The Detector shall have ENorUL/FM approval. It shall be possible to test the Detectors working both from the FACP as well as locally. It shall be possible to mount the detectors in Duct Casting Unit for sampling of Supplying Air from the AHUs.
- i) Response indicators with LEDs shall be provided for all the Above False Ceiling Detectors /for Closed Rooms.
- j) The detector shall have LEDs for 360degree viewing angle. LED on the detector shall blink each time the sensor is scanned by the FACP. If the FACP determines that the sensor is in alarm, the FACP will command the sensor LED to remain on to indicate the same. Each sensor will be capable of being tested for alarm via command from the FACP. Each sensor shall respond to FACP scan with the information about its type for identification.
- k) It shall be possible to connect loop powered base sounders on the detector loop.

B. Heat Detector

- a) Heat detector shall provide temperature measurement when it reaches pre-alarm in normal course. However, the operator shall have the option of calling up the temperature measured by the specific detector as and when required.
- b) It shall have in-built locking mechanism to check the removal and pilferage of the detector.
- c) The heat detector shall be Analogue Addressable type and be able to send analogue output to the FACP regarding its condition. It shall be able to communicate with the FACP by the pulses emitted from the FACP. The detector should be programmed using decade or rotary switch/Soft programming.

- d) The base of the Detector shall be electronics free and interchangeable with other smoke or heat detectors. It shall be able to withstand temperature variations from -0 degree centigrade to 60 degrees centigrade. Further, Relative Humidity (non-condensing type) 10 to 90% shall not hamper its performance. The voltage rating shall be from 15V to 32V DC though the voltage may be changed depending upon the Manufacturer's standards.
 - e) The Detector shall have EN or UL/FM approval. It shall be possible to test the Detectors working both from the FACP as well as locally by means of magnet to do a Functional Test.
 - f) The detector shall have LEDs for 360 degree viewing angle. LED on the detector shall blink each time the sensor is scanned by the FACP. If the FACP determines that the sensor is in alarm, the FACP will command the sensor LED to remain on to indicate the same. Each sensor will be capable of being tested for alarm via command from the FACP. Each sensor shall respond to FACP scan with the information about its type for identification.
 - g) It shall be possible to connect loop powered base sounders on the detector loop.
- C. High Sensitivity Laser Smoke/ Dualray Detectors.
- a) Laser Smoke detector will provide extremely high Sensitivity to fire conditions, by detecting earliest particle of Combustion.
 - b) Detector should detect both fast flaming and slow smoldering fires.
 - c) The detector should have different sensitivity levels from (0.07-6.56%/m).
 - d) Detector shall have LEDs for 360 degree viewing angle. LED on the detector shall blink each time the sensor is scanned by the FACP. If the FACP determines that the sensor is in alarm, the FACP will Command the sensor LED to remain on to indicate the same. Each Sensor will be capable of being tested for alarm via command from the FACP. Each sensor shall respond to FACP scan with the Information about its type for identification.
 - e) it shall be possible to connect loop powered base sounders on the Detector loop. The sounder shall have a sound output of at least 85db and will not require a separate cable for power supply.
 - f) The Detector should be more sensitive than normal Smoke Detector.
 - g) These shall be provided in High-Risk areas like Substation, Electrical Rooms, Server Room. And need to be Integrated with Gas based Fire Suppression System for quenching the Arc / Fire in those areas.
- D. Addressable Beam Detector (Infra-RED-LIGHT detector)
- a) The Beam Detectors shall be long range, projected beam type smoke detector which consist of a separate transmitter and receiver and evaluating unit integrated into a compact housing.
 - b) The transmitter shall emit an invisible pulsed infra-red beam to receiver when beam is obscured beyond selected threshold (20%, 30%, ... 70% obscuration) by smoke, the receiver shall signal an alarm. If the beam is completely blocked, receiver shall signal a trouble.
 - c) It shall provide selectable sensitivity and alarm response time for flexibility of installations.

- d) It shall have a range coverage from 7 mtrs. to 160 mtrs. with upto 15 mtrs.spacing between adjacent detect ors on smooth, flat ceilings.
- e) It shall have automatic environment compensation. These detectors shall be installed in the main entrance atrium with Double height.
- f) The beam detector shall be conventional and motorized type able to be commissioned through a mobile/tablet based app by using Bluetooth technology

3.2.5 Manual Call Stations

- a) The Manual Call Station shall be addressable type with Input Modules to define the address for each station. The function shall be similar to that of conventional Manual Call Point and should be resettable without replacing the glass.
- b) The manual station shall be a push type type. The device shall bered in color and suitable for surface or flush mounting. Manual stations shall be interfaceable to an addressable input module that can be accommodated within the device.The manual station shall have normally open fire alarm and annunciator contacts and these contacts shall close on activation.Contacts shall remain closed until station is manually reset.
- c) The Manual Call Station shall be fully addressable with its own addressable module and operated by digitized signals from the FACP.The voltage range shall be from 15V to 32V. It shall have protection as per IP33.The operating temperature range shall be from 0 degree C to 60-degree C. Relative Humidity (non-condensing) range of performance parameters shall be between 10 to 90%.

3.2.6 Fire Alarm Repeater /Annunciator Panel

- a) The Alarm Repeater /Annunciator Panel shall display fire /fault messages simultaneously with the FACP. It shall be capable of interfacing with the FACP on a single RS 485 Bus. The panel shall be capable of operating on 24VDC supply.
- b) The panel shall have backlit type alphanumeric LCD display, which shall display date, time &description of alarm/ trouble events that are displayed in the FACP with an inbuilt buzzer to indicate fault /fire alarm.
- c) The panel shall be powered from the FACP.
- d) It shall have control keys for Sound, Silence, Mute and to reset the FACP from the repeater station.
- e) The repeater panel shall have the following LED's indications
 - a. Supply
 - b. Fault
 - c. Mute
 - d. Silent
 - e. Disabled
 - f. Fire

3.2.7 Sounder/hooterscum Strobes

- a) The sounder shall be Addressable Loop Powered electronic type and shall give discontinuous /intermittent audible alarm whenever any detector or MCP operates. The sound output from the Hooter should not be less than 85 decibels and up to120 decibel sat1mtr distance.

- b) The sounder/Hooter shall be powered from either 2-wire detector loop or separate power supply 24 VDC can be used or additional cable shall be used in case of external power supply.
- c) The horn/strobe shall be listed to UL 1971/ UL 464/ LPCB and shall be Approved for fire protective service. The horn/strobe shall be wired as a primary-signaling notification appliance and flashing over the strobe's entire operating voltage range. The horn shall have three audibility options and an option to switch between a Temporal pattern and a non-Temporal (continuous) pattern. These options are set by a multiple position switch.

3.2.8 Duct Casting Unit

- a) The Duct Casting Units are to be directly installed in the return Air conditioning ducts for detecting any hazardous quantity of products of combustion carried through the ducts.
- b) The complete unit shall consist of Polycarbonate housing to accommodate Photo Electric Detector with plug - in facility and sampling tubes, one for Air inlet and other as the air outlet.
- c) The Inlet tube shall extend into and across the duct width; the outlet tube shall be of fixed length.
- d) When the AHU blower fans operate, a continuous cross-sectional Sampling of air from the duct shall flow through the housing containing the Detector. The outlet tube shall return the sample air into the duct.
- e) The functional requirements of the Duct Casting Unit shall be:
 - i) Uniform Sensitivity-irrespective of air velocity-up to 1200 meters per minute.
 - ii) It shall function on the Venturi principle, with Aluminium Venturi tubes.
 - iii) The Duct Casting Unit shall be compact, easy to install and with the facility to dismantle the cover or Detector for maintenance purposes.
 - iv) The housing shall be mounted outside the duct; the probe tubes shall be inserted through the duct by cutting precision sized holes into the duct and sealed with rubber gaskets.
 - v) The Duct Casting Unit shall be LPCB/UL Approved.

3.2.9 Addressable Monitor Module

- a) The input modules shall be of dual /single channel type. The dual channel module shall be selectable for Normally Open or Normally Close by a 2-bit DIL switch.
- b) The monitor module shall provide an addressable input for N.O. or N.C. Contact devices such as manual stations, Water flow switches, sprinkler Supervisory devices, etc. It shall provide a supervised initiating circuit. An open-circuit fault shall be Annunciated at the Fire Alarm panel (Subsequential alarm shall be reported.)
- c) The device shall contain an LED, which blinks upon being scanned by the Fire alarm panel. Upon determination of an alarm condition of an alarm condition, the LED shall be latched on. The device shall have a selectable inbuilt fault isolator.

3.2.10 Addressable Control Module

- a) Output module shall mean Addressable points from the FACP with potential free contacts for tripping of AHUs, power supply to Lifts etc. as required. Any module shall operate two relay outputs powered from the loop and preferably consuming single address on the loop. The system shall also be able to handle separate modules to interface the speakers of the Public Address System.
- b) Addressable Control Module shall be provided to operate dry contacts for switching ON OFF pressurization fans, AHU's etc. in case of fire etc. It shall have a built-in type identification to automatically identify this Device to the control panel. It shall have internal circuitry & relay powered directly by two-wire loop. It shall have a selectable inbuilt fault isolator.

3.2.11 Fault Isolator Module

- a) The fault isolator device shall be placed at every 20 devices to limit the Number lost in the event of a short-circuit/wiring fault. All the other detectors shall remain functional because of the Class A wiring of the loop. The isolator shall not utilize an address and shall be built into the detector base wherever required.
- b) The Fault Isolator Device shall detect and isolate a short-circuited segment of a Fault-tolerant loop. The device shall automatically determine and turn to normal condition of the Loop and restore the isolated segment.

3.2.12 Graphic Monitoring Software

- a) The Graphic Software Shall Provide both Alarm Management and system maintenance tool.
- b) All the information is available on a single screen allowing quick Assessment, whilst any actions can be taken by accessing the Built-in menu. Building Evacuation, Alarm Silencing and Reset are available to any users with suitable security clearance.
- c) System maintenance can be performed on any device or zone whether the workstation is connected to a single panel or a series of networked panels. From a single location simple check can be performed to assess the status of individual devices, whilst devices and zones can easily be temporarily isolated for on-site works to be performed. Advanced functionality is available to users with level 3 access permitting the maintenance of PC software security passwords, Time & Date setting and control of the work station functionality.
- d) The schematic view offers users the site plan. It can be configured to provide a number of levels representing the overall site, individual floorplans, small sections of the floor plans or even individual rooms. Each plan is independently named and can be configured to show all devices as installed on the site.
- e) The event log details a complete history of the activity of the fire system. All major control actions are recorded with date, time, user and an Optional comment field. Entries are colour coded to help easy Identification of specific types of events.

3.3 Installation Guidelines for Detectors

3.3.1 Zones:-

- a) In buildings, wherever an alarm is activated it shall initiate a number of different activities, e.g., provision of assistance, commencement of firefighting operations and emergency evacuation procedures, summoning of fire brigade etc. It is essential that these activities are well coordinated. It is therefore important, for ease of communication that

the building may be divided in number of identifiable sectors/zones.

- b) All buildings with the exception of smaller ones need to be divided into detection zones. The zones need to be small enough for a fire to be located quickly. Even if the system is addressable, zoning indications need to be provided as this often provides a quicker display. Also, this would enable firefighters who are not familiar with the building to proceed to the location of fire.

3.3.2 Requirements of detection zones shall be as follows:

- a) The floor area of single zone shall not exceed 2000 Sqmtr.
- b) Each zone shall be restricted to a single floor.
- c) Voids above or below the floor area of a room, can be included in the same zone. The voids and the room constitute a single compartment.
- d) The traveled distance by any one responding to a fire alarm signal, shall not exceed 30mtrs.
- e) Any enclosed stairwell, lift well or other enclosed shaft-like structures shall be considered as a separate zone.
- f) If manual call points are located on the landings of an enclosed staircase, such points at each level shall be incorporated within the zone that serves the adjacent accommodation on that level.
- g) The detectors and manual call points within sectors/zones shall be wired to the control and indicating equipment.
- h) The entire electrical installation pertaining to the entire fire alarm system as described above shall be independent of other systems.
- i) It is advisable to provide adequate fire separation between the zones.
- j) If the requirement of detectors or call points is less than 20 in any area division of the area into zones is not necessary. Similarly, sectorization is not necessary if the number of zones is not very large.
- k) For larger system covering more than one building it may be necessary to create sectors in addition to zones in order to restrict the number of zones from which alarm originate simultaneously or in succession.
- l) The division into zones and/or sectors shall be decided based on careful consideration on the type risk and accessibility of zone in respect of main circulation routes and main control and indicating equipment. Response indicators outside doors of rooms, cabin etc., within a zone may be useful, if doors are likely to be locked. Making an area easier to search, the use of remote indicator lamps reduced the need for a large number of smaller zones.
- m) Where a special risk is present with in a larger protected area, e.g., a spray painting both in engineering workshop and it is considered important to obtain rapid identification of fire in that risk, such special risk shall be deemed as a separate zone.

3.3.3 Sitting of fire Detectors:-

At the time of installation and prior to commissioning, every fire detector should be allotted an identification number, preceded by alphabetic initials showing the type of detectors, for example, Z1/SD(I)20 meaning Smoke Detector, Ionization, zone 1, 20th detector. Z2/SDOT/3 meaning Smoke detector Optical, Zone 2, 3rd detector, HFT/2

(Fixed Temperature heatdetector, 2nd detector), HFR (Rate of rise heat detector) etc. A record of this should be maintained in the control center.

3.3.4 Spacing and sitting of detector:-(Common to all types of smoke and Heat Detectors).

- a) Under flat ceilings, the horizontal distance between any point in a protected area and the detector nearest to that point shall not exceed i) 7.5mtrs. in case of smoke detector and ii) 5mtrs. in case of heat detector.
- b) Under sloping roof pitched ceiling (where the distance between the top of apex and bottom of the roof exceeds 600mm), spacing of detectors in the vicinity of apex may be spaced between 7.5mtrs. to 8.5mtrs. for smoke detectors.
- c) Heat detectors should be installed that sensing element is not less than 25mm and more than 150mm below the ceiling/roof level. For smoke detectors, sensing element should not be less than 25mm and not more than 600mm below the ceiling /roof level except as necessary.
- d) Detectors shall not be mounted within 500 mm of any walls, partitions or obstructions to flow of smoke or hot gases, such as structural beam and duct work where the obstructions are greater than 250mm in depth.
- e) When structural beams or ductwork of any other ceiling attachments, not greater than 250mm depth, create obstacles to the flow of smoke, detectors shall not be mounted closer to the obstruction than twice the depth of the obstruction.
- f) Where partitions or storage racks that reach within 300mm of the ceiling, they shall be considered as walls that extend to the ceiling for the purpose of sitting the detectors.
- g) Similarly, ceiling obstructions such as structural beams, deeper than 10% of the overall ceiling height shall be considered as walls for the purpose of sitting the detectors.
- h) Detectors shall not be mounted within 1000mm of any air inlet (supply air Grills of HVAC system) or a forced ventilation system.
- i) A clear space of 500mm is maintained below each detector. Where detectors are constrained to be fixed to the wall, they shall be sited in such a way that the top of the detection element is between 150mm and 300mm below the ceiling. Additional detector shall be placed on the ceiling at a position 1500mm from any opening.
- j) A detector shall be placed on the protected side of the premises on the ceiling 1500mm from any door, window or any opening in the wall partitions separating the protected premises from the other premises.
- k) All stairwells, lift shafts, other utility shafts, etc. shall have a detector at the top. Lift machine rooms shall be provided with a detector. All enclosed staircase shall have one detector at each main landing within the staircase.
- l) The detector shall also be provided in cable tunnels, ducts, false floors, AC & AHU room, A.C. return ducts and distribution boards, main Board A.C. niches. Every enclosure e.g., room/cabin shall have a detector at ceiling, level and also under false ceiling, if provided.
- m) A response indicator shall be installed at the entrance to each room/cabin to the indicated where the detector has actuated. This arrangement shall also be followed in case of all concealed detectors in false floors, plenums, shafts, tunnels, etc.
- n) Void area in case of false ceiling, false flooring more than 800mm shall also be

protected with detectors with spacing like in normal installation. However, voids in false ceiling / flooring less than 800mm height need not necessarily have independent coverage unless the void is such that the spread of fire products between the rooms or compartment take place through it.

- o) No detector should be subjected to any interior decorations treatment that is painting, alteration of exterior cover etc. to conform with environment.

3.3.5 Spacing of Detectors at different Ceiling Height—This is given below

Type of Detectors		Up to	Spacing for ceiling Heights (s)							Remarks
			4.0	5.0	6.0	7.0	8.0	9.0	10.0	
Smoke detectors conforming to IS 11360 both ionization and optical type		9	No change	No change	No change	7.5	6.5	6.0	5.0	The spacing in corridors should not be greater than
										3 S/2
Heat detector conforming to IS 2175	Grade -I (instant 20 s)	7	No change							Spacing From the boundary wall should be kept S/2
	Grade -2 (instant 40 s)	6	5.5	5	4	3.5	3	Nil	Nil	
	Grade -3 (instant 60 s)	5	4.5	4	3	3.5	Nil	Nil	Nil	

Note:

The spacings have been adopted from the charts published by Fire Detection Institute of America and adopted by NFPA (National Fire Protection Association of America). The spacing for parameters of other than those considered here can be found from these charts.

- 3.3.6 In Case of Computer /EDP Center/Other Electronic Equipment Installed in Air-Conditioned Areas; The Following Requirements Should Apply:- The exact location where detectors should be installed on ceiling /below false floor should be determined after observing /studying air movements. This could be done by suitable smoke generating devices and observing smoke density by suitable measuring instruments. All detectors in the rooms, below false floor, above false ceiling or generally hidden should have external response indicators sited at

prominent place.

3.3.7 Compensation to the spacing of detectors:-

Height consideration: Spacing of 7.5 meter for smoke detectors is valid only upto a height of 7meter only and that 5meters for heat detectors is valid only upto a height of 5meter. Beyond these heights, spacing between the detectors shall be adjusted as below:

- a) Above 7-meter ceiling height: Only beam detectors shall be provided.
- b) Heat detectors for heights between 5meter and 7meters: 3.5 meter spacing.

3.3.8 High air movement consideration:

Spacing between detectors shall be suitably reduced in areas where high air movement or where high air changes prevails. Modified values of spacing is given in the following table.

Air changes per hour in side block	Multiplying factor for modified	
	Spacing(in meter)	(Area coverage) (in Sq. meter)
Lessthan7.5	1.00	(1.00)
8.5	0.95	(0.91)
10.0	0.91	(0.83)
12.0	0.83	(0.70)
15.0	0.74	(0.55)
20.0	0.64	(0.40)
30.0	0.50	(0.25)
60.0	0.38	(0.15)

- i. Detectors shall not be located in the vicinity of supply air diffusers. Minimum distance between the detector and the air inlets /diffusers shall be at least 1.5meter.
- ii. Detectors shall be so mounted as to favour the air flow towards return air openings.
- iii. After designing the detector spacing, it shall be crosschecked to ensure that there is at least one smoke detector for every 100m² or one heat detector for every 50m² of the compartment area.

3.3.9 Additional requirements for optical detectors:-

- a) Optical beam-type detectors shall be sited in such away that no point in the Protected space is more than 7.5meters from the nearest point of optical beam.
- b) Incase of as loping roof or pitched ceiling (where the distance between the top of apex and bottom of the roof exceeds 600mm), distance stated above may be

increased to 8.5meter.

- c) Where optical beam type smoke detector sareused morethan 600mm from ceiling level in order to provide supplementary detection of rising smoke with in a highspace (like Atriumetc.), the width of the are a protected on each side of optical be amshall beregarded as12.5% of the height of the above beam from ground level.
- d) Where there is a probability of people walking through the beam or where the be amis likely to be obstructed by fork lifts etc.,detectors shall be mounted at a suitable height.
- e) Transmitters, Receivers and/orreflectors shall be mounted on a solid construction which shall withstand vibrations, temperatures or any imposed load.
- f) The path length of the optical be am shall be within the limits specified by the manufacturers.
- g) Beam detection area shall not exceed the detection zone in which it isinstalled.

3.3.10 Siting of flame detectors

The location and spacing of the detectors shall be based on sound engineering evaluations taking into account the following.

- (a) Size of the fire requiring detection
- (b) Fuel involved
- (c) Sensitivity of detectors
- (d) Distance between the fire and detector
- (e) Radiant energy absorption of the atmosphere
- (f) Presence of other sources of emission
- (g) Purpose of detection system

Certain flame detectors respond to the instantaneous level of radiation received whileothers depend upon the level received over a period. In either case the response will depend on the distance between the flame detector and the fire, since the radiation level received is inversely proportional to thesquare of this distance. Increased distance from the fire will, therefore, lead to an increase in the size of the fire at detection. A clear line sight to the area being protected is of great importance but at the same time care must be exercised to avoid a directline sight to likely sources of non-fire radiation to prevent false alarms.

3.3.11 Spacing guideline

- a) Sufficient number of detectors shall be used and they shall be positioned such that no point requiring detection in the hazard area is obstructedor outside the field of view of at least one detector.
- b) The spacing of the detectors shall vary from fuel to fuel. It is there fore necessary to fix the distance as per the recommendations of the manufactures.
- c) The location of the detectors shall also be such that structural members or any other

opaque objects or materials do not obstruct their line of sight.

- d) When installed outdoors, detectors shall be shielded to prevent diminishing sensitivity due to rain, snow, ice etc., and allow a clear vision of the hazard area.

3.4 Inspection, Testing and Commissioning

3.4.1 Testing before supply

- a) Detectors, control and indicating panels, sounders, PA system equipment and battery unit with charger etc. shall be tested at the manufacturer's works to indicate satisfaction to the contract specifications, and test certificates be furnished with the supply at site of work by the contractor.
- b) In case of imported fire alarm components such as main fire alarm panel, Repeater panel, Smoke, Heat and Beam detectors, Manual Call points, Monitor and Control modules, Response Indicators, etc.; individual certificate with individual number confirming to the relevant international standard shall be provided by the contractor at the time of supply at site of work.

3.4.2 Initial Installation Inspection:

- a) After installation, a visual inspection of all the detectors should be made to make sure that they are properly placed. Each detector should be inspected to ensure that it is properly mounted and connected.
- b) Restorable heat detectors and restorable elements of combination detectors should be tested by a heat source, such as a hair dryer, or shielded heat lamp until it responds, making sure that the sensing element is not damaged. After each heat test, the detector should be reset and precaution should be taken to avoid damage of the non-restorable fixed temperature element of a combination rate of rise/fixed temperature detector.
- c) Non-resettable fixed temperature heat detectors which are not to be heat-tested should be tested mechanically or electrically for fire alarm function.
- d) Heat detectors with replaceable fusing alloy element should be tested first by removing the element to see whether contact operates properly and then reinserting the element in proper position.
- e) In periodic testing, heat detectors should be visually examined for damages for other conditions (such as heavy coats of paints etc. likely to interfere with the correct operation).
- f) Each smoke detector should be tested to initiate an alarm at its installed location with smoke or other approved aerosol which demonstrates that the smoke can enter the chamber and initiate an alarm.
- g) In order to ensure that each smoke detector is within its sensitivity range, it should be tested using either.
 - I. A calibrated test method, or
 - II. A manufacturer's/supplier's approved calibrated sensitivity test instrument, or
 - III. Approved control equipment for the purpose, or
 - IV. Other approved calibrated sensitivity test method.
- h) Detectors found to have a sensitivity outside the approved range should be replaced.

Note: Detectors sensitivity cannot be tested or measured using any spray /smoke producing device that administers an unmeasured concentration of aerosol /smoke into the detector.

3.4.3 Testing after installation:

Following tests shall be conducted in a completed FAS/AFAS/intelligent addressable FAS installation, in the presence of the Engineer-in-Charge and the test certificate shall be furnished for the following test.

- (i) Continuity test.
- (ii) Test for insulation resistance of the wiring and the control and indication panels.
- (iii) Test for system operation.

In the case of AFAS (See the note below), this test for fire conditions shall be conducted using a test fire at normal floor level. The number of locations for such a test shall be 1% of the total number of detectors in an installation subject to a minimum of two and maximum of five. The system operation for fault conditions shall be conducted by introducing faults such as open circuit, short circuit, removal of detector, open/short circuit in a sounder circuit etc.

Note: Use of a test fire in the case of installation using heat detectors need not be insisted upon.

3.4.4 Inspection by local bodies

It shall be the responsibility of the contractor to get the installation inspected and passed by the local authorities concerned, as may be required by the local bye-laws, and 'No Objection Certificate (N.O.C)' shall be obtained. Payment made for statutory fees shall be reimbursed on production of receipts.

3.5 Integrated Public Address and Voice Announcement system

The scope of work includes planning, designing, supplying and installation, testing & commissioning of Public Address System complete with Speakers, Amplifiers, Mike, and Zone Selection Panel for interfacing with other systems. The PA system is designed to serve the dual purpose of making general announcement and Voice Evacuation at the time of Fire alarm. The Public Address and Voice Evacuation System shall comprise Audio Matrix Units, High-quality speakers, Audio rack all mounted on a Rack and fully connected and integrated in to the fire alarm system.

The system shall be fully programmed to accommodate fire alarm and voice communication zones. The system shall be configured to allow on-site modifications with the minimum of disruption using the PC-based software to facilitate changes or alterations.

3.5.1 Applicable Standard:

EVAC Compliant with IEC/EN60849 Loudspeakers-Rated power IEC60286-Part5 Tested in accordance with BSEN60268-5A acoustic models ready for CATT, ULYSSES & EASE Compliant with BS5839Part8

3.5.2 General requirements:

- a) All system components shall be monitored including and not limited to amplifiers, backup amplifiers, speaker circuits, paging microphone, and 230 V AC line. Each amplifier/line circuit shall be monitored individually and shall report any faults back to the master controller unit.
- b) The system should support announcement consoles and multiple remote announcement stations as required.

- c) In the equipment/console room, all cables and wires should be terminated in the main junction box and should be clearly marked with cable ferrules. The system design should be such that it allows for future expansion at lowcost. The system should be modular for ease of maintenance.
- d) The system should have provision to avoid echo during announcement and suitable feedback suppressor and audio processor should be used in the system integration as may be required depending on the analogue or digital interface.
- e) The system should have a provision for playing continuous soft background music round the clock in all the floors of the building with a music level of 55-60dB. Band should be maintained. For inviting the attention of the announcement, a pleasing chime should precede every announcement. The music should be cutoff during the announcements.
- f) The equipment must be able to operate continuously and satisfactorily, without deterioration in performance, safety and reliability at temperatures 0deg to 55deg centigrade ambient. The level of PA announcement should be uniform at listening level of an adult person. The loudness level should be 16dB to 20dB above the ambient noise for clear and intelligible speech. The measured speech intelligibility STI (Speech Transmission Index) should be a minimum of 0.5 or more in all the floors /areas where the announcements are made.
- g) The system integration should take into consideration the height of the ceiling at various places, critical distance and directivity factor of the speaker system. The reverberation time of each zone in the terminal should be measured and the Electro acoustical adjustments should be carried out to achieve the target criterion as required, where announcements are made.

3.5.3 System Design

- a) The PAVA system shall be connected to the Fire Alarm system with in-built isolators to protect the system in case of any cable faults. The system shall be decentralized in nature, each distributed rack DAU (Distributed Amplifier Unit) shall have all the DSP (Digital Signal Processing), amplifiers and monitoring in such a way that can work in a stand-alone mode in case the master rack is faulty or down.
- b) All system components shall be digitally monitored including and not limited to, Messages, Amplifiers, and backup amplifiers, Speaker Circuits, Audio Matrix units, Paging Microphone, Battery Charger and the 230VAC line. Each amplifier /line circuit shall be monitored individually and shall report any faults back to the Master Audio Matrix Unit as well as the Paging Microphone.
- c) The Man-Machine Interface (MMI) shall be connected back to the control room, to monitor and control the entire PAVA system. Voice Evacuation and Public Address system integration include paging system and background music system.
- d) The system shall be capable of sending messages automatically to any zone at any time interval, without affecting the music in the other areas. Each Zone and circuit speaker shall have a separate amplifier, system sharing two amplifiers with multiple circuit speakers are not acceptable. There shall be one backup amplifier for every five amplifiers, the system shall automatically change over to the backup in case of any amplifier failure, and the backup amplifiers shall be monitored as well. In case of any system component failure, the paging microphone shall override any defective unit and provide paging to the required zone. The System can provide any Cause & Effect programs after integrating with the Fire Alarm System, thus Alert/Evacuate messages can be programmed and delayed as well as played on

any zone/floor as per the Cause & Effect approved by the Engineer.

- e) The Battery backup shall provide 24 hours of backup in standby mode and 30 min in normal operation. The power supply/charger shall be rack mounted. Battery calculation shall be based on the amplifier size and not the speaker circuit load.

3.5.4 Digital Amplifiers

- a) All amplifiers shall be digital & power amplifier type with High-quality speech and Music broadcast. The power amplifiers shall have adequate continuous (RMS) power output to meet the requirement of the configuration. The unit shall deliver the rated output power with less than 0.1% harmonic distortion in the design bandwidth. The amplifier shall have a broadband frequency response of 60 Hz to 15 KHz. The output voltage and impedance shall meet the system requirements. Amplifiers shall be protected against overloads and output shorts and a special thermal overload on the heat sink.
- b) The Amplifier shall have eight channels, four primary & four backups, and each primary channel have a rated power of 100W. The Amplifier shall have switch power technology for power saving, sleep mode is automatically enabled when no signal input is detected. Total number of Amplifiers and rating of each one shall be designed as per the actual requirement.
- c) The amplifier shall have AC 70V or 100V power supply and DC 24V input, having a separate fuse for each channel. The Amplifier shall be connected through balanced audio input and shall work on 100V Speaker Line.

Technical Specifications

➤ Main power supply	100-240V, 50Hz
➤ Amplification	Digital
➤ Battery Voltage	24V/48VDC (max 10% deviation)
➤ Frequency Response	60Hz to 16KHz
➤ S/N Ratio	70V mode, >70dB
➤ Total Harmonic Distortion	<0.5% at rated power
➤ Power Efficiency	>75%
➤ Operating Temperature	0 to 50 Deg. C
➤ Humidity	90% (Non-Condensing)

3.5.5 Speakers

- a) Speakers shall be specially designed for broad casting high-quality, integrated emergency fire alarm signals and voice communications and approved by an appropriate authority for use in such situations. Speakers shall be ceiling, wall-mounted or Horn speakers and shall be completed with mounting bracket, accessories and metal enclosures etc. as required.
- b) Speakers shall be of high efficiency, providing maximum output at minimum power across 60—16000Hz frequency range for Indoor Speakers. Speakers shall have a line matching transformer for direct connection to amplifiers with multiple taps. Speakers external appearance shall be approved by the Engineer-in-charge. Speakers shall be interconnected in the zone configuration.

I. Ceiling /Wall Mounted Digital Speaker

The speakers should be designed to simulate the sound quality and distortion prior to installation. The Ceiling speaker shall allow easy parallel connection of multiple

loudspeakers. The Speaker shall have multiple tapping for different applications according to room size and ambient noise environment. The Speaker shall have Aluminium grille and metal baffle and shall have a spring clip clamp for easy installation.

II. Technical Specifications

a. Rated power	6-9W(ceiling)/9-12W(wall)
b. Tapings	100V line 25%/50%/75%/100%
c. Operation Voltage	100V or 70V
d. Effective frequency range	60Hz-16kHz (10% Variation allowed)
e. SPL@1W/m(1KHZ)	90+/-5dB

3.5.6 Rack

- The equipment shall be housed in a standard rack of suitable height, with a Plexiglas door or metal mesh and lock. Ventilation panels of 1U height shall be provided between each item of equipment.
- Details of the proposed equipment shall be forwarded to the engineer-in-charge with performance specifications, dimensions, construction and finish for approval.
- The Rack should have DIN Rail Mounted Terminal Blocks for termination of Speaker Zone cables on the rear. All cables coming from Speaker zones, Call Stations, and Power supply should enter from the Bottom. The rack should be installed at a location which has a minimum of 600mm space from front & back for accessing it easily. The rack should be installed in a well-ventilated room preferably Air-conditioned. The unit should have Fans from the top. The unit should have a Lockable Glass door at front.

3.5.7 Speaker Cables

All cables associated with PA System shall be of the following specifications:

The 2-core speaker cable will be connected to the speakers by screw terminals. Care has to be taken for avoiding any single strand of wire that shall not come out of Lug & screw terminals to avoid noise & leakage. Speaker cables used shall be multi-Stranded type Flexible Copper Conductor of 1.5 Sq. mm FRLSPVC insulated, PVC sheathed. These Cables shall be laid in MS Conduits/cable trays. Call station cables should be CAT6A type, it should be crimped by RJ45 Shielded Male Connectors.

PUBLIC ADDRESS SYSTEM

1. Scope of work

Design, supplying, installation, testing and commissioning of public address system in the building. Each floor of the building shall be divided into suitable number of zones as number of speaker and its location and every equipment of PA system coming in that particular zone shall be in that Zone only. Each zone of fire alarm system shall be in sync with each zone of PA system. Integration of system shall be done accordingly, and all hardware components, converters, relays, software components etc. required for the same shall be included in the scope of contractor. The Public Address System provided shall be a standalone system with local control and no centralized control system is required.

The system shall be fully redundant, scalable, completely supervised and flexible. It shall consist of IPbased PAcontroller, Amplifiers, Callstation, speakers and communication cable i.e., the system bus. The system shall be fully IP-network based. The features like audio processing, communication using MODBUS protocol and control functions shall entirely be in the digital domain. The sound quality shall be improved by providing Digital signal processing (DSP) in every equipment.

2. Control Panel: The control Panel shall be IP based of minimum 8 zone Panel with features like voice alarm controller with USB, MP3 player (including 8 zone touch screen paging station) with Rack Mounted expandable up to 450 zones. The required zones can be integrated with the FAS panel and all hardware and software components required for the same are included in the scope. The voice alarm controller should be able to connect directly over Ethernet having seamless integration facility with main fire alarm panel for Zone wise voice evacuation complete as required. All system devices such as system controller, amplifiers and call stations shall communicate via IP, using an Audio over IP (AoIP) protocol which supports the controller for control with optional encryption and authentication to prevent unauthorized access, misuse and modification of data.

The speaker loops shall be directly fed from the controller instead of amplifier in order to provide effective the control and monitoring of speakers and coming devices.

3. Amplifier: The amplifiers shall be of minimum of total 125w/ 250w/ 500w/750 W Class-D Amplifier as per the requirement of design) with 2 speaker circuits with 1 channel and should have inbuilt feature like protection against re-settable overcurrent, overload, overheating, overvoltage, under-voltage and DC protection and should have 100V/70 Output, with 100 - 240 VAC input and 24 VDC backup with UPS power supply complete etc. as required.

- Each amplifier shall not be loaded more than 80% of its rated capacity
- Every alternate speaker shall be connected with two different amplifier circuits to provide speaker line redundancy for each zone.
- All amplifier channels shall supervise the integrity of connected loudspeaker lines without interruption of audio distribution.
- Every amplifier shall have an independent spare channel for redundancy or one separate spare amplifier for providing channel wise redundancy for a cluster of N main amplifiers, where $N \leq 7$. Th

4. Paging Station: The paging station shall be IP based with appropriate size Networkable capacitive touch screen for selection of zones. It should be having inbuilt features like supervision of system status, setting of scheduled broadcasts with the minimum features of Built-in monitoring loudspeaker, Detachable goose- neck microphone or handheld microphone, LCD touchscreen display with up to 2000zones complete etc. as required. The power supply shall be done through POE switches as required.

The priority of paging shall be as follows:

- (i) Fire/security control room–1st Priority
- (ii) PA control room -2nd Priority
- (iii) OT floor and Doctors call -3rd Priority

5. Speakers: The speakers required for PA system shall be of recessed type with metal box in ceiling/wall with minimum power rating of 6W and shall be tapped to 3W/1.5W as per the requirement of the system.

6.System Management Software: Supply, Installation,programming customization as per site conditions,testing&commissioning of System Management software in integration with IBMS software with one server & client license of **minimum 10 years**. It should connect with upto 250controllers. Administrator can decide No.of users and define user authorities freely.It shall display all equipment status and indicate fault alarm location, record and read history of operation and fault logs. It shall support Text-to-Speech (TTS) function. The flexibility of accessing Audio files stored on the server from any zone on the system network etc as required.

7. The components of PA system shall be neatly installed in sufficient sized Rack assembly of not less than10U made of aluminum channels, side & rearpanels made up of 16 SWG powder coated steel sheet, front transparent perspex door bearing with rails & rollers, 2 fans at the top for ventilation. The ventilation requirement shall be varied with the size of rack used. The rack assembly shall be so designed for proper mounting of amplifiers, system controller & all accessories etc. as required. The rack assembly shall provide a dedicated arrangement for cable management system and all network racks shall be powder coated with guarantee of not less than 10 years.

8. The wiring of PA system shall be done with suitable grade FRLS PVC insulated twin core, shielded,copper conductor flexible cable in the recessed MS(mildsteel) conduit laid in wall/ slab including connections and interconnections etc. as required.

9.Power supply of Equipment: The power supply shall be done from OEM prescribed DC power device which provides DC-power supply to connected amplifiers and peripherals from the mains, withstandards compliant charger for a single 12 V backup battery, saving on installation and battery maintenance costs. The integrated 6-port POE switch which shall be connected with RJ45 of SFP port, with glass fiber support is required for the interconnection of decentralized clusters of devices.

The power supply of paging station, amplifier etc shall be done through separate POE switch of minimum 8 port with 2 Nos SFP ports.

In addition to the standalone battery mentioned in above para, The Main power supply shall be taken from the UPS room from the dedicated supply provided in electrical shaft.

C-4 LIFTS

4.0 Technical Specifications for Lifts

4.1 The scope includes Planning, Designing & preparation of Drawings providing, installation at site, testing and commissioning of Machine Room or machine room less depending upon the site requirement Passenger / Fire lifts of various capacities block wise details as given, as per architectural plans and in accordance with NBC 2016 / CPWD Specifications as amended up to the date. If any item required to make the service functional, is not specifically mentioned in the scope and specifications, the same is deemed to be included within the scope of this tender. These technical specifications shall be read along with the General Conditions for all E&M works given undersubheadC-B.

4.1.1 The lift manufacturer should fulfil the following eligibility criteria.

- a) The lift manufacturer shall comply with BIS standards, duly certified by the manufacturer itself.
- b) The manufacturer shall be compliant to the Public Procurement (Preference to Make In India), Order 2017 (as amended from time to time) issued by the Department of Industrial Policy and Promotion (DIPP), Ministry of Commerce and Industry.
- c) The manufacturer shall furnish an undertaking regarding availability of spares for the entire expected life of the lift i.e. 15 to 20 years.
- d) The complete lift installation including its components, safety devices, various types of controls etc., testing, inspection, operation & maintenance shall conform to relevant Codes, Standards, code of practices, guidelines, safety rules, inspection manual(s), rules issued by Bureau of Indian Standards, as amended up to the last date of receipt of tenders.
- e) Quality standards shall conform to latest IS/ISO-9001:2015.
- f) The down time of installed lifts being maintained by the manufacturer shall not be more than 8 hours (average) in case of minor faults and 7 days (average) in case of major faults during the last one financial year.

4.1.2 Following features shall be considered while designing:

- a) Safety to personnel and equipment during both operation and maintenance Reliability of service
- b) Minimal fire risk
- c) Automatic protection of all electrical equipment through selective relaying system
- d) Maximum inter change ability of equipment
- e) Fail safe feature.
- f) Suitability of applicable environmental factors
- g) These specifications define the basic guidelines of the system as necessary for lifts. All data required in this regard shall be taken into consideration to develop a detailed engineering of the system. Site conditions as applicable are mentioned else where. Compliance with these specifications and or approval of any of contractor's documents shall in no case relieve the Contractors of his contractual obligations.
- h) All works to be performed and supplies shall be affected as a part of contract requirement, specific approvals/ review of Engineer-in-Charge.

4.1.3 Major activities requiring approvals /review shall include but not be limited to the

following:-

- a) General Arrangement drawings for the lifts including section through lift pit and lift shaft,
- b) Quality assurance procedures,
- c) Field testing and commissioning procedures
- d) Engineering activities to be performed by Contractor.
- e) Control and protection scheme.
- f) Factory inspection and testing procedures.
- g) Preparation of as-built drawings
- h) Any other work /activity, which is not listed above, however is necessary for the completion of lift / system.

4.1.4 Conformity with statutory Acts, Rules, Regulations, Standards and Safety Codes:

The installation shall be carried out in conformity with the local lifts Act and Rules. where no local Lifts Act are in force, the Bombay Lift Act shall be followed. The installation shall also conform to requirements of local Municipal By laws, norms laid by Uttar Pradesh State Electricity Board etc.

All electrical works in connection with installation of electric lifts shall be carried out in accordance with the provisions of Indian Electricity Act 2003 and the Indian Electricity Rule 1956 amended upto date and CPWD General Specifications for Electrical works amended upto date.

4.1.5 Verification of correctness of Equipment at Destination The contractor shall have to produce all the relevant records to certify that the genuine equipment from the manufacturers has been supplied and erected.

4.1.6 Training

The scope of works includes on job technical training of two persons at site.

4.1.7 Guarantee

The installation shall be handed over to the department after necessary testing and commissioning. The installation materials shall be guaranteed against any defective design /workmanship. The guarantee period will be for a period of 12 months from the date of handing over of entire work covered under agreement to the Department. The firm will be required to submit guarantee of material from the manufacturer to the department. AMC (Comprehensive) of lifts during the defect liability period will be in the OEM scope, nothing extra payable for AMC during defect liability period.

Sufficient trained and experienced staff shall be made available to meet any exigency of work during the guarantee period till the end of defect liability period. The maintenance up to the end of defect liability period, routine as well as preventive, as per manufacturer's recommendation, shall be carried out and there cord of the same shall have to be maintained.

4.1.8 Running In period:

After satisfactory final inspection & after complete installation, the contractor shall demonstrate the trouble-free running of the installation for a period of not less than 30 days before the department takes over. During this period, the lift shall be kept either automatic or

manual mode by the department. After the installation and operation without any major break down for 30 days it shall be taken over by Department. Subject to the guarantee, clause date of taking over the installation after 30 days of trouble-free operation shall be the date of acceptance. Any undue wear and tear of components during the running in period shall be made good by the contractor free of charge.

4.1.9 Works to be Done by the Contractor:

- a) To provide scaffolding the hoist way required for erection of lift.
- b) To carry out minor civil work, such as modification and making good the pocket /cut out in wall/ ceiling for car, counter weight, rail bracket, hall buttons, indicator and laying of sills in positions or any other work required for smooth operation & commissioning of lifts.
- c) To provide and fix the steel items such as machine beams, load bearing hook in the lift well slab, lift shaft for installation of machinery. Separators wherever required and buffer support channel and vertical iron ladder in lift.
- d) Providing of hoisting beam, lifting hook in the lift shaft for hoisting of equipment during erection and to facilitate maintenance in future including their fixing etc.
- e) Providing and fixing of necessary sill supporting projections, sheet steel facia plates on all landings as per requirements.
- f) Inside the lift shaft, there shall be an arrangement of one light point at each floor level and one light point at overhead, one light point in lift pit. All light points shall be in group controlled and wired with 2.5 sq mm FRLS PVC insulated copper conductor cable. One 15-amp power plug and one 5-amp power plug shall be provided at each floor with individual switch. Wiring of these power plugs shall be done with 4 sq mm FRLS PVC insulated copper conductor cable. LED Bulkhead fitting of suitable rating to provide minimum 200 lux shall be connected with each point of lift shaft.

4.1.10 Permission to Install the Lifts and License to Run

It shall be the responsibility of the successful tenderer for obtaining the necessary permission, if required, to install the lifts from the Inspector of Lifts, and relevant local authorities and subsequently to have the installation inspected by Inspector of Lifts, & the relevant local authorities and arrange to obtain the license to run the lifts. All relevant papers connected for obtaining the permission and final inspection will be signed by the Engineer-in-Charge. The requisite fee for this purpose shall be reimbursed to the contractor on production of the receipts on this account.

4.1.11 Requirements as per CPWD Manual on Accessible Built Environment for Lifts.

All lifts shall meet the accessibility requirements.

a. Lift door:

Lift door shall be automatic with horizontal sliding centre opening. Gap between the lift door and building floor shall not be more than 12mm. Time of closing of an automatic door shall be more than 5s and the closing speed shall not exceed 0.25 m/s. A mechanism to increase this time shall be installed to be customized by a user with mobility impairments.

b. Call button:

Clear floor space of at least 900 mm X 1200 mm with no obstruction placed for wheel chair user from reaching the call button and shall be installed at a height 800-1000 mm.

c. Control panel

The control panels inside the lift shall be placed at a height of between 900 mm to 1100 mm from the floor level either horizontally or vertically with in this space.

d. Handrails

Handrails shall be placed at a height of 900mm from the floor level and are fixed on both sides and at the rear of the lift.

e. Audio and visual indicators

Voice announcements system clearly audible shall be provided to indicate the floor level with the information that the door of the cage is open or closed for entry or exit.

f. Lift signage

A sign indicating the number of the floor arrived shall be provided oneach lift landing on the wall opposite the lift in big font with good colour contrast.

g. Emergency warning alarm

Lift car shall be equipped with emergency warning alarm Device (two-way communication system) permanently connected to amanned security point with visual and audible information feedback to the passengers confirming that, the alarm has been received, voice communication established, using the green enlightened symbol consisting of two heads.

4.2 Codes

The following Indian Standard Specifications and Codes of Practice, currently applicable and as per amended updated as on date irrespective of dates given below, shall apply to the equipment and the works covered in this contract. Wherever appropriate, If Indian Standards are not available, relevant British and / or IEC Standards shall be applicable.

Electric Traction Lifts	IS14665 (Part-1to5)
1100-volt grade XLPE /PVC insulated cables	IS7098/IS1554
FRLS PVC insulated copper conductor wires	IS694
Rigid steel conduits	IS95371981
Flexible steel conduits	IS34801966
Safety procedure and practices in electrical works	IS52161982
Electrical installation fire safety of buildings	IS16461997

4.2.1 Hoist Motor

- (a) Each elevator shall be provided with 415 Volt AC 3 phase, 50 cycles AC Motor. The motor shall be designed for lift duty i.e., for repeated starts and shall be of high-capacity integral motor with class Finsulation and equipped with thermal protection. It shall be AC reversible type for elevator service with high starting torque and low starting current. It shall be with minimum sound during operation and shall comply

with latest relevant IS specifications for lifts.

- (b) Protection for motor - Provision shall be made for over load protection of motor. Protective relay shall be provided on the controller to protect the lift equipment against low voltage and phase failure. The slow speed winding of this motor shall function automatically when the car is approaching a floor so as to provide a greater stopping accuracy.
- (c) Reverse phase relay - A reverse phase relay shall be provided on the individual controller to protect the lift equipment against phase reversal, low voltage and phase failure switches. Relays shall have suitable contact to withstand wear due to frequent make / break operation in hoist way.

4.2.2 Braking System

The brakes shall be used only to hold the counter weight and car in position. The brakes should not be used for stopping the lift. The electro mechanical brakes mounted on the motor and gear shall work on rectified D.C. supply. The brakes shall be fitted with self-aligning shoes and operated on power release principle to ensure safety if the power supply fails. The brake should be capable of operation automatically by various safety devices, current failure and by normal stopping of car. It should be possible to release the brake manually, such releases requiring the permanent application of manual force so as to move the lift car in short stops. For this purpose, onsets of brake release equipment shall be supplied. Stopping of the lifts shall not be achieved electrically but by electro mechanical system.

4.2.3 Control

The control shall be by microprocess or controlled electronically regulated A.C. Variable Voltage & Variable Frequency drive with phase reverse relay. Controller with Simplex / duplex full collective control and selective, drive control with digital technology.

4.2.4 Hoistway

- a) Car Frame: A suitable car frame shall be provided with adequate bracing to support the platform and car enclosure. The buffer striking plate on the underside of the car-frame platform assembly must fully compress the buffer spring in the pit before the plunger reaches its lower limit of travel.
- b) Platform, Heavy Loading Type: The car platform shall be arranged to accommodate load weighing up to 25% of the rated capacity, such as Hospital stretchers, wheeled food carts, passenger's baggage etc.
The platform shall be recessed 25mm for flooring Granite stone flooring as per approved samples pattern.
- c) Wiring for hoist way electrical devices included in scope of the elevator system, hall panel, pit emergency stops switch, and the travelling cable for the elevator car.

4.2.5 Car Frame Safety Gear And Governor

The car frame which supports the car platform and enclosure shall be made of structural steel and equipped with suitable guides and car safety devices mounted under car platform. The safety gear shall be of instantaneous type. Car safety, to stop the car when ever excessive ascending speed is attained, shall be operated by a speed governor through a continuous

steel rope. Suitable device shall be provided to cut off power from the motor and apply the brake on application of safety.

4.2.6 Thermal Overload Protection

Auto thermal overload protection is to be provided to protect the driving motor against overloads. If the car is overloaded, it should not start. The over load indicator and the sounding buzzer shall signal the overload condition.

4.2.7 Priority Control

Switching on the key contact and at the same time pressing the required floor buttons will allow a direct travel to the selected floor while the already registered car commands will be cancelled.

4.2.8 Full Load Control

Fully loaded cars should respond only to car commands. Floor calls remain registered and are served by then available not fully loaded cars.

4.2.9 Counter Weight & Guides

- a) All counter weights shall be of cast iron and shall travel between rigid guides of steel frame capable of withstanding buffer impacts. Suitable metallic counter weight guard of required length shall be provided at the bottom of the hoist way.
- b) Car and counter weight guides shall be of rigid steel guides and shall be of machined 'T' section only. The size being in accordance with relevant standards, it shall be capable of withstanding the forces resulting from the application of car or counter weight safety devices.

4.2.10 Sound Reduction

The contractor shall provide necessary sound reduction materials, preferably antivibration pads of proper density to effectively isolate the machine from the machine beams or flooring.

4.2.11 Terminal and Final Limits

Terminal switches shall be provided to slow down/ stop the car at the terminal landings. These terminal switches shall act independently of the operating device or final limit switches. Ultimate or final limit switches shall also be provided to automatically cut off the power and apply brake in case the car travel beyond terminal landings.

4.2.12 Terminal Buffer

Suitable spring buffers shall be installed to stop the car and counter weight at the extreme limits of travels. Buffer must be suitable for installation in the space available.

4.2.13 Ropes

The hoist ropes shall be of traction steel of suitable size, construction and number to ensure the proper operation of elevator and shall give satisfactory wearing qualities. The Governor rope shall be of steel. No car or counter weight ropes shall be repaired or lengthened by splicing. Fixing arrangements shall conform to IS 2365-1977.

4.2.14 Car Platform

The car platform shall be of framed construction and designed on the basis of rated load evenly distributed. The flooring shall be sound isolated platform having 6mm Chequered plate with tough wearing floor cover and fire-resistant material and final finish with

approved granite stone. Car stoppage accuracy at floors shall be within 5mm.

4.2.15 Car Enclosure or Body

The car body shall be in approved finish of 1.6 mm thick stainless-steel material. The car shall have suspended ceiling with arrangement for air through pressure fan / blower mounted on the roof of car and indirect lighting shall be with LED lamp fixture evenly distributed in the cabin.

4.2.16 Cabin Finishes

- a) Telephone cabinet with phone and lead up to the lift well. Microphone with switch along with communication cable between cabin car and Centralized Security Room/ Reception shall also be provided.
- b) Full height infrared light-ray with photo-electric cells across the car entrance.
- c) The lift should have a voice announcement system along with a visual display to indicate the floor level and also the information that the door of the car is open or closed for entrance or exit.
- d) The announcement system should be clearly audible i.e., the announcement should be 50 decibels.
- e) The provision of a mirror on the wall of the lift car opposite the lift door is a positive aid to navigation for wheel chair users. It allows the wheel chair user to see if anyone is behind them and also to see the floor indicating panel. The mirror should not extend below 900 mm from the lift floor to avoid confusing the people with impaired site.

4.2.17 Car Door & Landing Door

Stainless steel finish shall be as per brief technical sheet. The door panels to be of centre opening type with horizontal sliding doors. Landing door shall be 1 hr. fire rated as per NBC 2016. An electric door operator for opening and closing the car door and the landing door, shall be provided. It shall consist of a machine on the elevator car for each stopping at a landing. The car door and the landing door shall be mechanically connected and shall move simultaneously while opening and closing. Every landing door shall be provided with a locking device which shall comply with the following requirements:-

- a) It shall not be possible to open the landing door from the landing side until the lift car is within that particular relevant zone.
- b) However, provision shall be made for opening the door by means of special key for use in case of an emergency.
- c) It shall not be possible for the car to be started or kept in motion unless all the landing doors and car door are closed and locked.
- d) An electric contact for each car door shall be provided which shall prevent car movement away from the landing unless the door is in closed position.

4.2.18 Car Door Safety Shoe

Full height infrared car Door safety panel shall be installed on the car door panel. In the event of a person interrupting the beam, the closing operation of the doors (the car and landing doors) shall return to the open position. The closing operation of the doors shall also be reversible by pressing a button (Door Open button) in the lift car operating panel.

4.2.19 Car and Car Frame

- a) The passenger cars shall be isolated from frames to prevent vibration being transmitted from the ropes and guide shoes. Lateral and up ward motion of the car shall be restrained by locking blocks but there should not be any metal contact between the car and the frame. The car frames shall be of suitable steel section, properly and securely braced and shall be sufficiently rigid to with stand the operation of the safety gear with out permanent deformation of car frame.
- b) All lifts shall be of metal construction with center opening sliding steel doors, side panels instainless steel finish.

4.2.20 Following features shall also be provided in all lifts:-

- a) False ceilings: Stainless Steel (Stainless steel finish and panels as per manufacturer) fitted with LED light fittings through two row soft ranslucent fixture & Pressure fan/ blower with grills. The fan shall be connected on electric mains independent of mains supplying power to lift machine. Ventilation opening shall be provided inside the enclosure as per standard practice of lift manufacturers. To permit switching off the power supply to the lift without switching off the fan and the light, a separate circuit with control shall be provided as per directions of Engineer-in-Charge.
- b) Two number car operating panels with buttons in stainless steel finish. All operating panels shall have Braille Buttons.
- c) Digital car position indicator in car and car position indicators at all landing floors.
- d) Car direction indicator showing up/down direction all movement of car is to be fitted on all landing floors.
- e) Overload warning indicator in car.
- f) DO's and DONTs notice for lift operation duly framed.
- g) Call Registration indicator for the purpose of registering the requirement of car at a particular landing.
- h) A three-pin plug socket with switch for a hand lamp shall be fitted on top of the lift car for use by a person working there on.
- i) Voice Announcement system for each landing
- j) Automatic Rescue Device shall be provided.

4.2.21 Emergency Light In Car

A trickle charged battery operated emergency light lamp shall be provided in the car which shall operate automatically in case of power failure for minimum 90 minutes.

4.2.22 Alarm Bell

An emergency alarm bell shall be provided. The alarm bell shall be located at the ground floor landing and push for the same shall beat the car operating panel. The system shall be operated by batteries with trickle charger and the bell/siren should work the moment the alarm button in the car is pressed (90 min Backup).

4.2.23 Communication System

Telephone system with cables shall be provided between cabin car and Machine Room for each lift. In addition to this, each lift shall be connected with centralized room /Reception.Cable for CCTV and potential free contacts for, interface shall be provided.

4.2.24 Floor Position Indicator & Direction Arrows

Digital signal indications at all landings shall be provided by the appropriate numeral and direction arrows being indicated when the car is passing the corresponding floor. The indicator shall remain illuminated when the car is stopped at a floor. The top cover of the floor position and direction arrow indicator units shall be stainless steel.

4.2.25 Emergency Key

Emergency key or equivalent device shall be provided as required by the elevator supplier.

4.2.26 Detailed Instructions

Inside the lift car suitable instruction for passengers on car operating panel shall be displayed. Such instructions in lift car shall indicate capacity, No. of persons, 'No smoking' and such other instructions as are suitable for proper and safe operation of the lifts.

4.2.27 Fire Man Switch

Each lift shall have fire man toggle switch for access of fireman shall be provided in a breaking glass. The operation of this switch shall cancel all calls to this lift and lift will stop at then extnearest landing if traveling upward. The doors shall not open at this landing and the lift should start travelling to ground floor. In case of its travel in the down ward direction when the fireman's switch is operated, it shall go straight to ground floor direct with out stopping enroute. The emergency stop button inside the car shall become in operative during the journey. Once the car has reached the ground floor, it shall be under the command of fireman by car buttons, landing calls being isolated. The lift can be put in normal use by putting the fire man switch in its original position.

4.2.28 Operation

The operation shall be Simplex, full collective-selective with or with out attendant. It shall generally function in the manner described below:

On every intermediate landing there is a Up/Down button with 'Call Registered' lights. The extreme positions have one call button with a 'Call Registered' lights. Inside the car shall be provided with complete set of buttons and a key operated change over switch to facilitate operation with or without attendant.

The car shall answer all calls in a sequenced order depending upon the direction in which it is travelling.

4.2.29 Emergency Stop Switch

On top of the lift car an emergency stop switch shall be provided for use by maintenance personnel. Similar switches shall also be provided in the car. Operation of these switches shall render the car and landing buttons in operative and cancel all registered calls.

4.2.30 Automatic Rescue Device (ARD) shall have the following specifications.

- a) ARD should move the elevator to the nearest landing in case of power failure during normal operation of elevator.

- b) ARD should monitor the normal power supply in the main controller and shall activate rescue operation within 10 second so normal power supply failure. It should bring the elevator to the nearest floor at a slower speed than the normal run. While proceeding to the nearest floor, the elevator will detect the zone and stop. After the elevator has stopped, it automatically opens the doors and parks with door open. After the operation is completed by the ARD the elevator is automatically switched over to normal operation as soon as normal power supply resumes.
- c) In case the normal supply resumes during ARD in operation the elevator shall continue to run in ARD mode until it reaches the nearest landing and the doors are fully opened. If normal power supply resumes when the elevator is at the landing, it shall automatically be switched to normal power operation.
- d) All the lift safeties shall remain active during the ARD mode of operation.
- e) The emergency battery unit shall consist of suitable capacity of SMF (Sealed Maintenance Free) batteries with battery charger having auto trickle/ boost rate of charge. The battery capacity should be adequate so as to operate the ARD at least seven times a day provided the duration between usage is at least 30 minutes. A battery run-down indicator shall be provided.
- f) The elevator shall be equipped with an automatic stopping device arranged to bring the car to a stop at the terminal landings, independent of the regular operating device in the car. This safety device is required so that in case of controller failure or power failure, the lift should not get stuck in the shaft. With this device, the lift will come to the nearest landing and its doors will open and the person can come out of the lift.

4.3 Electrical Wiring

Power wiring between the controller and main board and controller to various landings shall be done in heavy gauge M.S. conduits conforming to Indian Electricity Rules and Specifications for electrical works. All cables shall be of appropriate size and voltage grading. Complete copper wiring for the entire lift installation shall be used.

4.3.1 Machine

The machine shall be, of gearless traction type for variable speed equipment for all lifts and shall include electric motors, electro mechanical brakes, steel sheave shafts and bed plate. The driving sheave shall be grooved to ensure sufficient traction and minimum rope wear. The machines shall be equipped with an arrangement for manual winding of machine for testing purpose or for operation when the power supply fails.

4.3.2 Dual Operation With Attendant

A Key operated switch shall be provided for Auto/ Attendant mode.

4.3.3 Automatic Self Levelling Devices

This device shall be operated in slow speed to bring the car door in level with landing door.

4.3.4 Light Fixtures

Suitable LED light fittings, recessed in the false ceiling and operated by a switch in the car operation panel shall be provided. Properly earthed lighting arrangement shall be provided in the hoistway in the form of Bulk-head fitting at each floor level.

4.3.5 Car Operating Panel/ Control panel

The car operating panel shall be flush mounted to full height in car enclosure and shall contain the following.

- a) Two numbers of car operating panels shall be provided in each lift.
- b) Bank of buttons shall correspond to various floors/ landings served.
- c) Emergency switch for stopping the car independent of regular operating device.
- d) Emergency alarm button. The alarm should be operated through DC battery.
- e) Light /Fan control switches.
- f) A key operated switch to operate lift “Automatic without attendant” and “With Attendant”
- g) Overload warning indicator in car.
- h) Battery operated emergency light.
- i) Have buttons with Braille letters and in sharp contrast from the background to aid people with visual impairments.
- j) Illuminated Lift Out of Order Board

4.3.6 Trailing Cable

The trailing cable shall have flame retarding and moisture resistant outer cover. They shall be flexible and shall be suitably suspended to relieve strain in the individual conductors. All multi-core trailing cables employed for the car shall satisfy the requirement of relevant Standard. Trailing cables shall be so suspended, anchored and run that the strain on individual cable conductor shall be reduced to a minimum and the cables are free from contact with the car counter weight, shaft sides etc. No intermediate jointing shall be permissible in the trailing cable.

4.3.7 The works listed as under shall be arranged by Contractor and deemed to be included in the quoted rates.

- a) All cuttings of walls, floors or partitions together with any repairs made necessary thereof, including grouting in position like bolts, sills, steel members, indicator, button boxes etc., after they are fitted in position.
- b) Scaffolding including temporary barricade required for lift works in elevator hoist way during the erection period and to remove the same there after.
- c) Facia Plates are to be provided and installed by the contractor.
- d) All painting works of elevator material.

The quoted rates shall be deemed to include for full and entire completion of all works in accordance with good engineering practice and recognized principles. If any additional civil works required other than mentioned in above to suit the lift well as constructed at site shall also be got executed by the contractor under his own arrangement, and

The cost of the same shall be deemed to have been included by them. The details of construction that may not have been specified but are apparently and obviously required for making the lifts functional, shall be deemed to be included in the lump sum rate quoted by the contractor. Decision of Engineer-in-Charge in such matter shall be final and binding.

4.3.8 Additional Features Required

a) Emergency Power Operation

The power supplies to lifts are provided from essential panel. A backup UPS system shall be provided to supply power to light fixtures, fan, alarm and intercom.

b) Anti-Nuisance

If number of calls registered is in excess of corresponding car load, all car calls shall be cancelled.

c) Load Nonstop

When the car load exceed sapre determined limit, the elevator shall not respond to hall calls.

d) Door Failure Operation

When an obstruction prevents a door from opening, the controller shall attempt its removal by repeated opening and closing, failing which the car shall travel to the next floor.

e) Self– Diagnostic Facility

The Controller shall perform self-diagnostic tests and report the health of the system. The system shall take care of minor faults like door operation and motor overheating.

f) Car Failure Operation

In case of car mal-function, the system shall make a self – diagnostic check and then allow the car to travel to the nearest floor at slow speed ,if safe.

g) Selective floor Service

Programming for selective floors services shall be software driven.

h) Auto Fan Off

In case no calls are registered for pre-set time, the cabin fan shall be automatically switched off.

4.4 Drawings

Before the commencement of work, the contractor on receipt of building drawings, shall prepare and submit all drawings, necessary shop drawings showing the general arrangement of the lift equipment for the approval of the Engineer-in-Charge. Contractor shall also check the exact dimensions of the lift shaft at site, before taking up the manufacturing the equipment at site.

4.5 Painting

All exposed metalwork furnished under the specifications, except as otherwise specified shall be properly spray painted over an anti-corrosive primer coat.

4.6 Schedule of requirements for lifts:

For Admin cum Laboratories Bldg & Farmers training Hostel Bldg.

Sl. No.	TECHNICAL PARAMETERS/ REQUIREMENT	Required Details of Lift		
		Admin cum Laboratories Bldg	Admin cum Laboratories Bldg	Farmers training Hostel Bldg
1	Type of Lift	13Passenger Lift	13Passenger Fire Lift	13Passenger Lift
2	Floors Served	G+6 Floor	G+6 Floor	G+1 Floor
3	Numbers of lifts required along with location	2 Nos.	1 No.	2 Nos.
4	Type of Operation	Single automatic push button Simplex/ duplex full selective collective system with/without attendant	Single automatic push button Simplex/ duplex full selective collective system with /without attendant	Single automatic push button Simplex/ duplex full selective collective system with/without attendant
5	Control	ACVVVF	ACVVVF	ACVVVF
6	Capacity			
	a. Rated Load (Kg)	884	884	884
	b. No. of Persons	13	13	13
7	Machine	Machine Room or Machine Room less depending upon the site requirement	Machine Room or Machine Room less depending upon the site requirement	Machine Room or Machine Room less depending upon the site requirement
8	Rated Speed (MPS)	1.5m/s	1.5m/s	1.0m/s
9	Stops & Openings			
	A. No. Of Stops	7	7	2
	B. No. Of Openings	7	7	2
10	Car And Hoist Way Entrance minimum (In mm)	1000	1000	1000
11	Height of Lift Car minimum	2200	2200	2200
12	Machine Room Dimensions	As per CPWD Specifications	As per CPWD Specifications	As per CPWD Specifications
13	Construction design and finish of car body	Car - i) Panels : Shall be Stainless Steel	Car - i) Panels : Shall be Stainless Steel (SS	Car - i) Panels : Shall be Stainless Steel (SS 304)

	work, car door and landing doors	(SS 304) 1.5 mm thick with scratch proof design. ii) Flooring :Shall be recessed granite stone of 25mm thickness or any other approved flooring with suitable pattern. iii) Ceiling : Stainless Steel Sheet (SS 304) with hairline finish or any approved design. iv) Lighting : Shall be 'LED' lights with illumination level of 150 lux, approximately v) Ventilation: Shall be cross flow blower with louver. vi) CCTV System -1 no. Dome camera to be provided in lift car	304) 1.5 mm thick with scratch proof design. ii) Flooring :Shall be recessed granite stone of 25mm thickness or any other approved flooring with suitable pattern. iii) Ceiling : Stainless Steel Sheet (SS 304) with hairline finish or any approved design. iv) Lighting : Shall be 'LED' lights with illumination level of 150 lux, approximately v) Ventilation: Shall be cross flow blower with louver. vi) CCTV System -1 no. Dome camera to be provided in lift car	1.5 mm thick with scratch proof design. ii) Flooring :Shall be recessed granite stone of 25mm thickness or any other approved flooring with suitable pattern. iii) Ceiling : Stainless Steel Sheet (SS 304) with hairline finish or any approved design. iv) Lighting : Shall be 'LED' lights with illumination level of 150 lux, approximately v) Ventilation: Shall be cross flow blower with louver. vi) CCTV System -1 no. Dome camera to be provided in lift car
		Car door :Power operated, centre opening horizontal sliding stainless steel with hairline finish	Car door :Power operated, centre opening horizontal sliding stainless steel with hairline finish	Car door :Power operated, centre opening horizontal sliding stainless steel with hairline finish
		Landing door :Power operated, centre opening horizontal sliding stainless steel with hairline finish including infra red full curtain control.	Landing door :Power operated, centre opening horizontal sliding stainless steel with hairline finish including infra red full curtain control.	Landing door :Power operated, centre opening horizontal sliding stainless steel with hairline finish including infra red full curtain control.
14	Type of signal system	i. Digital floor position indicator in the car and at all landings TFT / LED type. ii. Travel direction indicator in the car and at all landings (to be provided in car operating panel & at landing operating panels / above landing doors) iii. Gongs and visual indication on all landing for the arrival of the car iv. Overload warning audio and Visual Indicator inside the car (lift should not start on overload) v. Battery operated alarm bell and Emergency light vi. Car operating panel with fade proof Luminous buttons in car and with		

		intercom vii. Luminous hall Buttons at all landings and inside car with Braille language signage. viii. Voice annunciation system. This will announce the position of the car landing in Hindi & English besides facilities for any other announcement to be made from the central control room/ reception of the building. ix. Firemen's switch at ground floor x. Floor announcement in the car.
15	Automatic Rescue Device	Required with dry maintenance free batteries
16	Fireman Lift provision	Required.
17	Intercom and Alarm provision indicating locations where facility required	Yes required.

4.7 Testing

Testing at manufacturer's facility of the various equipment and components as required by IS codes/standards and other standards shall be done before dispatching the materials to site. If Engineer-in-charge or his representative, wishes to witness these tests, the scheduled dates for the same shall be informed well in advance before carrying out such tests.

4.7.1 Tests at Site:

a. Leveling Test:

Accuracy of the floor leveling shall be tested with the lift empty, fully loaded. The lift shall run to each floor while travelling both in upward and downward directions and the actual distance of car floor above/below landing floor shall be measured. The tolerances for leveling shall be as ± 5 mm accuracy.

b. Safety Gear Test:

Instantaneous safety gear controlled by a governor, should be tested with contract load and a contract speed, governor being operated by hand. Two tests should be made, however, with wedge clamps or flexible clamp safeties, one with contract load in the car and the other with 68 kg (equivalent to one person) in the car. The stopping distance obtained should be compared with specified figures and the guides, car platform, and safety gear should be carefully examined after wards for signs of permanent distortion.

Counterweight safety gear should be tripped by the counterweight governor and the stopping distance shall be noted. In this case, The governor tripping speed should exceed that of the car safety governor but by not more than 10 percent.

During the safety gear test, car speed (from the governor or the main sheave) can be determined at the instant or tripping speed with that stated in I.S. The governor jaws and rope should be examined for any undue wear.

c. Contract Speed:

This should be measured with contract load in the car, with half load and with no load, and should not vary from the contract speed by more than 10 percent. The convenient

method is by counting the number of revolutions, made by the sheave or drum in a known time. Chalkmark on the sheave or drum and a stop watch will facilitate timing but care must be exercised to ensure that no acceleration or retardation periods are included. If the roping is 2 to 1, the sheave speed is twice the car speed. Alternatively, the speed can be measured by a tachometer applied directly to shaft immediately below the sheave.

d. Car and landing doors interlocks:

The lift shall not move with any door open. The car door relay contact and

The retiring release cam must be tested. The working of the door operation and the safety edges and light equipment, if any, provided shall also be examined.

e. Normal Terminal Stopping Switches:

This shall be tested by letting the car run to each terminal landing in turn, first with no load and then with contract load and by taking measurements, top and bottom overtravels can be ascertained.

f. Final Terminal Stopping Switches:

The normal terminal stopping switches shall be disconnected for this test. It shall be ensured that these switches operate before the buffers are engaged.

g. Insulation Resistance:

This shall be measured (after removing the electronic PCBs and their connection) between power and control lines and earth and shall not be less than 5 mega-ohms when measured with D.C. voltage of 500 volts. The test shall be carried out with contactors so connected together as to ensure that all parts of every circuit are simultaneously tested.

h. Earthing:

All conduits, switches, casing and similar metalwork shall have earth continuity.

i. Buffers: The car should be run on to its buffers at contract speed and with contract load in the car to test whether there is any permanent distortion of the car or buffers. The counterweight buffers should be tested similarly.

Undertaking

We, M/s, _____ here by
submit this undertaking in respect of work of

We will provide all the required spares and materials for smooth comprehensive maintenance of lifts till their useful life of 20 years from the date of successful handing over of the total project to the department. In nocase, the department shall be asked to replace/ upgrade the lift or any parts i/c controller either manufactured by us or outsourced from our vendors, before expiry of the life of equipment, on account of becoming the model obsolete/ upgraded design. No extra charges shall be claimed on account of upgradation/ obsolescence of spares during the life time of the lifts.

1. We also agree for carrying out maintenance for 1 years i.e., till competition of defect liability period

1. (Signature of lift manufacturer)

Name:

Designation:

Company Name & address:

2. (Signature of Contractor)

Name:

Designation:

Company Name & address:

For lift work: SITC of lifts shall be got executed from the OEM of Lift who fulfill the following criteria: -

- (i) The lift manufacturer shall comply with BIS standards, duly certified by designated labs/certifying agencies.
- (ii) The Manufacturer shall be PPP MII Order-2017 (as amended) compliant.
- (iii) The experience of successful completion of similar works shall be as per CPWD works manual/SOP.
- (iv) The manufacturer shall furnish an undertaking regarding availability of spares for the entire life of the lift i.e. 15 to 20 years.
- (v) The complete lift installation including its components, safety devices, various types of control etc., testing, inspection, operation & maintenance shall conform to relevant Codes / Standards / Code of practices / Guidelines / Safety Rules / Inspection Manual(s)/Rules issued by Bureau of Indian Standards, as amended up to date.
- (vi) Quality Standards shall conform to IS/ISO-9001:2015 as amended.
- (vii) The Down Time of installed lifts, which are being maintained by the manufacturer, shall not be more than 8 hours (average) in case of minor fault and 7 days (average) in case of major faults in last one year. The data to be considered shall be for last financial year.

C-5- Substation

5.0 Technical Specifications for Sub-Station Work

Contractor Shall facilitate application for obtaining electrical connection for UPPCL of required Capacity & take up all necessary preparatory work for taking connection in the Sub-station on else where in the Campus to facilitate UPPCL to provide the requisite connection. The expenditure on the work regarding connecting shall be borne by the department and paid directly to be UPPCL on the receipt of demand note for statutory Fee and electrical distribution system extension work. For providing connection to the institutions. Contractor shall pay the fees to the Supply Company. Which shall be reimburse or Paid directly to UPPCL.

The specifications given below pertains to the Electrical sub-station 2x 1250 KVA capacity installation work. Sub-station equipment is proposed to be located in a separate Building. The Electrical sub-station consists of HT Panel Room, Transformer rooms, LT Panel room. The electrical service connection is at 11KV supply from the electrical utility i.e., UPPCL (PVVNL). The coordination with local electricity authority including obtaining the approval from the Central Electricity Authority shall be the sole responsibility of the contractor. However, statutory fees paid by the contractor will be reimbursed.

The Electrical power flow will be from Metering Unit to ICAR-CIRC's incoming H.T.VCB Panel to 11 KV / 440V step down transformers to the Main LT Panel. The power from Transformer to LT Panel shall be fed using sandwich type Copper Bus bar Trunking. Under power supply failure conditions, the D.G. Set shall be started to cater to emergency loads of the building, other non-residential Buildings.

The set technical specifications shall be read along with the General Conditions for all E&M works given under subhead C-B.

5.1 HT Panel

Technical Specification for 11KV VCB Panels.

The HT Panel shall comprise of Indoor type, floor mounted metal clad, 11KV VCB panel board with 6 panels, 2 I/C & 4 O/G panels (Three for Non-Residential + One Spare), totally enclosed & fully interlocked, Horizontal draw out, Horizontal isolation type breaker as per IEC-62271-100/200, as amended upto date and additional specifications, having capacities as mentioned below, shall be designed as per requirement and get it approved by Engineer-in-charge as per following specifications.

5.1.1 Codes and Standards

- a. All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC which are mentioned above except wherever modified and/or supplemented by this specification.
- b. The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

5.1.2 Design Criteria

- a) The VCB, shall be used to supply power to power transformers. The VCBs shall be located in a clean atmosphere. Equipment shall be furnished in strict accordance with the design and

requirements.

- b) For continuous operation at specified ratings, temperature rise of the various VCB components shall be limited to the permissible values stipulated in the relevant IEC standards.
- c) The VCB, and components thereof shall be capable of withstanding the mechanical forces and thermal stresses of the short circuit current without any damage or deterioration of material.
- d) Circuit breaker shall not produce any harmful over-voltage during switching of induction motors, unloaded line and unloaded transformers. If required, surge protective device shall be provided in the scope of supply to limit over-voltage.

5.1.3 Construction

- a) The VCB shall conform to the latest IS/ IEC 62271-200, Front-Lateral-Rear access, medium voltage parts which are connected to earth and with separate the bus bars, the withdrawable part (circuit breaker, fuse-contactor, disconnector truck or earthing truck) type, which means that the panels shall be four side internal arc tested and shall have metal partitions. The panel shall be floor mounted, draw out type. Design and construction shall be such as to allow extension at either end (modular). Unless otherwise stated, the H.T. (11 kV) Vacuum Circuit Breaker Panel shall conform to IS 3427, IS: 13118 (1991), IEC 62271- 100 & 200 for breakers & Panel and Indian Electricity Rules and Regulations amended upto date.
- b) The panel shall be single break, trip free mechanism, motor charged and manually/electrically closing breaker suitable for use on 11 KV, 3Phase, 50Hz A.C. supply with STC 26.3 KA for 3 Sec. Internal Arc for AFLR 26.3 kA at rated voltage for 1s at individual compartments i.e., Busbar, VCB and cable compartment. Complete with self-contained, fully interlocked rack in and rack out mechanism, air insulated and encapsulated copper busbars not less than 1500 Amps capacity, breaker featured with ON/OFF indicator with hand trip device, spring release coil, shunt trip coil and auxiliary switch of 6 NO + 6 NC and equipped with following switchgears and accessories. Separate earthing truck shall be required for each bus earthing & cable earthing. Earthing truck shall be so designed that it is impossible to earth alive. It shall be provided with capacitive voltage divider and complete with audio visual annunciation, one for each panel. Contractor should offer all type of test reports as per IEC 62271-100 & 200 for the model being offered.
- c) Enclosure and internal: Partitioning of the cubicles is of 2mm thick, CRCA sheet, coated with Alu-Zinc for corrosion resistance. The front shall be closed off by pressure resistant doors which open to an angle of almost 130°.
- d) The correct performance of the circuit breaker operations shall be ensured by proper interlocks with the addition of mechanical indicators and inspection windows, guarantee the utmost safety for the operating personnel.
- e) The VCB assembly shall comprise a continuous, dead-front, line-up of free standing, vertical cubicles. Each cubicle shall have a front-hinged door with latches and a removable back cover. All covers and doors shall be provided with neoprene gaskets. The panel board shall be provided with Lifting Lugs for each shipping section.
- f) VCB cubicle shall be so sized to permit opening of the front access door only when the breaker is pulled out to TEST position. The movement of the Circuit Breaker from TEST to SERVICE position should be possible only with the Breaker door closed.

- g) Circuit breakers, instrument transformers, bus bars, cable compartment etc., shall be housed in separate compartments within the cubicle. The design shall be such that failure of one equipment shall not affect the adjacent units.
- h) All relays, meters, breaker control switches, selector switches and indicating lamps shall be flush mounted on the respective cubicle door or on control cabinet built on the front of the cubicle. AC/DC auxiliary supply switches / isolation switches for cubicle space heater, cubicle lamp, spring charging motor circuit shall be located inside metering compartment.
- i) Dummy panel shall be provided in the VCB line up, if required, for easy termination access of power and control cables. Dummy panel / bus trunking panel shall be of full cubicle with closed roof and rear covers similar to enclosures for active cubicles.

5.1.4 Bus and Bus Taps

The main buses and connections shall be of high conductivity Electrolytic copper as per IS:1897. The busbar shall be insulated, covered, and supported on rigid epoxy support insulators, sized for specified current ratings with maximum temperature.

- a) Bus bars shall be of same size for the entire length of the VCB. Continuous current rating of bus connections shall be same as that of continuous in panel current rating of associated breaker.
- b) Adequate contact pressure shall be ensured by means of two bolts connection. Busbar joints shall be complete with high tensile steel bolts and Belleville washers and nuts. Bus bars shall be thoroughly cleaned at the joint locations and suitable contact grease shall be applied just before making a joint.
- c) Bus bars shall be sleeved with heat shrinkable joint sleeves with adequate phase/ground clearances. Insulating sleeves for bus bars and cast-resin shrouds for joints shall be provided, suitable for maximum temperature rise of busbars.
- d) All buses and connections shall be supported and braced to withstand stresses due to maximum short circuit current and also to take care of any thermal expansion.
- e) Bus bars shall be colour coded for easy identification and so located that the sequence R-Y-B shall be from left to right, top to bottom or front to rear, when viewed from front of the switch-gear assembly.

5.1.5 Vacuum Circuit Breaker

- a) Vacuum Circuit breaker shall be triple pole, single throw type, not less than 1250 Amps rated.
- b) Circuit breakers shall be Cassette type, horizontal isolation and horizontal draw out type, having SERVICE, TEST and DISCONNECTED positions with positive indication for each position.
- c) Circuit breakers of identical rating shall be physically and electrically interchangeable. The Operating duty of offered CB shall be O- 0.3 sec — CO- 3 min — CO. (Opening operation followed, after 0.3 sec delay, by a close open operation, finally after 3 minutes delay another close open operation)
- d) The make of Vacuum Interrupter shall be same as that of Circuit breaker. The Vacuum Interrupter should withstand 100 nos. of full load short circuit operations. The panel should be tested with power frequency withstand voltage of 70kVrms & Impulse Withstand Voltage of 170kV peak.

- e) Circuitbreaker shall have motor wound springcharged trip free mechanism with anti-pumping-feature and shunt trip. In addition, facility for manual charging of spring shall be provided. The spring charging handle shall be an integral part of the CircuitBreaker. The vacuum bottles shall be encapsulated in epoxy housings. Open type vacuum bottles shall not be Provided.
- f) For motor wound mechanism, spring charging shall take place automatically after each breaker closing operation. One open-close-open operation of the circuit breaker shall be possible after failure of power supply to the motor.
- g) Mechanical safety interlock shall be provided to prevent:
 - I. The circuitbreaker from being racked in or out of the service position when the breaker is closed.
 - II. Racking in the circuitbreaker unless the control plug is fully engaged.
 - III. Automatic safety shutters shall be provided to fully cover the female primary disconnects when the breaker is withdrawn.
- h) Each breaker shall be provided with an emergency manual trip, mechanical ON-OFF indication, an operation counter and mechanism charge /discharge indicator. The breaker shall also be provided with Mechanical anti-pumping feature.
- i) Each breaker shall be provided with Auxiliary switch, with 6 NO + 6 NC contacts, mounted on the draw out portion of the VCB. Position/cell switch with 3 NO + 1 NC contacts, one each for TEST and SERVICE position. Auxiliary switch, with 4 NO + 4 NC contacts, mounted on the stationary portion of the VCB and operated mechanically by a sliding lever from the breaker in SERVICE position. Alternatively, electrically reset type latching relay may be used for the purpose.
- j) Switch contact shall be rated 10 Amp AC. and 2 Amp DC at their respective operating voltage.
- k) Closing and Tripping coils shall be continuous rated to ensure longer life. The Circuit Breaker mechanism shall be designed for easy access to the coils and spring charging motor.
- l) Meter selector switches shall be maintained contact, stay put type with knob handle. Ammeter & voltmeter selector switches shall be four position type. Ammeter selector switches shall have make before break feature to prevent open circuiting of CT secondary.
- m) Breaker control switch shall be multistage, spring return to normal, with lost motion device and pistol grip handle. The protection and tripping arrangement of incoming & outgoing circuit breaker shall be as per actual requirement/design.

5.1.6 Interlocking features

In order to ensure proper operation and to prevent dangerous situations and malfunction, that might jeopardize the personnel safety and put at risk the installation functionality, a series of interlocks must be provided to protect the operators and the VCB itself.

In particular the following interlocks must be provided:

- a) The withdrawable part can only be moved from the test/disconnected position (and back) when the circuitbreaker is off.
- b) The circuitbreaker can only be switched 'ON' when the withdrawable part is in the test or service position. In the in-between position, the circuitbreaker is mechanically interlocked.
- c) Connecting and disconnecting of the control wiring shall only be possible in the test position of the circuitbreaker.
- d) The shutters shall be secured independently of each other with padlocks when the circuitbreaker part has been removed. Cable and circuitbreaker doors shall be padlockable.
- e) Prevent the racking in of a circuitbreaker truck having a different size through the codification of the control wiring plug.

5.1.7 Control & Indication

The circuit breaker shall be wired up for local & remote operation. Each Breaker cubicle shall be equipped with the following:-

- i. One (1) TEST-NORMAL-TRIP selector switch stay put type with pistol grip handle and key interlock.
- ii. Two (2) heavy-duty oil tight, push buttons for TRIP & CLOSE.
- iii. Four (4) indicating lights on front of compartments: GREEN: Breaker Open and Spring Charged RED: Breaker Closed
AMBER: Trip/Trip circuit trouble
- iv. Lamps shall be clustered type LED module pilot lights in the rmoplastic enclosure with polycarbonate lens and diffuser. LED shall be protected by in-built fuse with surge suppressor and leakage voltage glow protection. Lamp and lens shall be replaceable from front.
- v. The general scheme of connection for control, interlock and protection is shown in the enclosed drawings. Detailed requirements shall be intimated later to the successful tenderer, who shall develop and furnish the schemes accordingly.

5.1.8 Current Transformer

- a) Accommodation shall be provided in the circuit breaker panel to mount one set of three numbers dual core dual ratio CTs for metering and protection purposes. Access to the CTs for cleaning, testing or changing shall be from the front, back or top of the panel.
- b) Accuracy class of the Current Transformers shall be as per IS/IEC 60044-1: 2003. The protection CTs shall be of accuracy class 5 P 10 of IS 2705-Part III as amended up to date. The metering CTs shall conform to the metering ratio and accuracy class 0.5 for incoming and class I for outgoing panels.
- c) Current transformer secondary shall be rated for 1 A or 5 A, depending on requirement. Secondary terminals of CTs shall be brought out suitably to a terminal block which will be easily accessible for testing and terminal connections.
- d) Feeders requiring remote metering and / or current monitoring shall be provided with

current transducers with calibration for full scale reading.

5.1.9 Voltage Transformer

- a) Voltage Transformer (VT) shall be cast-resin, drawout mounted in a separate compartment below the circuit breaker in the same panel. The VT shall be mounted on the separate trolley and not on the breaker trolley. Voltage transformer shall be accessible from front of panel & shall be independent of breaker position/ operation. However, due to design constraints if Line PT & Bus PT cannot be offered in separate compartment in same panel, then separate Line PT & Bus PT panel shall be offered by Manufacturer. A voltage transformer of burden not less than 100VA and of proper ratio as specified shall be provided.
- b) High voltage windings of voltage transformer shall be protected by current limiting fuses. The voltage transformer and fuses shall be completely disconnected.
- c) MCBs shall be suitably located to permit easy replacement while the VCB is energized. The accuracy class for the VT shall be class 0.5 as per IS 3156 Parts I to III for incomer and class 1 for outgoing panels.

5.1.10 Numerical Relays

- a) The offered relays shall be provided both HV and LV sides completely numerical with protective elements having software algorithm based on sampling of energized currents, analogue to digital conversion and numerical handling. Hardware based measurement shall not be acceptable.
- b) Relays shall be suitable for flush mounting type and consisting of multifunctional drawout type modules. In case separate module is considered, then main protection relay and module should be supplied from the same manufacturer. Panel shall be supplied with numerical relay along with arc sensors to protect from arc flash fault at Breaker, Cable and Busbar. To avoid any nuisance tripping for ARC, relay should work on principle of detecting Light and Current both to take decision.
- c) The relay shall have minimum 4 CT inputs, of which 3 Nos. can be used for over current and 1 No. for Earth fault. The relay shall be suitable for both 2 CT and 3 CT connections. It shall be possible to energize the relay from either AC or DC auxiliary supply.
- d) The relay enclosure shall be dust tight having degree of protection minimum as IP5X.
- e) The relay must have facility for local settings through front keypad from relay itself. Relay should have facility of online relay setting i.e., it should be possible to alter setting without switching of breaker or contactor.
- f) The offered relay shall have LED/LCD display for settings, status, measurement and fault data & indication. It shall have at least 4 Fixed function LEDs (for fault trip, relay healthy, control supply ON & Relay out of service) and 4 programmable LEDs
- g) Relay shall have comprehensive self-diagnostic feature with indication of relay failure on relay front and alarm should be generated without tripping the feeder. However, while diagnostic circuit runs, it must not interfere in the main protective relay circuit and allow working of main protective circuit continuously.
- h) The relays shall have the following tools for fault diagnostics.

- I. Fault record — The relay shall have the facility to store at least 5 last fault records with information on cause of trip, date, time, trip values of electrical parameters.
 - II. Event record — The relay shall have the facility to store at least 75 sequence of event records with 1ms resolution.
 - III. Disturbance records—The relay shall have capacity to store at least 5 disturbance record wave forms with at least 3 s duration each.
- i) No separate earth bus is necessary for the relays. It shall be possible to connect the relay earth to the common earthbus in the substation.
- j) The offered relay must be immune to any kind of electromagnetic interference. Contractor to submit all related type test reports for the offered model along with the offer.
- k) The relay should conform to the requirements of IS: 3231 / IEC60255 standards with respect to features/ construction/design etc. All the Relays shall belong to a common platform and shall be of single make with Electro mechanical relays in Draw out casing.
- l) The relay shall be built in communication facility for hooking the relay on MMI / upstream communication system. The offered relay shall have a comprehensive local MMI for interface.
It shall have the following minimum elements to enable viewing and setting the relay locally.
- I. Key tactile keypad for browsing and setting the relay menu
 - II. The relay shall have a front RS 232 communication port for connecting to a local PC/Laptop for setting and viewing the data from the relay.
 - III. The relays shall have a RS485 rear port for connecting many relays in multidrop fashion to connect to a remote master (SCADA/DCS)
 - IV. It shall be possible to provide the relay with at least two standard communication protocols (viz, MODBUS & BaCNET IEC-870-5-103) in addition to any proprietary protocols.
- m) Set of software should be supplied along with relays for viewing and downloading measurement, fault records and to carry out easy settings of relays locally.
- n) The relay shall be suitable for providing the following protections:
- i. The relay shall have 2 independent stages for both over current and earth fault protection.
 - ii. First stage can be selected as definite time or inverse time over current characteristic. The inverse characteristics shall be as per IEC which should include normal inverse, very inverse, extremely inverse, long inverse curves and shall be software selectable at site.
 - iii. The second stage of protection can be with instantaneous or definite time operations. There should be a possibility to disable the unit in case of contactor-controlled feeders.
 - iv. Relay shall be suitable for both residually connected CT input as well as CBCT (Circuit Breaker Coil Tester) input. This protection should have automatic doubling function when the protected object is connected to network i.e., at starting, allowing the set value being lower than the connection inrush current. Relay should have minimum 2 nos. independent selectable setting groups.
- o) In case any trip function is not available in a single relay, separate numerical relays shall

be provided to achieve the requirement. All protective relays shall be provided with self-reset type of contacts.

- p) A part from protection relays, each breaker shall be provided with separate discrete auxiliary relays for anti-tripping or Trip-free relay (trip circuit supervision Relay), trip annunciation (Annunciator Relay), trip supervision (Alarm Relay), electrically reset type breaker contact multiplication (A.C. Circuit Breaker auxiliary) relay and lockout or master trip relay functions. Lockout relay shall be hand reset type. Individual trip circuit supervision function shall be provided with respect to each trip coil of circuit breaker.
- q) Numerical under voltage relays with time delay relay including VT fuse failure relay shall be provided for Bus VTs.
- r) Zero-sequence CT and associated relay combination shall be such as to ensure a pickup sensitivity of 10A primary ground fault current.
- s) Circuit Breaker failure protection:

The relay should have a feature of circuit breaker failure protection, which generates another trip signal if the breaker fails to trip on fault, which can be wired to upstream breaker trip coil. The relay shall have comprehensive self-diagnostic feature. This feature shall continuously monitor the healthiness of all the hardware and software elements of the relay. Any failure detected shall be annunciate through a output watch dog contact. The fault diagnosis information shall be displayed on the LCD and through the communication port.

- t) Arc Flash Fault Protection: Each panel shall be equipped with the following for Arc flash fault protection: Relay should have integrated feature sensing any ARC produced in any of the 3 chambers i.e., Breaker, Cable and Busbar apart from Protection features. In case integrated offer is not available, separate module to be considered without compromising on the tripping time. Necessary sensors to be supplied along with the relay and it should have supervision of the sensors. Relay should operate due to ARC such that overall relay trip time should not exceed 18-20ms.

5.1.11 Metering Instrument, Panel Accessories (Digital)

5.1.12 Metering

Digital Multifunction Meter, accuracy class 0.5, with LED display of Max Demand Load, Current, Voltage, Frequency, Active, Reactive, Apparent Power & Energy; Power factor; % unbalance of current & voltage; calculated neutral current; %TDH individual harmonics upto 15th level (complying with IEC61557-12) with RS 485 port and protection MCBs. And required accessories to complete the system.

Lamp indication shall be provided to indicate ON/OFF (BY red green respectively) of switchgear.

Voltage Selection Scheme: VT Transfer Relay shall be incorporated to provide necessary potential for metering. This will be necessary when energy metering is done on individual feeders or where VT supply is used for trip circuits. Alternatively, PTs shall be provided on both the bus sections (incomers) with individual metering on each incomer.

Instrument Panels: The instrument panel shall form part of the housing. Relays, meters and instruments shall be mounted as per general arrangement drawings to be submitted by the tenderer. They shall be preferably of flush mounting type at a maximum height of 2000mm.

5.1.13 MCB

MCBs, shall be with manual close / open mechanism. Automatic tripping provision for overload and shortcircuit shall also be provided. MCB shall be provided with required number of auxiliary contacts as per circuit requirement.

5.1.14 Push Button

Push button shall be heavy duty, shrouded, push to actuate type with coloured button and inscription plate. Each push button shall have 2NO+2NC contacts, rated for AC and DC operating voltage.

Identification tags shall be fitted to all wire terminals to render identification easy and to facilitate checking in accordance with IS 375. Necessary terminal blocks and cable entries shall be provided for RTD relay wiring, power supply etc.

5.1.15 Small Wiring

The VCB shall be fully wired at the factory to ensure proper functioning of control, protection; transfer and interlocking schemes. The small wiring shall be carried out with minimum 2.5 sq.mm multi FRLS PVC insulated copper conductor cables.

- a) Fuse links and MCB shall be provided to permit individual circuit isolation from bus wires without disturbing other circuits. All spare contacts of relays, switches and other devices shall be wired up to terminal blocks.
- b) Each wire shall be identified, at both ends, with interlocking type permanent markers bearing wire numbers. AC / DC wiring shall have separate color-coding.
- c) Wire termination shall be made with crimping type connectors with insulating sleeves. Wires shall not be spliced between terminals. All spare contacts of relays, timers, auxiliary switches shall be wired up to the terminal block.

5.1.16 Terminal Block

1100V grade, multi way terminal block complete with mounting channel, Binding screws and washers for wire connections and marking strip for circuit identification shall be provided for terminating the panel wiring. Terminals shall be stud type, suitable for terminating 2.5 sq.mm Multistranded copper conductor cable. Terminals for C.T. secondary leads shall have provision for grounding.

- a) Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished. Separate terminal blocks shall be provided for AC/DC wiring termination.
- b) Terminal blocks used for interface with SCADA via termination cabinet shall be suitably sized to facilitate proper termination of interconnecting cables.

5.1.17 Cable Termination

- a) VCB shall be designed for cable entry from bottom. Sufficient space shall be provided for ease of termination and connection.
- b) Gland plates shall be of minimum 3 mm thick. The gland plate and supporting arrangement for incoming power cables shall be of CRCA sheet with Zinc coating or pre-galvanized sheet.
- c) Sufficient space shall be provided between the power cable termination and gland plate. Core balance CTs wherever specified, shall be accommodated within this space, inside the

cubicle.

5.1.18 Ground Bus

- a) A ground bus, rated to carry maximum fault current, shall extend for the full length of the VCB. The ground bus shall be provided with two-bolt drilling with G.I. bolts and nuts at each end to receive 50 mm x 5 mm copper strip.
- b) Each stationary unit shall be connected directly to the ground bus. The frame of each circuit breaker and drawout Voltage Transformer unit shall be grounded through heavy multiple contacts at all times except
When the primary disconnecting devices are separated by a safe distance.
- c) Wherever, the schematic diagrams indicate a definite ground at the VCB, sufficient size conductor for each circuit thus grounded shall be run independently to the ground bus and connected there to.
- d) CT and VT secondary neutrals shall be earthed through removable links so that earth of one circuit may be removed without disturbing other.

5.1.19 Earthing Truck

- a) Earthing trucks shall be provided for earthing the VCB busbars or outgoing cables. The trucks shall have a voltage transformer and an interlock to prevent earthing of any live connection. The trucks shall have audio-visual annunciation to warn the operator against earthing of live connections. It shall not be possible to use bus-earthing truck for cable earthing & vice versa. Earthing truck shall be non-fault making type. Panels with integral earth switch are acceptable.
- b) The earthing of the breaker body and moving portion shall be so arranged that the earthing of the non-current carrying structure to the frame earth bar is completed well before the main circuit breaker plugs enter the fixed house sockets. The entire panel board shall have a common tinned copper earth bar of suitable section with 2 earth terminals for effectively earthing metallic portion of the panels. The frame earthing of panel shall be in accordance with Section earthing of the specifications.

5.1.20 Caution notice on suitable metal plate shall be affixed at the back of each vertical panel.

5.1.21 Space heaters and Plug socket

Each cubicle shall be provided with Anti-condensation thermostat-controlled space heaters and 5A, 3 pin plug socket. These space heaters shall be suitable for operation on 240V, 1 phase, 50Hz A.C. In addition, motor feeder cubicle shall be wired-up for feeding the motor space heater through a suitable rated breaker auxiliary NC contact and /or contactor. Cubicle heater, Motor heater, Plug/socket circuits shall have individual switch fuse units.

5.1.22 A.C/D.C Power Supply

It shall be possible to energize the relay from either AC or DC auxiliary supply. The following power supplies shall be made available to each VCB:

DC shall be provided through SMF batteries of minimum 26AH capacity with a battery charger as per recommendation of the manufacturer both for protection as well as indications. Alternatively, Power Pack converters fed through PT/ 230V externally could be provided with 2 Nos., 12 volts, suitable AH SMF batteries for tripping. In cases where tripping is fed through PT, VA burden of PT shall be suitably increased (say 200 VA) as recommended by the

manufacturer depending upon the number of panels and connected controls. In addition, external DC supply shall be provided for indications etc. through 2 No. SMF batteries of 12 volts of minimum 26 AH capacity with a battery charger as per recommendation of the manufacturer.

Numerical Relay shall have inbuilt breaker failure protection as local breaker backup. Built in Trip Circuit Supervision to ensure healthy trip circuit. The offered relays shall have a battery backed real time clock for providing accurate time reference.

- a) Isolating switch fuse units shall be provided at each VCB for the incoming supplies, 4-pole, single throw for A.C. and 2-pole, double throw for D.C. Moulded case circuit breaker (MCCB) shall also be accepted as an alternative for AC circuit only.
- b) Bus-wires of adequate capacity shall be provided to distribute the incoming supplies to different cubicles. Isolating switch fuse units/MCCB shall be provided at each cubicle for A.C/D.C. supplies.
- c) A.C. load shall be so distributed as to present a balance loading on three-phase supply system.

5.1.23 Tropical Protection

- a) All equipment, accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects & corrosion.
- b) Screens of corrosion resistant material shall be furnished on all ventilating louver stop prevent the entrance of insects.

5.1.24 Painting

- a) The panels shall undergo seven tank pre-treatment process followed by powder coat painting having a paint thickness as per Manufacturer's standards.
- b) The VCB shall be finished in light gray colour (or) any other colour as per Industry standards with two coats of powder paint. The coating shall be done electrostatically followed by stoving.
- c) Sufficient quantity of touch-up paint shall be furnished for application at the site.

5.1.25 Tests

The VCB shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standards. Tests at Works: All routine and other tests prescribed in IS shall be carried out at the manufacturer's works before the dispatch in the presence of Engineer-in-charge or his authorized representative. Copies of the test certificates shall be furnished to the department. The Contractor shall give 15 days' advance intimation to Engineer-in-charge for witnessing the routine tests. No material shall be dispatched from its point of manufacture before inspection, unless inspection is waived off in writing. The acceptance of any quantity of material shall in no way relieve the Contractor of any of his responsibilities for meeting all requirements of the specification, and shall not prevent subsequent rejection if such material is later found to be defective.

5.1.26 Type Tests

The Manufacturer should submit the Type test reports conducted earlier on similar equipment's/ Panels carried out from National/International accredited Laboratory as per relevant IS/ IEC-62271-200 and IEC-60694 Standard.

5.1.27 Installation

The installation work shall cover assembly of panels lining up, grouting the units etc. In the case of multi panels switch boards after connecting up the bus bar all joint shall be insulated with HV insulation tape or with approved insulation compound. A common earth bar shall be run preferably at the back of the switch board connecting all the sections for connecting the earth system. All protection, indications & metering connections and wirings shall be completed. Where trip supply battery is installed, the unit shall be commissioned, completing initial charging of the batteries. All relay instruments and meters shall be mounted and connected with appropriate wiring. Calibration check of units as necessary and required by the licensee like CTs, VTs Energy Meters etc. shall be completed before pre-commission checks are undertaken.

5.1.28 Testing and Commissioning

Procedure for testing and commissioning of relay shall be in general and in accordance with good practice. Commissioning checks and tests shall include in addition to checking of all small wiring connections, relays calibration and setting tests by secondary injection method and primary injection method. Primary injection test will be preferred for operation of relay through CTs. Before panel board is commissioned, provision of the safety namely fire extinguishers, rubber mats and danger board shall be ensured. In addition, all routine megger tests shall be performed. Checks and test shall include following.

- a) Operation checks and lubrication of all moving parts.
- b) Inter lock function checks.
- c) Continuity checks of wiring fuse set etc. as required.
- d) Insulation tests.
- e) Trip test and protection gear tests.
- f) The complete panel shall be tested with 5000 V megger for insulation between poles and poles to earth. Insulation test of secondary CTs and VT.
- g) Any other tests as may be required by the Licensee/Inspector shall be conducted
- h) Where specified, the entire switch board shall with stand high voltage test after installation.
- i) Any other test required by the consignee/inspecting officer.

5.1.29 Guaranteed Technical Particulars

S.No.	Description	Parameters
1.0 System Parameters		
1.1	Ambient Temperature for design	40°C
1.2	Main System	3-Phase, 3-wire
1.3	Frequency	50Hz
1.4	Highest system Voltage	36KV
1.5	Rated System Voltage	33KV
1.6	Dry Frequency withstand voltage(rms)	70KV
1.7	Rated Impulse voltage	170KV(Peak)
1.8	System Fault Level	26.3KA
1.9	Duration	3sec
2.0	Breaker	

2.1	Type	Vacuum
2.1.1	Make	As per Preferred makes list
2.2	Control voltage	
2.2.1	Closing coil	24/30/48/110/220VDC
2.2.2	Tripping Coil	24/30/48/110/220VDC
2.2.3	Spring Charging motor	230VAC
2.3	Castle Lock Requirement	Yes
3.0	Current transformer	
3.1	CT Make	As per Preferred makes list
3.2	CT Fault Level	25KA
3.3	Duration	3sec
4.0	Potential transformer	
4.1	PT Make	As per Preferred makes list
5.0	Main Protection Relays	
5.1	Make	As per Preferred makes list
5.2	Type	Numerical
5.3	Relay communication	IEC103/IEC61850/Modbus, RS485
6.0 Construction		
6.1	Type of Switchboard	Cassette type
6.2	Installation	Indoor
6.3	Mounting	Floor Mounted
6.4	Front access	Required
6.5	Degree of Protection	IP4X
6.6	Fabrication & Painting	
6.6.1	Material	CRCA
6.6.2	Thickness of Panelboard	2mm
6.6.3	Surface protection	Aluzinc coating/galvanization
6.6.4	Exterior & Interior shade	RAL7032
6.7	Busbars/Connections	
6.7.1	Temperature rise limit	50°C
6.7.2	Rated Current	1250Amps
6.7.3	Material	Copper
6.7.4	Phase Identification	R,Y,B sleeves
6.8	Earth Bus Bar	
6.8.1	Material	Copper
6.8.2	Size	Not less than 250sq.mm
7.0 Feeder Connections		

7.1	Size of conductor from Main Bus bar to Circuit Breaker	As per breaker rating and Manufacturer's standards
7.2	Material	Copper
7.3	Insulation	Full Rated Voltage Sleeve
7.4	Feeder Connections (in cable chamber)	As per CT rating
7.5	Material	Copper
7.6	Insulation	Full Rated Voltage Sleeve
8.0 Auxiliary Equipment and Supply		
8.1	Cable compartment Space Heater	As per Manufacturer standards
8.2	Breaker compartment Space Heater	As per Manufacturer standards
8.3	Wiring & Size of wire (Control and Auxiliary Circuits)	As per standards
8.3.1	Auxiliary Circuit	FRLS PVC insulated copper conductor, 1.1KV grade
8.3.2	CT Circuit/ PT Circuit/ Control Circuit	2.5 Sq.mm
9.0 Termination Arrangement		
9.1	Incomer Feeder	Entry-Bottom
9.2	Outgoing Feeder	Entry-Bottom
9.3	Gland plate-For single core, three core	3mm thick GI or better
10.0 Reference Standards		
10.1	Common specification for high voltage switchgear	IS/IEC62271-1
10.2	High voltage AC circuit breaker	IEC62271-100&IS13118: 1991(Reaffirmed 2002)
10.3	AC metal-enclosed switchgear and control gear	IS/IEC62271-200
10.4	Degree of Protection provided by enclosures	IS/IEC60529(2001)
10.5	Current transformer	IS/IEC60444-1(2003) (Part-I to III)
10.6	Potential transformer	IS:3156 (Part-I to III)

5.1.30 Incomer Panel (1 No each comprising of):

- a) 1-Metal clad housing with trunk having 1250 A, 350 MVA, TP integral VCB with manually /electrically operated mechanism (spring charging motor-

230VAC)

- b) 1 set of air insulated copper busbar of 1500A
- c) 1 set of isolating plug and receptacle
- d) 1 set of automatic safety shutter
- e) 1 set of breaker control switch, lockable type Trip/Neutral/Closed (TNC)
- f) 1 set of dual core CTs
- g) Corel 200/50/5/5A class 5P-10(15VA) protection
- h) Corell 200/50/5/5A class 1.0(15VA) metering
- i) Shunt trip closing coil 24VDC/110VA.C
- j) 11 KV end termination kit for 3x300sq.mm AIXLPE 11KV armoured cable
- k) 3-Nos PTs of 33/0.11KV of (100VA) cast resin type
- l) 1-set ON/OFF/Trip & Circuit healthy and phase indicating LED Lamps.
- m) 1 No Microprocessor based Numerical relay with O/CEF&SC Protection.
Relay
- n) Should have arc flash fault protection in cable, busbar and breaker chamber.
- o) 1-no UL&CE Multifunction Digital meter displaying Voltage, Amps, kWh, kW, P.F., Active, reactive, apparent energy, disturbance and direction detection, Individual harmonic up to the 63rd harmonic. At least 256 samples/cycle with Ethernet Port with inbuilt web server and complying to IEC 61557-12, IEC 62053-22 certified by third party laboratory.
- p) 1-no master trip relay
- q) 1-12 nos annunciation window with relays and push buttons

5.1.31 Outgoing Panel (2 nos. Each Comprising of):

- a) 1-Metal clad housing with trunk having 1250 A, 350 MVA TP integral VCB manually/electrically operated mechanism (spring charged motor 230VA.C.)
- b) 1 Set of air insulated copper busbar 1500A
- c) 1 Set of isolating plug and receptacle
- d) 1 Set of automatic safety shutters
- e) 1 Set of breaker control switches (TNC)
- f) 1 Set of dual core CTS
- g) Corel 200/50/5/5A class 5P-10(15VA) protection
- h) Corell 200/50/5/5A class 1.0(15VA) metering
- i) Shunt trip closing coil 24VDC/110VA.C
- j) 11KV end termination kit for 3x300sq.mm AIXLPE 11KV armoured cable
- k) 3-Nos P.TS 33/0.11KV of (100VA) cast resin type
- l) 1-set ON/OFF/Trip & Circuit healthy Indicating LED lamps.
- m) 1 No Microprocessor based Numerical relay with O/C, EF&SC Protection. Relay should have arc flash protection in cable busbar and breaker chamber.
- n) 1 No- Over Voltage Relay 1 No-Master
- o) 1-No master trip relay
- p) 1-12 No's annunciation window with relays and push buttons
- q) 1-No 2 elements auxiliary relay for transformer (WTI with alarm & trip)
- r) 1-set of terminal block with 20% extra terminal for connection with 2.5sq.mm 4core PVC insulated PVC sheathed copper cable from panel to transformer

- s) 1 set of 3 phase differential relay with set of CTs of class 5P10 on bothsides.
- b) The above VCB rating details are indicative only.

5.2 Power Transformers

5.2.1 This specification covers the design, manufacture, testing, supply, installation, testing and commissioning of Three-phase cast resin dry type indoor transformers, having class F insulation with Air Natural (AN) cooling designed for use in three-phase distribution systems. The equipment offered shall conform to the relevant standards complete in all respects and capable to perform continuous and satisfactory operations. The transformer and accessories shall be designed to ensure satisfactory operation under sudden variations of the load and voltage including shortcircuit.

5.2.2 Minimum 2 Nos. (1 working + 1 standby) of Suitable KVA, 3 Phase, 11KV/433V, 50Hz Transformers shall be provided. The capacities of Transformers given in the schedule of quantities are indicative only. Contractor has to design according to the load requirements in the campus.

5.2.3 Standards:

The Transformers shall comply with the following Indian Standards as amended up to date:

- I. IS 11171:1985-Dry type power transformers. IS:2026 Power Transformers,
- II. IEC: 60076, IS 10028 (Part II & III)-Installation and Maintenance of Transformers.
- III. IS: 5621-1980 & IS: 2099-1986-High Voltage porcelain Bushings.
- IV. These transformers shall be manufactured in accordance with a quality system in conformity with ISO 9001, ISO 14001.

5.2.4 Windings & Connections

- a) All windings shall be made of electrolytic high conductivity copper, fully insulated with class F insulation. The windings shall be so designed that all coils as assemblies of identical voltage, rating shall be interchangeable. The windings shall be cast in a class F fire proof epoxy resin casting.
- b) HV connections shall be made from copper connection bars protected by heat shrinkable tubing. The output from each LV winding will comprise copper connection terminal, enabling all connections to be made without using a contact interface.
- c) Off load type tap changing switch with tapping range of +5% to -7.5% in 2.5 percent steps shall be provided on HV windings to keep LV Voltage constant. Relevant provisions of IS 2026 (Part-IV): 1977 shall be applicable.

5.2.5 Thermal protection

These transformers shall be equipped with a thermal protection device. An electronic converter with two independent monitoring circuits equipped with a changeover switch should be installed. A plug-in terminal block for connection of the sensors to the electronic converter shall be provided. The sensors will be assembled and wired to the terminal block fixed on the upper part of the transformer.

5.2.6 Metal enclosure

All the MS parts shall be galvanized to make them corrosion free. The corecoil assembly shall be housed in a prefabricated enclosure. The enclosure shall be fabricated with sheet steel CRCA sheets with adequate provision for ventilation. The enclosures shall undergo the seven-tank process. Finally, the external and internal surfaces of the enclosure shall be powdercoated with the required paint shade.

5.2.7 Continuous Maximum Rating and Overloads:

- a. Transformers shall comply as regards to rating temperature rise and over load with the appropriate requirements. Transformers shall be capable of operation continuously in accordance with IS loading guide at their C.M.R (continuous maximum rate) and at any ratio irrespective of the direction of flow of power and with voltage of the untapped winding maintained at the voltage stated in the ordering schedule.
- b. The transformers may be operated without danger on any particular tapping at the rated KVA provided that the voltage does not vary by more than +10% of the voltage corresponding to the tapping. Transformers shall be designed for 110% continuous over fluxing with stand capability.
- c. The maximum loss of each transformer shall be corresponding to energy efficiency level 3 of IS:1180/ Super ECBC.

5.2.8 Accessories

Each transformer shall be equipped with other accessories such as flat bi-directional rollers, lifting lugs, Haulage holes on the undercarriage, Earthing terminals, RTD temperature controller, rating diagram, Marking plate and Danger notice plate.

5.2.9 Testing

- a) Tests at Works: All routine and other tests prescribed in IS shall be carried out at the manufacturer's facility before the dispatch of the transformer in the presence of Engineer-in-charge or his authorized representative. Copies of the test certificates shall be furnished to the department. In addition to the prescribed routine tests, temperature rise test shall invariably be done on one transformer of each design. The Contractor shall give 15 days advance intimation to Engineer-in-charge for witnessing the routine tests. No material shall be dispatched from its point of manufacture before inspection, unless inspection is waived off in writing. The acceptance of any quantity of material shall in no way relieve the Contractor of any of his responsibilities for meeting all requirements of the specification, and shall not prevent subsequent rejection if such material is later found to be defective. Type test certificates as specified in IS shall be submitted to the Department.
- b) Tests at Site: In addition to tests at manufacturer's premises, all relevant pre-commissioning checks and tests conforming to IS code of practice shall be done before energization. All test results are to be recorded and reports should be submitted to the department. These tests shall be carried out by the contract or in the presence of Engineer-in-charge or his authorized representative.

5.2.10 Installation and Commissioning

The transformer shall be installed in accordance with IS 10028-Code of practice for Installation and maintenance of transformer. Necessary support channels shall be grouted in the flooring. The transformer shall be moved to its location and shall correctly be positioned. Transformer wheels shall be either locked or provided with

wheel stoppers. Earthing of neutral and body of the transformer shall be done in accordance with relevant specifications. Manufacturer's authorized representative shall be present at the time of commissioning of Transformers.

5.2.11 Technical Particulars of Vacuum Cast Coil (VCC) Dry type Transformers

S.No.	Description	Parameter
1	Name of Manufacturer	As per preferred makes list
2	Type	Dry Type Transformer
3	Installation	Indoor
4	Duty	Continuous
5	Application	Distribution
6	Altitude	upto 1000m
7	Rated power (based on AN Cooling) KVA	As per requirement
8	Rated No-Load Voltage Ratio (Primary/Secondary)	11/0.440KV
9	Rated Frequency	50Hz
10	Number of Phases	3Nos.
11	Material of Winding (Primary / Secondary)	Cu/Cu
12	Vector Group	Dyn11
13	Connection (Primary/Secondary)	Delta/Star
14	Type of Tap Changer	Off Circuit Tap Links
15	Tapping Range/Tap step	+5to-7.5@2.5%
16	No. of Steps	6Steps
17	HV Variation/LV Variation	HV Variation
18	Class of Insulation	F
19	Method of Cooling	AN
20	Avg. Temp. Rise of Winding (at principal tap)	90/90°C
21	Ambient Temp.(Max./Mini.)	40/20°C
22	%Impedance at Rated Current, at 75 Deg. C & at Principal Tap	As per Super ECBC.
23	Efficiencies at 75Deg.Cat Unity Power Factor (Reference value)	
a	a)At Full Load	
b	b)At 3/4 Full Load	
c	c)At 1/2 Full Load	
24	Regulation at Full Load at 75Deg.C	
A	At Unity Power Factor	
B	At 0.8 Power Factor (Lagging)	
25	BIL(Insulation Level):	
26	Full Wave Lightning Impulse Withstand Voltage (HV/LV)	170kVpeak
27	Separate Source Power-Frequency Voltage With stand (HV /LV)	70/3KVrms

28	Enclosure degree of protection class	IP23
29	Termination Arrangements	
A	HV	Cable Box
B	LV	Flange for Busduct
30	Orientation between HV&LV Deg.	180°C
31	Fittings/Accessories	Rating & Diagram plate, Base Channel, Earthing terminals & WTIwith3PT-100 Sensors.

5.3 Busbar Trunking System

5.3.1 This specification for design, manufacture, transporting, installation and testing at site of compact sandwich type copper conductor LT BusBar Trunking systems suitable for indoor/outdoor installations as required. Compact sandwich type busbar trunking products and fittings (straight length, elbow, tees, flanged ends, cable tap box etc. shall be in accordance with IEC 61439 or UL857 and from the same manufacturer as the busbar trunking system. 3-Phase, 4 strip (100% neutral) with continual integral earth busbar shall be provided. The neutral conductor should have the same cross-sectional area as the phase conductor. The earth busbar must be one continuous piece without bolting on housing.

5.3.2 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 following standards as amended up to date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC 61439-6 Standards shall be applicable.

5.3.3 Electrolytic quality Copper Conductor with Halogen Free insulation shall be used for busbars. Rated operating voltage of the bus bar trunking is 1000V, 3 Phase, 4 strip with integral earth. Copper Bus trunking (Busduct) having suitable capacity shall be used to feed Main LT Panel from the transformers, from transformer to APFC and HVAC panels (all contacts should be silver plated). The busbar trunking system, both feeder and plug-in shall be compact sandwich construction.

5.3.4 The Busbar trunking system shall be capable of withstanding the short circuit of the electrical installation without damaging the electrical, mechanical, and thermal stress under fault condition at a service voltage of 1000V, 50Hz. Rated impulse withstand voltage 12KV at 1000V.

5.3.5 Housing/Enclosure

- a) The bus bar trunking housing shall be constructed of electro galvanized steel/ aluminium and shall be provided with a suitable protective finish epoxy paint. The busbar trunking housing shall be totally enclosed, non-ventilated for protection against mechanical damage and dust accumulation and tested for IK10. There shall be no bolts passing through the busbars of the busway.

- b) It shall pass at least 1500 hours salt spray test to ensure the anti-corrosion ability. The enclosure of Bus Trunking System shall be fabricated from 1.5 mm thick CRCA sheet steel/ GI/ Extruded Al and shall be powder coated to suite the aesthetic ambience or as approved after regress metal treatment process. Busbars shall be of copper with silver plated contacts.
- c) The absolute temperature at any point of the busbar trunking enclosure and at joints shall be strictly in conformance to IEC 61439-6.
- d) Ingress protection for the enclosures shall be minimum IP54 for indoor Bus duct and IP 65 (without considering any Canopy) for outdoor Bus ducts as per IEC 60529. However, suitable canopy to be provided to cover the outdoor bus ducts to avoid any mechanical damage by any accidental falling of foreign bodies.
- e) The bus bar trunking joint shall be with Factory fitted Monobloc type which utilizes high strength steel bolt(s) and Belleville washers to maintain proper pressure over a large contact surface area. The bolt shall be two-headed design to indicate when proper torque has been applied and require only a standard long handle wrench to be properly activated.
Access shall be required to only one side of the bus-bar trunking for tightening joint bolts.
- f) It shall be possible to remove any joint connection assembly to allow electrical isolation or physical removal of a bus-bar trunking length without disturbing adjacent busbar trunking lengths.
- g) There shall be no bolts passing through the bus bars of the busway as a part of safety.

5.3.6 Insulation

Each busbar shall be insulated with minimum Class F (155 Deg. Centigrade) Multilayer PET film. Epoxy insulation shall not be permitted. The insulation shall be certified as "halogen-free" by the manufacturer. All plastic components shall have a V1 Self-extinguishing degree.

5.3.7 Flange End Boxes

Flanged end box shall be provided to accommodate flange end for connecting the bus trunking with the flanges of panels, transformers etc., as recommended by manufacturer. The flange end termination on panel should be guaranteed for Ingress protection for indoor/outdoor application. Phase matching of bus trunking with equipment shall be done prior to installation.

5.3.8 Plug-in Boxes/Tap off Boxes:

- a) The connecting jaw of the plug-in unit shall plug directly on to the bus-bar Rising Mains and have full contact with bus-bar itself. Welded tab at plug-in bus-bar is not allowed.
- b) All contact on joint and plug-in opening should be silver plated copper.
- c) It shall be possible to inspect the plug-in opening and busbars prior to the installation of the plug-in units.

- d) The tap-off boxes are made 1.5 mm thick sheet steel with powder coated and provision for fixing MCCBs.
- e) Tap-off boxes should have an interlock with a cover and can be inserted and removed from the outlet only when the cover is in the 'OPEN' position that is in the isolated position.
- f) All tap-off boxes should have protective conductor which is the first to make an electrical connection when plugged into the outlet, and the last to disconnect when the tap-off is unplugged.
- g) All insulating plastic components comply with the incandescent wire test and have self-extinguishing properties.
- h) Operating voltage and Insulation voltage level must be 1000 Volts and suitable for 50Hz frequency.

5.3.9 Support of busbar Trunking

Hanger spacing shall not exceed manufacturer's recommendations. Indoor feeder rising main shall be approved for minimum hanger spacing of up to 3 meters for horizontally mounted run and 2 meters for vertically mounted runs except at the bends. Outdoor feeder busbar trunking shall be approved for spacing of up to 1.5 meters for horizontally or vertically mounted runs. Installation shall be done with all the required hot dipped galvanized iron supports as per the manufacturer's recommendations.

5.3.10 Earthing

The entire bus trunking system shall be provided with Cu integral earthing, and with two independent earthing conductors of size, at least 25x5 (mm) throughout the length of the system. The earth flats shall be effectively connected to the enclosure by riveting / bolting. End covers shall be provided as required.

5.3.11 Certificates/Documents to be enclosed:

The type test certificates from independent testing authority are to be enclosed and submitted before supply of materials:

5.3.12 Testing at factory:

Routine tests like dimensional checks, electric continuity checks, IR test, dielectric withstand test shall be carried out at facility / factory as per IEC 61439-6 in the presence of department engineers in order to qualify the product. All routine test reports are to be submitted to the Engineers visiting the factory for inspection. All test facilities required shall be provided for the tests prescribed without any additional cost at their factory. The product shall be dispatched from the factory only after obtaining necessary clearances from the department engineers.

5.3.13 Installation, Testing and Commissioning at site:

- a) It is the responsibility of the contractor to inspect all the materials for damage, if any, after unloading at site. Installation shall be done with required supports, joints etc strictly as per the recommendations of the manufacturer and IEC standards. Care should be taken by the contractor to ensure that no damage is caused either to the product or the technicians who are deployed for

the installation work.

- b) Department shall not be responsible for any such losses that may occur during installation, testing and commissioning works.
- c) All the required commissioning tests shall be carried out in the presence of department engineers.
- d) Installation, Testing & Commissioning shall be done by the manufacturer personnel only. The system shall be commissioned only after the manufacturer's engineer qualifies that the product has been installed and tested as per the manufacturer's recommendations and in conformation with IEC 61439.
- e) All the required operating and maintenance manuals, as-built layout of the bus way along with complete details of all the components of the system, necessary protocols to be followed during maintenance etc shall be handed over to the Department. The agency shall provide three complete sets of operation and maintenance manuals and test certificates.
- f) The department reserves the right to accept / reject any part of work, In case of any failure to carry out the scope of work in time as per the instruction of department, the work shall be carried out / got done by the department at the risk and cost of the agency and the entire amount with supervision charges shall be recovered from the agency.

5.4 LT Panels and Switchgear

This section covers the detailed requirements of medium voltage Panel board for 415 volts, 3 phase, 50 Hz, 4 wire system. The Panels shall have incoming sectionalization and outgoing switchgears as per requirement. The design shall be cubical type. The degree of enclosure protection shall be IP43 for Indoor panels and IP 54 for outdoor panels unless otherwise stated. The panels shall be of 1100V Insulation Voltage grade for switchgears & Operating voltage of 415 +/- 10 %. All LT panels should be TTA type conforming to IEC 61439-1 & 2.

These panels shall comprise of following:

- I. Incoming & outgoing feeders.
- II. Busbars and feeder connections.
- III. Meters, indicators and wiring.
- IV. Steel enclosure.

- a) The Panel boards and the associated equipment including switchgear, control gear, Busbar supports, Busbar orientation, and Busbar links etc. shall be identical in construction to the assembly which has undergone the type test. The drawings of the type-tested assemblies shall be made available for inspection.
- b) The main LT panels shall be located in the substation building, and having sufficient no. of outgoing to feed all other Sub-panels/Services such as APFC panels, HVAC panels, Rising mains, UPS, Firefighting Panels, Water supply panels, Street lighting, STP and ETP plant,
- c) Suitable size XLPE insulated copper/ Aluminium conductor cables shall be laid for interconnecting panels within the service building.

- d) Panel boards shall have a short circuit level withstand as per relevant standard amended upto date.
- e) The enclosures shall be designed to take care of normal stress as well as a normal electro- mechanical stress due to short circuit conditions. All covers and doors provided shall offer adequate safety to operating persons. Suitable pressure relief devices shall be provided to minimize danger to operator during internal fault conditions.
- f) The compartmentalization shall be achieved by using metal separators. Use of PVC sheet / phenolic laminated sheets shall not be allowed.

5.4.1 Standards and Codes

- a) Updated Indian Standard Specifications and Codes of Practice shall apply to the equipment and the work covered by the scope of this contract.
- b) Low Voltage switchgear Assemblies IEC 61439-1/2, IS 8623
- c) Low Voltage switchgear & control gear IEC 60947/IS 13947:1993

5.4.2 Panel Configuration

- a) The Panel shall be designed with Air Circuit Breakers, MCCB's. for incoming and outgoing feeders as per the required
- b) The MCCBs can be arranged in multi-tier formation whereas the Air Circuit Breakers shall be arranged in Single tier formation only to facilitate operation and maintenance.
- c) The Panel boards shall be of adequate size with a provision of spare space to accommodate possible future additional switchgear.
- d) There should be total discrimination and co-ordination between upstream and downstream switchgear & protection on devices i.e., ACBs, MCCBs etc. upto the service breaking capacity level as per IS/IEC-60947-2 for better continuity of supply and fault localization.
- e) Electro mechanical interlocking facility shall be provided between the circuit breakers fed from different supply panel shall be designed in such a way to feed total load using standby transformer in case of failure of any one transformer.
- f) The Panel boards shall be metal clad totally enclosed; floor mounted free-standing type of modular extensible design suitable for indoor/ Outdoor mounting.
- g) Panel board construction shall employ the principle of compartmentalized and segregation for each circuit.
- h) Incomer and bus section panels or sections shall be separate and independent and shall not be wired with sections required for feeder. The incomer panel shall be suitable for receiving bus trunking or MV cable of required size.
- i) Panel boards shall be made up of requisite vertical sections, which when

coupled together, shall form continuous dead front Panel boards. Panel board shall be readily extensible on both sides by addition of vertical sections after removal of the end covers.

- j) Neoprene gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust and verminproof to provide a degree of protection as specified.
- k) Special care to be taken to ensure effective earthing of the frame and door so the Panel boards.
- l) Each vertical section shall be provided with a rear or side cable chamber housing the cable end connections and power/control cable terminations. There should be generous availability of space for ease of installation and maintenance with adequate safety for working in one vertical section without coming into contact with any live parts. The design of the Panel board shall allow standard extension chambers if required to accommodate cables.
- m) Panel boards shall be fabricated with CRCA Sheet Steel of thickness not less than 2.0 mm and shall be folded and braced as necessary to provide a rigid support for all components. The doors and covers shall be fabricated from CRCA sheet steel of thickness not less than 2 mm. Joints of any kind in sheet metal shall be seam welded and all weldingslag shall be ground off and welding pits wiped smooth with plumber metal.
- n) Panel board shall be provided with "Danger Notice Plate" conforming to relevant Indian Standards.
- o) All metallic parts shall be given pre-treatment for degreasing, phosphatizing etc. in seven-tank process. Enclosure shall be powder coated with RAL7035 coat with matt finish.
- p) Feeder connections shall be by solid copper strips of suitable size for 100A or higher size switchgear through nuts, bolts and spring washers.
- q) Four lifting bolts per cubicle shall be provided for easy lifting of the enclosure.
- r) The louvers shall be covered with brass wire mesh to avoid access of reptiles and insects in the Enclosure. The Enclosure shall be provided with hinged cover for access to equipment.
- s) The overall height of the Panel board shall be limited to 2200mm for all the Busbar ratings and type of Panel boards. Panel should have integral base frame of 100 mm MS channel duly painted. Operating levers, handle etc. of highest unit shall not be higher than 1.7 meters.

5.4.3 Panel board Compartmentalization

- a) For compartmentalized Panel boards, separate totally enclosed compartments shall be provided for horizontal busbars, vertical busbars, ACBs, MCCBs, and cable alleys.

- b) Earthed metal or insulated shutters shall be provided between draw out and fixed portion of the switchgear such that, no live parts are accessible with equipment drawn out.
- c) Sheet steel hinged lockable doors for each separate compartment shall be provided.
- d) Circuit breakers separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, control contactors and control MCB etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, busbars, and connections.
- e) Each switchgear cubicle shall be fitted with label in front and back identifying the circuit, switchgear type, rating, and duty. All operating devices shall be located in front of switchgear only.
- f) A horizontal wire way with screwed cover shall be provided at the top to take interconnecting control wiring between vertical sections.
- g) Separate cable compartments running the height of the Panel board in the case of front access boards shall be provided for incoming and outgoing cables.
- h) Cable compartments shall be of adequate size for easy termination of all incoming and outgoing cables entering from bottom or top. The construction shall include necessary and adequate and proper support shall be provided in cable compartments to support and clamping the cable in the cable alley /cable chamber.

5.4.4 Logic for PLC Based Main LT Panel

- i. The Main LT Panel shall have PLC logic control with three section shoving Electrical and Mechanical inter locking.
- ii. Section A shall be connected with Transformer 1 and DG synchronization panel Feeder 1
- iii. Section B connected with Transformer 2 & DG synchronization panel Feeder 2
- iv. All sections shall be coupled through 2 nos. Suitable sized Bus coupler ACB
- v. Section A & C shall have outgoings to different feeders in the building as specified & section B treated as standby
- vi. Each section shall be operated in both Auto and Manual Mode.
- vii. Auto Mode:
 - a) If Mains Supply fails at any particular section, load of that particular section shall be transferred to Transformer 2. Other section loads shall not be disturbed & shall remain on mains supply.
 - b) In case of Mains fail, all the Two DG sets shall be started and load should be transferred to DG sets through synchronization panel. Number of DG sets to be operated, shall be decided automatically on load requirement at that time. Preference of DG sets which to be operated shall be decided on previous running hours of DG sets. The DG sets which are stopped based on load requirement shall come into the operation immediately in case of increasing of loads suddenly or failure of operating DG sets due to faults.

- c) There shall be two 1600 Amps outgoing feeders for PLC based VRV/VRF panel. On Mains failure VRV/VRF plant shall run for essential loads only so any one of outgoings shall be open.
- d) After restoring of mains, load shall be transferred to mains with time delay and DG engine shall be stopped after cooling period.

5.4.5 Bus Bars

- a) The bus bars shall be of copper of high conductivity electrolytic quality and of adequate section. Current density for copper shall not exceed 160 amps /sq.cm.
- b) Busbars shall be of rectangular cross sections, suitable for full load current for phase bus bars and neutral bus bar. Busbar shall be suitable to withstand the stresses of fault level as designed as per site requirement.
- c) Main Horizontal busbar and Neutral should be in same compartment.
- d) The bus bar system may comprise of a system of main horizontal busbars and auxiliary vertical bus bars run in bus bar alloy on either side in which the circuit could be arranged with front access for cable entrances
- e) The bus bars shall be supported on non-breakable, non-hygroscopic epoxy resin or glass fibre reinforced polymer insulated supports able to withstand operating temperature of 110 degree C at regular intervals. The material and the spacing of the Busbar support should be same as per the type tested assembly
- f) Auxiliary buses for control power supply, space heater power supply or any other specified service shall be provided. These buses shall be insulated, adequately supported, and sized to suit specific requirement. The material for auxiliary supply bus will be insulated electrolytic copper Wires.
- g) Clearances between phases and phase to neutral should be in line with CPWD Specifications for Internal Electrical works-2013 amended up to date.

5.4.6 Requirement of main LV panel and other panels.

- a) Busbar capacity of any panel shall be more than the capacity of Incomer.
- b) The outgoing of the 2 transformers shall be terminated into Main LT panel through minimum 3 nos suitable capacity ACBs through separate Copper sandwich type bus trunking. These 3 ACBs shall be connected through couplers of minimum 3200Amp capacity with the facility of Electrical/ Mechanical interlocking and castle key arrangement.
- c) The outgoing of the Synchronization panel of 2 Nos DG Sets shall be terminated into 2 ACBs of minimum 2500Amp capacity through separate Copper, sandwich type bus trunking of minimum 3200 Amp capacity.
- d) The outgoing switch gears shall be designed on the basis of functional requirement as per the provisions contained in the NBC 2016.
- e) The additional spare ACBs /MCCBs of each capacity from minimum 25% to maximum 100% of the minimum functional requirement shall

Be included in the design of the panel for future extension. The same is included in the scope of the work.

5.4.7 Draw out Features

Air Circuit Breakers shall be provided in fully draw out cubicles, unless otherwise stated. These cubicles shall be such that draw out is possible without disconnection of the wires and cables. The power and control circuits shall have self-aligning and self-isolating contacts. Mechanical latches shall be integrated in ACB at service, test and isolated position to ensure that Breaker is firmly latched in respective position. It shall not be possible to move the breaker from the position unless latch is manually operated.

5.4.8 Instrument Accommodation

All voltmeter and ammeter and other instruments shall be flushed mounted type conforming to class 0.5 of IS 1248 for accuracy. All meters shall be protected with MCBs.

- a) Instruments and indicating lamps shall not be mounted on the Circuit Breaker Compartment door for which a separate and adequate compartment shall be provided, and the instrumentation shall be accessible for testing and maintenance without danger of accidental contact with live parts of the Panel board.
- b) For MCCBs, instruments and indicating lamps can be provided on the compartment doors.
- c) The current transformers for metering and for protection shall be mounted on the solid busbars with proper supports.
- d) On all the incomers of switch boards ON/OFF indicator lamps shall be provided suitable for operation on AC 230 volts supply. All lamps shall be protected by MCBs.
- e) For Incomer and outgoing feeders more than 200Amp rating, comprehensive power meters shall be provided which shall display A, V, Pf, Hz, Kw, KVA, KVAR, Kwh, Kvarh, average and maximum values, demand values, THD on current and Voltages. Also add on modules for RS 485 port, programmable contacts, analogue output etc. to link to SCADA system.
- f) All the Outgoing feeders of Main LT panel shall be provided with Sub metering equipment as per Super ECBC requirements.

5.4.9 Wiring

All small wiring for Controls, Indication etc. shall be with 2.5 sq. mm size FRLS/HFFR (halogen free fire retardant) copper conductor cables. The wiring shall be coded and labelled with approved ferrules for identification. Runs of wires shall be neatly bunched and suitably supported and clamped.

Means shall be provided for easy identification of wires. Identification ferrules shall be used at both the ends of wires. All control wires meant for external connections are to be brought out on a terminal board.

5.4.10 Earthing

Continuous GI earth bus of suitable size for prospective fault current to be provided with arrangement for connecting to station earth at two points. Hinged doors / frames to be connected to earth through adequately sized flexible braids.

5.4.11 Sheet Steel Treatment and Painting

Sheet steel used in the fabrication of Panel boards shall under go cleaning and surface treatment, seven tank process comprising of alkaline degreasing, descaling in dilute sulfuric acid and a recognized phosphating process after which a coat of primer paint compactivity with the final paint shall be applied over the treated surface. Final paint coat of oven baked powder coating, of shade approved by Engineer-in-Charge shall be provided.

5.4.12 Name Plates and Labels Suitable engraved white on black name plates and identification labels of metal for all Panel boards and Circuits shall be provided. These shall indicate the feeder number and feeder designation.

5.4.13 Type test reports.

Panel board configurations offered shall be tested for all the tests as per IEC61439 and internal arc tests. Type tests for the enclosure as per IEC61439 shall be submitted along with the verification tests.

5.4.14 Testing and Commissioning Copies of type test carried out at ACB/MCCB manufacturer's facility and routine tests carried out at the Panel board fabricator's shop shall be furnished along with the delivery of the Panel boards. Engineer-in-Charge reserves the right to get the Panel board inspected by their representative at fabricators facility prior to dispatch.

Commissioning checks and tests shall include all wiring check and checking up of connections. Relay adjustment/setting shall be done before commissioning in addition to routine Megger tests. Checks and tests shall include the following

- a) Physical variation and dimensional check
- b) Verification of material
- c) Operation checks.
- d) Inter lock function checks.
- e) Continuity checks of wiring, fuses, earthing etc. as required.
- f) All enclosures shall be tested for dielectric test with 1000V megger.
- g) HV test, Triptests and protection gear test.
- h) Functional test shall be done for all ACBs, MCCBs and other components.

5.5 Air Circuit Breakers

- a) The ACB shall conform to IEC/IS— 60947-2. The ACB shall have ultimate breaking capacity (I_{cu}) shall be equal to Service breaking capacity (I_{cs}) and Short Ckt With stand capacity ($I_{cs}=I_{cu}=I_{cw}$ for 1 sec). Rated Impulse withstand voltage shall be 12kV and rated insulation voltage at 1000V. The ACB release should have true RMS sensing.
- b) The breaker shall provide class II insulation between the front panel and internal power circuits to avoid any accidental contact with the live main current carrying path with the front cover open.

- c) Protective devices, metering, CTs, PTs, push buttons and indicating lamps shall be provided as per relevant CPWD specifications.

5.5.1 Constructional Features

- a) The Circuit Breaker shall be flush front, metalclad, horizontal draw-out pattern, three/ four pole as required and fully interlocked. Each Circuit Breaker shall be housed in a separate compartment closed on all sides.
- b) The Circuit Breaker cradle shall be designed and constructed to permit smooth withdrawal and insertion. The movement shall be free of jerks, easy to operate. Mechanical Latch to be provided to identify the Isolated, test & service position of breaker to prevent over racking.
- c) All current carrying parts in the breaker shall be silver plated and suitable arcing contacts shall be provided to protect the main contacts which shall be separate from the main contacts and easily replaceable. In addition, Arc chutes shall be provided for each pole, and these shall be suitable for being lifted out for the inspection of the main and the arcing contacts.
- d) The circuit breaker shall have indication of mechanical wear of contacts enabling visible indication of contact life.
- e) Self-aligning cluster type isolating contacts shall be provided for the Circuit Breaker, with automatically operated shutters to screen live cluster contacts when the Breaker is withdrawn from the cubicle. Sliding connections including those for the auxiliary contacts and control wiring shall also be of the self-aligning type. The fixed portion of the sliding connections shall have easy access for maintenance purposes.
- f) There shall be flexibility in changing the types of terminals at site to suit the bus bar orientation if required.
- g) The cubicle for housing the Breaker shall be free standing dead front pattern, fabricated from the best quality sheet steel.

5.5.2 Operating Mechanism

- a) The Circuit Breaker shall be trip free with independent manual spring operated also motor wound spring-operated mechanism as specified and with mechanical ON/OFF indication. The operating mechanism shall be such that the circuit breaker is at all times free to open immediately the trip coil is energized. The breaker shall be provided with built anti-pumping mechanism.
- b) The closing time shall be less than or equal to 70 ms to ensure faster closing of the breaker. And tripping time should be less than 30 ms to reduce the let through energy in the event of fault.
- c) The operating handle and mechanical trip push button shall be at the front of and integral with the Circuit Breaker.
- d) There shall be mechanical indicator on the front panel for 'Ready to close' situation for the breaker by checking all inter lockings.

- e) The Circuit Breaker shall have the following four distinct and separate positions which shall be indicated on the face of the panel. The breaker shall get latched in each of three positions namely Service, Test and Isolated, operator to de-latch before moving in/out to other position
 - I. "Service"—Both main and secondary isolating contacts closed
 - II. "Test"—Main isolating contacts open and secondary isolating contacts closed
 - III. "Isolated"—Both main and secondary isolating contacts open.

5.5.3 Circuit Breaker Inter locking

Sequence type strain free interlocks shall be provided to ensure the following:

- a) It shall not be possible for the Breaker to be withdrawn from the cubicle when in the "ON" position. To achieve this, suitable mechanism shall be provided to lock the Breaker in the tripped position before the Breaker is isolated.
- b) It shall not be possible for the Breaker to be switched "ON" until it is either in the fully inserted position or, for testing purposes, it is in the fully isolated position.
- c) It shall not be possible for the Circuit Breaker to be plugged in unless it is in the OFF position.
- d) A safety latch shall be provided to ensure that the movement of the Breaker, as it is withdrawn, is checked before it is completely out of the cubicle, thus preventing its accidental fall due to its weight.

5.5.4 Circuit Breaker Auxiliary Contacts.

The Circuit Breaker shall have suitable free/minimum 4NO/N Auxiliary contacts rated at 10amps 440 volts 50Hz. The contacts shall be approachable from the front for connecting all external wiring from the front. They shall close before the main contacts when the Circuit Breaker is plugged in and vice versa when the Circuit Breaker is Drawn Out of the cubicle.

5.5.5 Electrical Auxiliaries

- a) All electrical auxiliaries, including the spring charging gear motor shall be installable on site without requiring adjustment or any tools other than as crew driver.
- b) The auxiliaries shall be placed in a compartment which under normal operating conditions, shall not contain any conducting parts capable of entering into electrical contact with the circuit breaker poles. It shall be possible to connect all auxiliary wiring from the front of the circuit breaker.

5.5.6 Circuit breaker Releases

All Air Circuit Breakers should have micro processor release.

- a) The Incoming circuit breaker to be equipped with adjustable short circuit protection with adjustable time delay, over current protection, and adjustable earth fault protection with adjustable time delay. There shall be graphical display showing the IDMT curve. It shall have display of all electrical parameters like V, A, W, VAR, VA, Wh, VARh, VAh. It should be

possible to store tripping history of last ten faults with time and date of fault and the type of fault with values.

- b) ACB should have thermal Memory and Zone selective interlocking for logic discrimination to reduce thermal/ electrodynamic stresses in the event of short circuit and earth fault.
- c) The outgoing ACB should have short circuit and over load protections with display of current. Percentage loading indication of all the three phases of the breaker to be available on the release. Online setting of the parameters should be possible. The setting of the ACB should be possible digitally as well as with dial settings with the help of screwdriver.
- d) Option of communication port on all types of the releases, even if the same is not specified at the time of ordering.
- e) As an option it should be possible to have programmable contacts if required at later date.

5.5.7 Earthing

The frame of the Circuit Breaker shall positively be earthed when the Circuit Breaker is racked into the cubicle.

5.5.8 Moulded Case Circuit Breakers (MCCBs)

The Moulded case circuit Breaker (MCCB) shall conform to the latest IEC 60947-2 and IEC 947-3- 1989. MCCBs shall be suitable for rated operation voltage up to 415 VAC.

MCCBs in AC circuits shall be of triple pole/four pole construction. Operating mechanism shall be Double break quick-make, quick-break and trip-free type. The "ON", "OFF" and "TRIP" positions of the MCCBs shall be clearly indicated and visible to the operator when mounted as in service. Front of door operating handle shall be provided with door interlock. The Service short circuit Breaking capacity of all MCCBs shall be $I_{cs}=100\%I_{cu}$. MCCBs of rating up to 200 A can be with thermal magnetic/ Micro processor release. Whereas MCCBs of 200 A and above ratings shall be with Micro processor release only.

MCCBs used with Three Pole and Neutral connections shall be of Four pole type only.

5.5.9 Construction, operation, environment

- a) MCCBs shall be actuated by a toggle or handle that clearly indicates the three positions: ON, OFF and TRIPPED.
- b) The operating mechanism shall be designed such that the toggle or handle can only be in OFF position (O) if the power contacts are actually separated.
- c) MCCBs shall be equipped with a "push to trip" button in front to test operation and the opening of the poles.
- d) MCCB rating, "push to trip" button and contact position indication must be clearly visible and accessible from the front, through the front panel or the door of the Panelboard.

5.5.10 Communication

MCCB should have option for communication in the Main LT Panel for critical feeders i.e., RS 485 communication port.

5.5.11 Thermal memory

All the MCCB should have thermal memory feature. In the event of repeated overloads, the electronic trip unit shall optimize protection of cable and downstream devices by memorizing temperature variations.

5.5.12 Miniature Circuit Breaker (MCB)

- a) Miniature circuit breakers shall be of approved design and make and must be tested and validated as per IEC/EN 60898 and IEC 60947-2 standards.
- b) MCBs shall be suitable for operation at 230V/415V, 50Hz supply. The rated short circuit capacity shall be 10kA. MCBs shall be offered with 'C' tripping characteristics. The MCBs shall be suitable for mounting on a DIN rail.
- c) 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).
- d) IP20 Degree of Protection shall be ensured to prevent electrical shocks by accidental touch to any live parts, by providing finger touch proof terminals.
- e) Operating knob shall have provision to lock in ON/OFF condition without affecting any automatic tripping.
- f) Circuit-breakers shall be capable of operation under ambient temperature up to 50°C, without derating of their over load tripping threshold with respect to the rated operating current. The same must be tested and validated as per IEC 60947-2 standard.
- g) MCBs shall be suitable for field-fixable Protection auxiliaries (viz. Over-voltage release, Under voltage release, Shunt trip) and Indication Auxiliaries (like Auxiliary Contact, Trip alarm contact).

5.6 11kV Surge Arrestors

5.6.1 Introduction

This section covers the specification of Distribution class Surge Arrestor for 33kV indoor type VCB breaker panel, transformers etc. with highest system voltage of 36kV at 50Hz.

5.6.2 Standards

The design, manufacture and performance of Surge Arrestors shall comply with IS:3070 Part3 and other specific requirements stipulated in the specification. Unless otherwise specified, the equipment, material and processes shall conform to the latest applicable Indian/International Standards as listed here under:

IS:2071-1993(Part-1&2)	Methods of High Voltage Testing General Definition & Test procedures.
IS:2629-1985	Recommended Practice for hot dip galvanizing on Iron & Steel
IS:3070-1993 (Part-3)	Specification for surge arrestor for alternating current systems. Metal-Oxide Lightning Arrestors
IS:5621-1980	Hollow Insulators for use in Electrical Equipment.
IS:6209-1982	Methods of Partial discharge measurement.
ANSI/IEEE-C.62.11	Design Test Report Polymer Distribution Arresters
IEC-60099-4	Surge Arrestors

5.6.3 General requirement

- a) The metal oxide gapless Surge Arrestor without any series or shunt gap shall be suitable for protection of 33kV side of transformers from voltage surges resulting from natural disturbance like lightning as well as system disturbances. The surge arrestor shall draw negligible current at operating voltage and at the same time offer least resistance during the flow of surge current. The surge arrestor shall consist of non-linear metal oxide resistor elements placed in series and housed in electrical grade porcelain housing/silicon polymeric of specified Creepage distance.
- b) The assembly shall be hermetically sealed with suitable rubber gaskets with effective sealing system arrangement to prevent rest of moisture.
- c) The surge arrestor shall be provided with line and earth terminals of suitable size. The ground side terminal of surge arrestor shall be connected with 25x6 mm GI strip, one end connected to the surge arrestor and second end to a separate ground electrode.
- d) The surge arrestor shall not operate under power frequency and temporary over voltage conditions but under surge conditions, the surge arrestor shall change over to the conducting mode.
- e) The surge arrestor shall be suitable for circuit breaker performing 0-0.3min-CO-3min-00-duty in the system.
- f) The reference current of the arrestor shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage.
- g) The Surge Arrestor shall be thermally stable and contractor shall furnish a copy of thermal stability test.
- h) The arrestor shall be capable of handling terminal energy for high surges, external pollution and transient over voltage and have low losses at operating voltages.

5.6.4 Arrestor housing

The arrestor housing shall be made up of siliconpolymeric housing and shall be homogenous, freefrom laminations, cavities and other flaws of imperfections that might affect the mechanical and dielectric quality. The housing shall be free from blisters, burrs and other similar defects. The housing shall be so coordinated that external flash over shall not occur due to application of any impulse or switching surge voltage up to the maximum design value for arrestor. The arrestors shall not fail due to contamination. Sealed housings shall exhibit no measurable leakage.

5.6.5 Arrest or mounting

The arrestors shall be suitable for mounting on VCB breaker panel for transformer and for incoming and outgoing lines.

5.6.6 Fittings & Accessories

The surge arrestor shall be complete with disconnect or and terminal connectors and all other accessories. The terminals shall be non-magnetic, corrosion proof, robust and of adequate size and shall be so located that incoming and outgoing connection are made with minimum possible bends. The top metal cap and base of surge arrestor shall be galvanized. The line terminal shall have a built-in clamping device which can be adjusted for both horizontal and vertical take-offs.

5.6.7 Tests on Surge Arrestors

The Surge Arrestors offered shall be type tested and shall be subjected to routine and acceptance tests in accordance with IS: 3070 (Part-3)-1993. In addition, the suitability of the surge arresters shall also be established for the followings

a) Acceptance tests:

- I. Measurement of power frequency reference voltage of arrester units.
- II. Lightning impulse residual voltage on arrester units (IEC clause 6.3.2)
- III. Internal ionization or partial discharge test.
- IV. Thermal stability test (IEC clause 7.2.2)

b) Routine tests:

- I. Measurement of reference voltage
- II. Residual voltage test of arrester unit
- III. Internal ionization or partial discharge test
- IV. Sealing test
- V. Verticality checks on completely assembled surge arresters as a sample test one each lot if applicable.

5.7 Automatic Power Factor Correction Panels.

The panels shall be indoor type floor mounting, fixed type, single front, self-standing, totally enclosed to make it dust and vermin proof (IP42).

a) The Panels shall be fabricated with 2mm thick CRC A sheet steel.

b) The number of steps and the KVAR rating of the Panels shall be as below:

Overall Rating
2 No. panels of suitable KVAR (40% of Transformer capacity) (1 No. for each side of main LT Panel) with 12 steps APFC layout of which suitable static capacitor shall be permanently connected to the bus.

- c) Adequate lifting facilities shall be provided and the lifting eye bolts shall be removable type.
- d) The Panel shall be so designed to maintain the Power factor above 0.99(lag)at all loads (confirming to Super ECBC standards).
- e) The panel shall consist of 4 Strip bus bars. The bus bars shall be of Electrolytic Copper and of sufficient cross section to carry fault current without any damage. The rating of bus bar shall be equivalent to rating of incomer ACB, current density shall not be more than 1.6 Amps/sq.mm, The bus bars shall be supported on epoxy cast resin /DMC insulators and covered by heat shrinkable PVC sleeves. The main busbars shall be adequately supported to withstand stresses developed due to short circuit current. Tapping points shall be treated against oxidation. Appropriate identification markings / labels shall be provided on the bus bar and tapings for distinguishing the various phase and neutral.
- f) The panel should be so designed that it should operate in auto as well as in manual mode and the relay should be capable of operating the total KVAR of capacitors with minimum stages up to 12 stages. The capacity of the Bus-Bar shall be designed on the basis of KVA Rating.
- g) The fabricated panel shall undergo 7 tank treatment and primer, before inside and outside powder coating.
- h) The equipment inside the compartment shall be arranged in a logical manner for ease of reference at site.
- i) Undrilled gland plates shall be provided at top and bottom of the panel and shall be removable type with nuts and bolts for proper fixing.
- j) The control supply shall be tapped after the Mains Incomer ACB. Control circuit shall be provided with MCBs for protection.
- k) Indicating lamps shall be provided for each Bank. Capacitors "ON" Indications shall be provided.
- l) The control wiring shall be provided with suitable size un-armoured copper conductor cable with ferrule number and the terminal block shall be numbered for ease in connection/identification.
- m) The individual capacitors & their control shall be provided in separate compartments in panel through MCCBs.

Capacitors	:MD-XL Type
Incomer Breaker	:ACB Three Pole, 65KA
Outgoing Circuit	:MCCB's
25KVAR	:63Amps
50KVAR	:125Amps
100KVAR	:250Amps

- n) Suitable rating contactors, copper wound Harmonic block with 7 % filtering factor shall be provided for the following capacities of Capacitors:

5.7.1 Current Transformer:

The C.Ts shall be of tape wound type and shall be capable of withstanding the rated fault current of the system for 1 second and should be of 10 VA burden.

5.7.2 APFC Relay:

The panels shall be provided with micro-processor based APFC relay having 12 step switch facility for setting target P.F. range in the form of high and low, step indication, low current indication, auto-manual selection, segment LED display to be provided to indicate existing power factor. The relay should be capable to provide over voltage protection upto 10% of rated voltage & Lead power factors eliminated and the switching shall take place on FIFO arrangement. LED Type Phase Indicating Lamps, Digital Multifunction meter to indicate Voltage, Current, PF, Freq, KVAR, KW, KVA etc shall be provided. The panels shall be provided with 2 nos Earthing terminals on both sides of the panel.

5.7.3 Specification for Capacitors Standards:

The capacitors shall conform to IS-2834-Shunt capacitors for power system. The capacitors shall be suitable for operation on 480V, 3Phase, 3wire, 50Hz AC supply system.

- a) The capacitor shall be mixed dielectric type. The capacitor should be self-healing type. Internal loss of the capacitor should not be more than 0.5W/KVA.
- b) The elements shall be connected to the terminals and enclosed in a metallic enclosure.
- c) After evacuation and impregnation, all voids shall be completely filled with the impregnant and the container shall be hermetically sealed to prevent ingress of air, dust and moisture.
- d) The capacitor shall be suitable for a rated voltage of 480 volts and shall be continuously operating at a maximum over-voltage of 10% above the rated voltage.
- e) The rated frequency is 50Hz. The capacitor shall however, be suitable for continuous operation with a frequency variation of +3% from the rated frequency.
- f) The capacitor shall be suitable for operation in temperature category 50 Deg.C.
- g) The capacitor shall also be capable of carrying without injury an increase in current loading up to 30% of the rated current, which may arise due to increase in voltage, increase in frequency, presence of non-sinusoidal voltage supply or other causes. The maximum continuous reactive output of the capacitor shall not exceed 30% over the rated reactive output.
- h) Each power capacitor shall be provided in separate compartment with door interlock arrangement to disconnect power contactor of the capacitor when the concerned compartment of capacitor is opened. Heat dissipation louvers covered with micromesh & exhaust fans shall be provided for cross ventilation in capacitor mounting compartments and busbar chambers.

5.7.4 Discharge Devices:

Each capacitor bank shall be internally fitted with a low loss continuously rated effective discharge device. It shall be designed to discharge the entire capacitor from the peak AC voltage not exceeding 50 volts measured at the terminals of the capacitor within a maximum period of 1 minute of disconnection from supply.

5.7.5 Tests At Manufacturer's facility

All routine and type tests as per IS 2834 relevant to capacitor banks as amended up to date shall be carried out at manufacturer's facility and test certificates shall be furnished to the department.

5.7.6 Installation

Capacitor banks shall be installed at least 30 cm away from the walls on suitable metal frame work of welded construction. The earth terminals provided on the body of capacitor bank shall be bonded to the main capacitor panel earth bus with 2 Nos. 8 SWG copper or 6 SWG GI earth wires.

5.7.7 Tests at Site

Insulation resistance with 500 V DC Megger shall be carried out and test results shall be recorded at site.

5.8 Cables

5.8.1 HT Cables

The specification covers the supply, installation, testing & Commissioning of PVC sheathed 11KV(E) grade, XLPE insulated Aluminium conductor cables. The cable shall be manufactured strictly conforming to IS:7098(Part 2) - 1985 amended up to date and shall bear ISI mark. The 11 KV HV cable size shall be designed based on the fault level of the feeder, obtained from the supply company.

5.8.2 Standards:

The cable shall conform to the following standards.

- a) IS 7098 Part 2: 1985 XLPE insulated PVC sheathed cables for working voltage up to and including 11kV.
- b) IS 3975:1988 Mild steel wires, formed and tapes for armouring of cable.
- c) IEEE-383:1974 Standard for type test of class IE electric cables, field splices, and connections for nuclear power generating stations.
- d) NEMA-WC5,1992 Thermo plastic Insulated Wire and cable for the transmission and distribution of Electrical Energy.
- e) IEC:754 (Part-1):1994 Test on gases evolved during combustion of electric cables-Determination of the amount of halogen acid gas evolved during combustion of polymeric materials taken from cables.
- f) IEC:332(Part I):1993 Test on electric cable under fire conditions. Test on a single vertical insulated wire or cable.

The cable, joints, outdoor and indoor termination and their accessories and fittings may conform to Indian and /or equivalent international standards.

5.8.3 Electrical Characteristics & Performance:

- a) All cables shall be suitable for high ambient, high humid tropical climatic conditions. Cables shall be designed to withstand the mechanical, electrical and thermal stresses under the unforeseen steady state and transient conditions and shall be suitable for proposed method of installation.
- b) Extruded Semi-conducting screening and metallic screening shall generally be as per IS 7098 (Part-II) with latest amendments. The semiconducting compound shall be suitable for the operating temperature of the cable and compatible with the insulating material.
- c) The interface between insulation and insulation screen shall be free of any voids. Insulation screen shall be strip able type.

5.8.4 Cable Construction:

- a) XLPE insulated underground cable shall be manufactured with use of suitable materials for XLPE semi-conducting, insulation and XLPE screen. The Cables in this specification does not have any metals heat and the short circuit rating of the cable shall depend on the conductivity and continuity of the strands of the armour wires, which shall be ensured by guarding against corrosion.
- b) A semi-conducting cross-linked polyethylene (XLPE) screening shall be extruded over the conductor to act as an electrical shield which together with elimination of the so called "Strand Effect" prevents to a great extent air ionization on the surface of the conductor. The main insulation of the Cable shall be extruded unfilled, chemically cross-linked polyethylene (XLPE) inert gas cured.
- c) The insulation screen shall be an extruded layer of black semi-conducting compound and continuously covers the whole area of insulation. The contact surface between insulation and insulation screen shall be smooth and free from protrusion and irregularities.
- d) The semi conducting XLPE screen shall be extruded over the main polyethylene-insulating wall to prevent partial discharge at the surface of the insulation. The copper tape shall be wrapped over the semiconducting tape or extrusion for 3 core cables. The metal screen so formed around the cores shall be in contact with one another as the cores are laid up in triangular configuration. Conductor screening, insulation and insulation screening shall be extruded in triple extrusion processes so as to obtain continuously smooth interfaces.
- e) Makes of cables Manufactured with "triple extrusion" process will only be considered. The Contractor shall produce necessary reports before getting approval for cables makes.
- f) The cable core shall be supplied with bedding of PVC (Innersheath) in the form of extruded PVC sheath for 11 KV cables.

- g) The cable shall be steel strip armoured for 33KV and 11 KV. Three core cables to ensure an adequate return path for the flow of fault current and also provide suitable mechanical protection.

5.8.5 Current Rating of Cables:

- a) Nominal Current rating shall not be less than the Specific Technical Requirements. Contractor shall submit design data in respect of all cable in the prescribed format.

5.8.6 Discharge Free Construction:

The inner conductor shield, TR-XLPE insulation, and outer insulation shield shall be extruded with a true triple extruder head using a dry cure process. The conductor screen, Insulation and Insulation screen shall all be extruded in single point at one time process to ensure homogeneity and reduction of voids in the insulation and the screening system of the cable.

5.8.7 Tests and Testing Facilities: Type

Tests:

All type tests in accordance with IS: 7098 (Part 2) amended up to date, shall be performed on cable samples drawn by department.

Type tests reports carried out from Government laboratories or Government approved laboratories on the cables shall be submitted.

5.8.8 Routine Tests:

All Routine tests and acceptance tests as per IS shall be carried out and result should be given in test report. Partial discharge test must be carried out in a fully screened test cell. It is, therefore, absolutely essential that the manufacturer should have the appropriate type of facility to conduct this routine test. The facilities shall be provided by the Contractor to the Engineer-in-charge or his authorised representative for witnessing the tests in the manufacturer's premises.

5.8.9 Marking:

Identification Marks on Cable:

The following particulars shall be properly legible embossed on the cable sheath at the intervals of not exceeding one meter throughout the length of the cable.

Manufacturer name and/or Trade name.

- a) Voltage grade of Cable.
- b) Year of manufacture.
- c) ISI Mark.
- d) Size of cable

5.8.10 Installation

HT Cables shall be laid in ground, trenches, cable trays and on walls as specified. Installation shall include all supports and clamps as required. The complete work shall be in accordance to CPWD General Specifications for Electrical Works - Part II (External) 1994 amended up to date. As far as possible cables shall not be fixed on walls directly but can be laid on cable trays.

5.8.11 Jointing for Cable Glands

Jointing work shall be carried out only by licensed experienced cable jointer and

shall be in accordance to CPWD General Specifications for Electrical Works- PartII(External)1994 amended upto date.

5.8.12 Earthing for Cable Glands

All HV cable glands shall be connected to the earth with suitable size copper or G.I. conductors.

5.8.13 Power Distribution System Losses

The power cabling shall be adequately sized as to maintain the distribution losses not to exceed 1% of the total power usage. Record of design calculation for the losses shall be maintained. The cables shall be designed as per the voltage drop regulation at peak load.

5.9 LT Cables

This specification covers the supply & installation of LT power & control cables. Cables shall be tested at manufacturer's facility and supplied in accordance to relevant Indian Standard Specifications. The LT power cables shall be XLPE insulated, PVC sheathed, aluminium/copper conduct or armoured cables conforming to IS:7098(Part-I).

5.9.1 Data and Manuals

Drawings, data and manuals shall be submitted for the following:-

- a) Manufacturer's catalogues giving cable details and characteristics.
- b) Cable current ratings for different types of installation inclusive of derating factors for ambient temperatures, grouping etc.
- c) Manufacturer's recommended method of jointing, termination of the cables.

5.9.2 The cables shall be used for connection of power circuits of the electrical system.

Cables will be generally laid in ground, surface or in RCC/Hume/GI pipes/ cable tray. For continuous operation at specified rating, maximum conductor temperature shall be limited to the permissible value as per relevant standard and/or this specification. The insulation and sheath materials shall be tough enough to withstand mechanical stresses during handling. Armouring shall be round/flat wire of galvanized steel. Core identification for multicore cable shall be provided by colour coding. The cables shall be designed as per the voltage drop regulations at peak load and length of the cable.

5.9.3 Specific Requirements

Cable identification shall be provided by embossing on the outer sheath the following at regular interval also 12/3 metres.

- a) Manufacturer's name or brand name or trade mark.
- b) Type of cable and voltage grade.
- c) ISI Mark.

5.9.4 Tests

All tests shall be carried out in accordance with relevant Indian Standard code of practice and Indian Electricity Rules. Test certificates of all the tests carried out at the works shall be furnished for approval of the Engineer-in-charge before the cables are dispatched from the manufacturer's facility to the site. Test reports shall be complete with all details and shall also contain IS specified limit values wherever applicable to facilitate review.

5.9.5 Laying of cables:

Cables shall be laid as per the CPWD specifications (Amended upto date) given below:

a) Duct system:

Wherever specified such as road crossing, entry to building or in paved area etc. cables shall be laid in underground ducts. The duct system shall consist of a required number of stone ware pipes, GI, CI or spun reinforced concrete pipe with simplex joints and all the jointing work shall be done according to the CPWD building specifications or as per the instructions of the Engineer-In-Charge as the case may be. The size of the pipe shall not be less than 150mm. The pipe shall be laid directly in ground without making any special bed but wherever asbestos cement pipes are used, the pipes shall be encased in concrete of 75mm thick. The ducts shall be properly anchored to prevent any movement. The top surface of the cable ducts shall not be less than 60 cm. below the ground level. The duct shall be provided with manholes of adequate size at regular intervals for drawing the cables. The manhole cover and frame shall be of cast iron and machine finished to ensure a perfect joint. The manhole covers shall be installed flush with the ground or paved surfaces. The duct entry to the manholes shall be made leak proof with lead-wool joints. The ducts shall be properly plugged at the ends to prevent entry of water, rodents, etc. Suitable duct markers shall be placed along the run of the cable ducts. The duct markers shall at least be 15cm. square embedded in concrete, indicating duct. Suitable cable supports made of angle iron shall be provided in the manholes for supporting the cables. Proper identification tags shall be provided for each cable in the manholes.

b) Cables in laid ground:

- i. The depth of the underground trench shall not be less than 75cm for cables up to 1.1 KV grade and 1.2m for cables above 1.1KV grade from the final ground level. When more than one cable is to be laid in vertical formation, the depth of the trench shall be increased by 30cm for each additional tier to be formed. The width of the trenches shall not be less than 45cm. However, where more than one cable is laid, an axial distance of not less than 15cm. shall be allowed between the cables. Wherever there is a change in direction, suitable curvature shall be provided complying with the requirements. Suitable shoring and propping may be done to avoid caving in of trench walls. The bottom of the trench shall be level and free from stone brick bats etc. The trench shall then be provided with a layer of clean, dry sand cushion of not less than 8cm. in depth.
- ii. The cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains. The entire cable length shall as far as possible be paved off in one stretch. However, where this is not possible, the remainder of the cable may be removed by "Flaking" i.e., by making one long loop in the reverse direction. After the cable has been uncoiled and laid into the trench over the rollers, the cable shall be lifted slightly over the rollers, beginning from one end by helpers standing about 10 mtrs. apart and draw straight. The cable should then be taken off the rollers by additional helpers lifting the cable and then laid in as on a straight line.
- iii. When the cable has been properly straightened, the cores are tested for continuity and insulation resistance and then the cable length be measured. The ends of all cables shall be sealed immediately. In case of PVC cables, suitable moisture se

altape shall be used for this purpose.

- iv. Cable laid in trenches in a single tier formation shall have a covering of clean, dry and of not less 17 cm above the base cushion of sand before the protective cover is laid. In the case of vertical multi-tier formation after the first cable has been laid, as and cushion of 30 cm shall be provided over the initial bed before the second tier is laid. If additional tiers are formed, each of the subsequent tiers also shall have a sand cushion of 30 cm as stated above. The top most cable shall have a final and covering not less than 17 cm before the protective cover is laid.
- v. Unless otherwise specified, the cables shall be protected by the second-class bricks of not less 20 cm x 10 cm x 10 cm (nominal size) protection covers placed on top of the sand (bricks to be laid breadth wise) for the full length of the cable. Where more than one cable is to be laid in the same trench, this protective covering shall cover all the cables and project at 5 cm. over the sides of the end cables. The trenches shall be taken back filled with excavated earth free from stones or other sharp edge debris and shall be rammed and watered, if necessary, in successive layers not exceeding 30 cm, unless otherwise specified.
- vi. At the time of original installation, approximately 3 m of surplus cable shall be left on each terminal end of the cable and on each side of the underground joints. The surplus cable shall be left in the form of a loop. Where there are long runs of cable such loop cable may be left at suitable intervals as specified by the Engineer-in-charge.

c) Cables in indoor trenches

Cables shall be laid in indoor trenches wherever specified. The trench shall be made of brick masonry with smooth cement mortar finish with suitable removable covers (i.e., pre-cast slabs or MS chequered plates). The dimensions of the trenches shall be determined depending upon the maximum number of cables that is expected to be accommodated and can conveniently be laid. Cables shall be arranged in tier formation in trenches and if necessary; cables may be fixed with clamps. Suitable clamps, hook and saddles shall be used for securing the cable in position. Spacing between the cables shall not be less than 15 cm centre to centre. Wherever specified, trenches shall be filled with fine sand and covered with RCC or steel chequered trench covers.

d) Jointing and Terminations

- i. Cable jointing shall be done as per the recommendations of the cable manufacturer. All jointing work shall be done only by qualified/licensed cable jointer.
- ii. All jointing pits shall be of sufficient dimensions as to allow easy and comfortable working. Jointing materials and accessories like conductors, ferrules, solder, flex, insulating and protective tapes, filling compound, jointing box etc. of right quality and correct sizes, conforming to relevant Indian Standards.
- iii. Each termination shall be carried out using brass compression glands and cable sockets. Hydraulic crimping tool shall be used for making the end terminations. Cable gland shall be bonded to the earth by using suitable sized copper wire/tape.

5.9.6 Route Marker

Route markers shall be provided along the runs of cables at locations approved by the Engineer-in-Charge and generally at intervals not exceeding 100m. Markers shall also be provided to identify change in the direction of the cable route and at location so funder ground joints.

Route markers shall be made out of 150mm dia x 5mm (Thickness) GI/Aluminium/ CI plate welded/ bolted on 35 mm x 35mm x 6mm angle iron, 60cm long. Such plate markers shall be mounted parallel to and at about 0.5m away from the edge of the trench.

The word "MV/HV CABLE" as the case may be, shall be inscribed on the marker.

5.10 Technical Specification for Cable Trays

5.10.1 The scope of work shall cover hot dip galvanized Cable trays, tray support systems, fittings and accessories for laying the power cables, control cables and teletechnical cables. Manufacture and finish shall be completed at the factory works.

The cable trays shall be of steel as per IS 226 and galvanized and the thickness of galvanization shall not be less than 100 microns. All bolts and nuts also be galvanized. Hot dip galvanizing shall confirm to IS 2633. The galvanizing shall be uniform, clear, smooth, continuous and free from acid spots.

5.10.2 The cable trays and accessories shall be fabricated out of hot rolled steel sheets, which shall be hot dipped, galvanized. The complete assembled cable tray sections shall be corrosion resistant, high strength and with extreme smooth surface. The tray shall have suitable strength and rigidity to provide adequate support for all contained cables. It shall not present sharp edges, burrs or projections injurious to the insulation of wiring/cables. It shall have side rails or equivalent structural members. It shall include fittings or other suitable means for changes in direction and elevation of runs.

5.10.3 Cable Trays — Types

Ladder Type Cable Trays

Ladder type cable trays shall be used for laying the power cables of medium Voltage and Low voltage. Ladder type cable trays shall be made out of Channels for side rails and rungs.

Ladder type cable tray shall consist of a Welded rung assembly of field proven design. It shall consist of side rails of 3.0 mtrs. Standard lengths and slotted rung spaced 250mm centre to centre.

Coupler, Coupler fasteners, tray assembly fasteners must form the part of the equipment. The Ladders should be heavy duty sheet metal constructions yet robust enough to carry a cable load of 50kg/m on a span of 1.25mtrs.

The design shall be flexible enough to accommodate change of widths at site. Sections of 2mm shall be standard for different width soft rays. Horizontal bends, Vertical internal / external, tees, crosses shall be standard products. Hinged or flexible couple assemblies for Vertical / Horizontal route changes shall be available

as standard as also reducers (off set couplers). Covers shall be of pre-galvanized sheet 18 SWG (1.25mm up to 300w) & 16 SWG 1.6mm on higher widths) construction possible for easy mounting on to trays wherever applicable. Provision to add on earth flat holding clamps, trays fixing clamps should be part of cable tray design.

5.10.4 Perforated Cable Tray

Perforated cable trays shall be used for laying the cables of low voltage and control cable. Perforated cable trays shall generally be of channel type and the perforation in the trays shall be either 8 x 15 mm or 10 X 20 mm oval holes.

Perforated cable trays of standard lengths of 2.5 mtrs shall be offered. Finish shall be as specified earlier. The cable tray of size 150mm Width and Less than that shall be of Perforated type.

Sizes

The cable trays shall be of the following standard sizes.

Width 300/450/600/800/1000mm as required.

Height 75/100mm

Thickness of sheet steel 2.0 mm / 3.0mm as per width of tray. The flange and width of the cable trays shall be decided based on the diameter and the number of cables running through each section of the cable tray.

5.10.5 Cable tray manufacturer shall supply suitable accessories for fixing the cable trays on supports from ceiling and beams of the building structure. Cable trays shall be supplied with GI coupler plates, hardware, nuts bolts and washers for joining the standard length of sections.

5.10.6 Installation

- a) Cable trays shall be installed as a complete system. Trays shall be supported properly from the building structure. The entire cable tray system shall be rigid.
- b) Each run of the cable tray shall be completed before the installation of cables. In portions where additional protection is required, non-combustible covers/enclosures shall be used.
- c) Where cables of different system are installed on the same cable tray, non-combustible, solid barriers shall be used for segregating the cables.
- d) Cable trays shall be grounded by two numbers, earth continuity wires. Cable trays shall not be used as equipment grounding conductors.
- e) At no place, the cable tray / rack / ladder running horizontally should rest on any building partition like Brick wall, RCC beams etc. but instead proper MS supports/ hangers to be provided at minimum of 1500mm intervals and at every Turning Angle.

5.10.7 Testing and Inspection

- a) Deflection load test at the manufacturer's facility Test span shall be simple beams span with free unrestrained ends.
- b) The cable tray shall be uniformly loaded along the span with cable tray simply supported at the two ends as per the load criteria.

5.11 Earthing System

- 5.11.1 This section covers the general requirements of the earthing system for Sub-station installation. Earthing system shall comprise earth electrodes in accordance with General Specifications for Electrical Works (PartI-Internal), 2013. All Neutral and Body earthing of all transformers / D.G Sets HV& MV panels shall be done using Connectors taken from the Structural Earthing of the building. Wherever it is not possible, the earthing shall be of copper plate type and as per CPWD specifications. After installation, the tests shall be carried out and results to be recorded.

5.12 Foundation Design.

- a) All foundations shall be of reinforced cement concrete. The design and construction of RCC structures shall be carried out as per IS 456 and minimum grade of concrete shall be M25. Higher grades of concrete than specified above may be used at the discretion of the bidder without claiming any thing extra from the department.
- b) Foundation drawings of VCB Panels, Transformers, LT panels shall be submitted to the department and work shall be commenced only after getting approved from the Engineer-in-charge.
- c) The procedure used for the design of the foundations shall be the most critical loading combination of the steel structure and/or equipment and/or superstructure, and other conditions which produce the maximum stresses in the foundation or the foundation component, and as per the relevant IS Codes of foundation design. The design calculations shall be submitted by the bidder showing complete details.
- d) All foundations shall rest below virging round level and the minimum depth of foundation below the virgin ground level as per relevant standards shall be maintained.
- e) Design shall consider any sub-soil water pressure that may be encountered. Necessary protection to the foundation work, if required, shall be provided to take care of any special requirements for aggressive alkaline soil, black cotton soil or any other type of soil which is detrimental or harmful to the concrete foundations.
- f) All building sub-structures shall be checked for sliding and over turning stability during both construction and operating conditions for various combinations of loads. Factors of safety for the secases shall be as stated as perrel event IS codes or as stipulatedelse where in the specifications. All foundations shall be designed in accordance with the provisions of therelevant parts of latest revisions of IS 2911 and IS 456.

5.13 Safety Requirements

This section covers the requirements of items to be provided in the substation for compliance with statutory regulations, safety and operational needs.

a) Requirements

Safety provisions shall begenerally in conformity with CPWD General Specifications of Electrical Works (PartI-Internal), 2013. Inparticular following items shall be provided:

b) Insulation Mats

Insulation mats conforming to IS 15652: 2006 shall be provided in front of panel boards

as well as other control equipment.

c) First Aid Charts and First Aid Box

Charts (one in English, one in Hindi, one in regional language), displaying methods of giving artificial respiration to a victim of electrical shock shall be prominently provided at appropriate place. Standard first aid boxes containing materials as prescribed by St. John Ambulance brigade or Indian Red Cross should be provided in each sub-station.

d) Danger Plate

Danger Plates shall be provided on HV and MV equipment. Danger notice plate shall be 200 mm x 150 mm made of mild steel at least 2 mm thick vitreous enamelled white on both sides and with the descriptions in signal red colour on front side as required. Notice plates of other suitable materials such as stainless steel, brass or such other permanent nature material shall also be accepted with the description engraved in signal red colour.

e) Fire Extinguishers

Portable CO₂ Fire Extinguishers conforming to IS:2878, Dry chemical powder extinguishers conforming to IS: 2171, HCFC Blend A (P-IV) shall be installed in the sub-station at suitable places. Other extinguishers recommended for electric fires may also be used.

f) Fire Buckets

Fire buckets conforming to IS 2546: 1974 shall be installed with the suitable stand for storage of water and sand.

g) Tool Box

A standard tool box containing necessary tools required for operation and maintenance shall be provided in the sub-station.

h) Caution Board

Necessary number of caution boards such as "Man on Line" 'Don't Switch on' etc. shall be available in the sub-station.

i) Key Board

A key board of required size shall be provided at a proper place containing castle keys, and all other keys of sub-station and allied areas.

5.14 Standards:

The following standards and rules shall be applicable.

IS 7098, Part -II, 1985	:	XLPE insulated HT cables
IS 3975	:	Mild steel wires, formed wires and tapes from armouring of cables.
IS 1255	:	Code of Practice for installation and maintenance of Power cables upto and including 11 KV ratings.

IS 10418	:	Drums for Electric Cables
IS 1554	:	PVC insulated (heavy duty) electric cables Part I for working voltages upto and including 1100 V.
IS 8130, 1984	:	Conductors for insulated electric cables and flexible cords.
IS 3961	:	Recommended current ratings for cables :(Part 2) PVC Insulated and PVC sheathed heavy duty cables.
IS 5831	:	PVC insulation and sheath of electric cables.
IS 10810	:	Methods of Tests for Cables.
IS 4905	:	Methods for random sampling

C-6- DG. SETS

6.0 Technical Specifications of D.G. Sets

The scope of work includes Design, Manufacture, supply, installation, testing, commissioning of DG Sets. The capacity of DG sets given in this tender are indicative only. Contractor has to design according to the load requirements of various equipment. However, Minimum 2Nos. of DG sets with prime power rating of each 500KVA at 1500RPM, 415V, 50HZ, 3Phase, 0.8pf (lag) with complete accessories, AMF control panel, Synchronization panel shall be provided in all respects as indicated in these specifications. Hence any material or accessories which may not have been specifically mentioned but are necessary for satisfactory and trouble-free operation and maintenance of the equipment shall be furnished by the Contractor. These technical specifications shall be read along with the General Conditions for all E&M works given under subhead C-B.

6.1 The contractor shall submit:

- a) Written commitment from OEM/OEA to supply the DG Sets and delivery schedule as per the requirement of the department.
- b) Certificate from OEM/OEA or authorized service provider of engine manufacturer for commissioning of DG Set after completion of the work.
- c) Required Guarantee of DG Set from OEM/OEA in favor of Engineer-in-Charge to cover defect liabilities.
- d) An undertaking that mandatory free service is carried out during the guarantee period by the authorized service provider of engine manufacturer

6.1.1 Each DG set shall be silent type with acoustic enclosure, heat exchanger type cooled, suitable for continuous operations & capable to deliver prime power rating at average load of 85%, manually and automatically operated. The DG set shall comprise of Diesel Engine coupled to four-pole Alternator on a single frame with integrated microprocessor based Genset monitoring and control system having self-regulated, brushless /static excitation system.

6.1.2 The Design, Manufacture, Inspection, Testing and performance shall comply with all the currently applicable standards, safety codes, relevant Bureau of Indian Standards (BIS), International Electro Technical Commission (IEC) Publications, CPWD specifications, latest CPCB norms .

6.1.3 All equipment shall be suitable for working under the conditions specified and shall withstand the atmospheric conditions without deterioration. The time schedule for routine maintenance /overhauling operations necessary for continuous satisfactory operation of DG set shall be intimated by the contractor.

6.1.4 All controls shall be of 24VDC. DG Sets shall be started/ stopped from Engine /DG Panel /Remote.

6.1.5 The scope of work includes providing,

- a) DG Sets complete with all the accessories like batteries, battery charging arrangement, fuel system, exhaust system etc.
- b) AMF(Auto Mains Failure) panels. These D.G. sets shall be designed to run in parallel and synchronized with Main LT panel on common bus. The Auto Synchronizing panel with auto load sharing shall be supplied with D.G. sets. The required controls, indications, interlocking etc. shall be provided.

- c) Neutral Earthing and Body Earthing for each DG set shall be provided from Structural Earthing of the services building and 25x5mm copper Strip for connecting the neutral with the provided connectors.
- d) Power and Control Cables, Earthing for all equipment and accessories. Battery system with chargers and switch for isolation of battery from engine.
- e) Heat Exchanger type Cooling system. Acoustic Enclosure (Silent canopy) for DG set.
- f) HSDUG Storage Tank & Pumping System shall be provided for continuous pumping of HSD oil to the DG Sets. Fuel Day Tank and related piping. Fuel tank should be with level indicator and marking. POL i.e., HSD oil and lube oil for testing at OEA/OEM works shall be arranged by the contractor.
- g) Exhaust system with piping & insulation including stack complete. Civil foundation for the DG set, Fuel Tank and other accessories including vibration isolation springs / pads.
- h) Minor building works necessary for installation of equipment, foundation trench for fuel line & cable, making of opening in walls or in floors and restoring them to the original finish and necessary grouting etc. as required.
- i) Painting of all exposed metal surfaces of equipment and components with appropriate colour.
- j) All tools and tackles required for handling of equipment and materials at site of work as well as for the disassembly and erection and also necessary test instruments shall be the responsibility of the contractor.
- k) Clearance/Approval of the complete installation from CPCB /State Pollution Control Board, Central Electricity Authority (CEA) /Local Bodies and other licensing authorities, wherever required.

6.2 Design Basis for DG Sets:

- a) Load estimation /Load Calculation: The generator supply shall give 100% backup to Lighting, Power, Lifts, and Other Some laboratory equipment including 30% of VRF/VRV units.
- b) The selection of DG Set rating shall be done after taking all above factors in consideration. The sandwich type copper bus duct shall be provided between DG sets and synchronization panel with rating more than the Ampere rating of DG sets.
- c) The incoming rating of Synchronization panel shall be equal to alternator rating of DG set or next rating available in ACB.

6.3 Performance Requirement:

- a) The equipment shall be capable of delivering continuously at the generator terminals, (100% output at 85% load at unlimited time) except for periodical maintenance when operating under the site and ambient conditions described in this specification as per relevant IS/BS5514.
- b) The design parameters of the generator and excitation system shall be so chosen, that the set is stable while running at any load between no-load and full load. It

should have isochronous speed control with load sensing governing system and should be capable of paralleling between sets at isochronous speed.

- c) Engine shall be of standard design of the original manufacturers. Engine should be heavy duty four stroke, turbocharged after cooled.

Climate conditions	
Design ambient temperature	40°C
Altitude above MSL	1000Mtrs.fromMSL
Relative humidity	85%
Type of Building	Admin cum Laboratories Bldg & Farmers training Hostel

6.4 Approvals

- a) The contractor shall obtain information relating to local regulations, Bye-Laws, application of all laws relating to his work or profession and his having to execute work as required. No additional claims shall be admissible on this account.
- b) Contractor shall obtain approval of the installation from the relevant inspection Authorities at all stages and on completion of the installation work. The contractor shall pass on these approvals to the Owner. Statutory charges payable to the Government / Municipal Authorities/ Statutory Bodies /Electrical Inspectorate/ Central/State Pollution Control Board/CCOE etc. for obtaining approvals will be paid by the department.
- c) 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. The entire installation shall be such as to cause minimum transmission of noise and vibration to the building structure.

6.5 Engine and Accessories:

6.5.1 Diesel Engine

- a) The engine shall be of standard design of the original manufacturers. It should be 4stroke cycles, Heat exchanger, turbocharged (as per manufacturer standard), diesel engine developing suitable BHP for giving a power rating as
Per ISO8528- Part-1 in KVA at the load terminals of alternator at 1500rpm at actual site conditions.
- b) The engine shall be capable for delivering specified Prime Power rating at variable loads for PF of 0.8 lag with 10% overload available in excess of specified output for one hour in every 12hours. The average load factor of the engine over a period of 24 hours shall be 0.85(85%) for prime power output.
- c) The engine shall conform to IS:10000/ISO3046/BS:649/BS5514 amended upto date.
- d) The manufacturer shall furnish certificate, that the engine for the DG set complies with the latest CPCB emission norms.
- e) The engine shall be fitted with following accessories subject to the design of the

manufacturer:

- i. Dry exhaust manifold with suitable Admin cum Laboratories Bldg & Farmers training Hostel grade silencer.
- ii. Suitable self-starter for 24V DC.
- iii. Battery charging alternator unit and voltage regulator, suitable for starting batteries, battery racks with interconnecting leads and terminals.
- iv. Necessary gear driven oil pump for lubricating oil, priming of engine as well as fuel systems as per manufacturer recommendations.
- v. Lubrication oil cooler
- vi. Crankcase heater as per manufacturer recommendations.
- vii. Fuel pump with engine speed adjustment

6.5.2 Fuel System

It shall be fed through engine driven fuel pump. A replaceable element of fuel filter shall be suitably located to permit easy servicing. Individual Daily service fuel tank of suitable liters capacity as per CPWD Specifications, fabricated out of 3mm thick M.S. sheet provided with all accessories such as inlet, outlet connections air vent tap, drain plug and level indicator (gauge) M.S. fuel piping from tank to engine with valves, unions, reducers etc. for each D.G Set. Fuel system shall comply with the latest environment flue gas data limitations amended upto date.

6.5.3 Lubricating Oil System

It shall be so designed that if the engine starts after a long shut down lubrication failure does not occur. A timer-based auto priming pump (operative on AC/DC) shall be provided to keep bearings primed all the time.

6.5.4 Cooling System

- a) Heatex changer cooled engines, forced ventilation system shall be provided. Care should be taken to avoid recirculation of hot air. In some cases, it may also be achieved by natural wind direction consideration.
 - i) Fan flow rate should be selected according to the engine breathing air and radiation heat dissipation with permissible temprise in DG room/Enclosure.
 - ii) Static head of the fan should be selected according to the restriction at air suction area and hot air outlet area, also consider the attenuation requirement.

Maximum temperature allowed to rise in DG Set room is:

Max. Ambient temperature Allowable temp. rise

Upto 40deg.C	10deg.C
40to 43deg.C	7deg.C
Above 45deg.C	5deg.C

6.5.5 Heat Transfer Coils

Air cooled fluid cooler consisting of heat transfer coils made of copper tubes and corrugated staggered hole continuous plate type aluminum fins.

6.5.6 Headers

Headers are made of carbon steel with vent and drain sockets.

6.5.7 Casing

Casing is made out of heavy gauge galvanized iron steel sheet. The casing is powder coated for protection against moisture/rust.

6.5.8 Fans & fan mountings

The fans used are to be Axial fans of aero foil design. The fans are of variable angle glass reinforced and pressure die cast aluminium alloy hub. The fan blades are very light weight, spark & corrosion resistant and are of high strength.

6.5.9 Motors

The motors are totally enclosed (TEFC) for protection against dust /moisture and class F insulated with IP-55 protection. The motors are foot mounted and are designed for $415 \pm 10\%$ Volts, 3 Phase and 50Hz.

6.5.10 Base Frame

Base frame is made up of heavy gauge steel section. The entire unit is assembled on this heavy-duty channel iron base frame and can be mounted on rooftop depending upon the job site requirement.

6.5.11 Air & Drain Valves

Air purging valves are mounted on the top of coil headers to make sure that the cooler is with water and no Air pockets in the system. The Air and drain valves shall have ball valves with dummy plugs.

6.5.12 Starting System

This shall comprise of necessary set of heavy-duty batteries of 12/24V DC and suitable numbers of batteries (180 AH capacity lead acid SMF type) as required as per specifications., and suitable starter motors ,axial type gear to match with the too the dring on the flywheel. A timer in the control panel to protect the starter motor from excessively long cranking runs, shall be integrated with the engine protection system. Battery capacity shall suitable numbers of batteries (180 AH capacity lead acid SMF type) as required as per specifications for meeting the needs of starting system (as 3 attempts starting), as well as the requirements of control panel, indications and auxiliaries such as priming pump as applicable etc. The scope shall cover all cabling, terminals, including initial charging etc. The system shall be capable of starting the DG set within 20-30 seconds even in winter condition with an ambient temperature down to 0°C.

The battery charger shall be suitable to charge required number of batteries at 12/24 volts complete with, transformer, rectifier, charge rate selector switch, indicating ammeter & voltmeter etc. Connections between the battery charger & batteries shall be provided with suitable copper leads with lugs etc.

6.6 Governor

Electronic governor of class A1, as per ISO3046/BS5514 with actuator shall be provided. Governor shall be a self-contained unit capable of monitoring speed.

6.7 Piping Work

All pipelines and fittings and accessories requirement inside the room/enclosure and outside for exhaust piping shall be provided by the contractor. This shall include necessary flexible pieces in the exhaust, fuel, lubricating Oil and waterlines as are necessary in view of the vibration isolation requirement in the installation. Piping of adequate size shall be used for lubricating Oil of the material as per manufacturer standard. However, only M.S pipes for the exhaust shall be used. For fuel lines with in the acoustic enclosure, PVC braided pipe as per manufacturer recommendations can

be used. However, for fuel lines outside the acoustics enclosure, only MS pipe be used.

The pipe work shall be inclusive of all fittings and accessories required such as bends, reducers, elbows, flexible connections, necessary hardware etc. the installation shall cover clamps, supports hangers etc., as are necessary for completing the work. However, the work shall be sectionalized with flanged connections as are necessary for easy isolation purposes for maintenance of unit as approved by Engineer-in-charge.

6.8 Exhaust System

Engine exhaust system shall be fitted with hospital super critical grade silencer. Thermally insulated aluminum cladding for exhaust piping etc. shall be provided along with structural support with stays for the engine.

6.8.1 Exhaust Piping: All M.S. Pipes of Class 'B' for exhaust lines shall be conforming to relevant IS. The work includes necessary cladding of exhaust pipe work using 50mm thick Loosely bound resin (LBR) mattress /mineral wool/Rockwool, density not less than 120 kg/m³ and aluminium cladding (0.6 mm thick) for the complete portion. The exhaust pipe work includes necessary supports, foundation etc.to avoid any load &stress on turbocharger /exhaust piping &the design and drawing for exhaust piping structure run along wall/building shall be got approved from the Engineer-in-charge.

- (a) Exhaust system should create minimum back pressure.
 - i. Number of bends should be kept minimum and smooth bends should be used to minimize back pressure.
 - ii. Pipe sleeve of larger dia. Should be used while passing the pipe through concrete wall &gap should be filled with felt lining.
 - iii. Exhaust piping inside the Acoustic Enclosure/ Genset room should be lagged with asbestos rope along with aluminium sheet cladding /insulated to avoid heat input to the room.
 - iv. 45 Degree downward cut should be given at the end of the pipe to avoid rain water entry into exhaust piping.
 - v. Care should be taken to ensure that no carbon particles emitted due to exhaust leakage enters and deposits on alternator
 - vi. When tail end is vertical, there should be rain trap to avoid rain water entry.
 - vii. Silencer should be installed with drain plug at bottom.

6.8.2 Engine Mounted Instrument Panel

Engine Shall be supplied with engine mounted microprocessor based fully integrated generating set monitoring, metering and control system which should be equipped with electronic governor along with electronic AVR to facilitate discreet control of speed and voltage. It should be equipped with starting control including integrated fuel ramping to limit the blacksmoke frequency overshoot with optimized coldweather starting. The indicating panel should have communication network facility to facilitate remote hooking on a common network. Engine instrument panel should be equipped with digital alarm and status mirage to monitor and display the parameters of engine and generator.

6.8.3 Alternator

The alternator shall be Separately excited, Screen Protected Drip Proof ,IP23, Class'H' insulation as per OEM, self-ventilated, aircooled, brushless, machine with exciter and shall be rated continuous duty temperature rise with in class

*HLimitsatrated load.

- a) The alternator shall be brushless synchronous and suitable for 3 phase, 415 volts, 50Hz. 0.8p.f. and 1500RPM and capable to deliver rated KVA at 40 degree C.
- b) The alternator shall be suitable for coupling directly to the engine. It shall be drip proof screen protected as per IP 23. The alternator shall be double bearing type.
- c) The alternator shall be continuously rated and designed to withstand tropical conditions. It shall be confirming to BS: 5000 (Part-99)/ IS: 4722-1992/IEC:34.
- d) Suitable Nos. Resistant Temperature Device (RTDs)to measure the winding temperature and (Bearing Temperature Device) BTDS to measure bearing temperature shall be provided as per OEM standards.
- e) The leads of space heaters shall be wired up to the terminal block in a separate terminal box. Manufacturer shall indicate the setting values for each RTD/BTD for alarm and trip.
- f) Alternator shall be provided with anti-condensation space heater of adequate rating suitable for 240 V, 50 Hz, 1 Phase AC supply and shall be wired upto a separate terminal box.
- g) The independent earth terminals on the frame complete with nuts, spring washer and plain washer shall be provided.
- h) Alternator shall be provided with suitable flanges for termination of cables. Suitable arrangement shall be provided in the terminal box for cable/earthing bus.
- i) DG Set shall be capable of working in synchronizing with other DG sets. The supply of any relays, contactors, CTs etc. required for this purpose shall be included.
- j) Alternator shall be suitable for bearing the starting (magnetizing/ in rush current) current of Transformer after changeover.

6.9 Excitation System

- a) The alternator shall be provided with a complete brushless excitation system, capable of supplying the excitation current of the generator under all conditions of output from no load to full load and capable of maintaining voltage of the generator constant at one particular value/ or as per manufacturer's standards.
- b) The excitation system shall comprise a shaft driven AC exciter with rotating rectifiers. The rectifiers shall have in-built protection for over-voltage.
- c) The alternator should be complete with shunt and boosterexcitation.The exciter shall be fast response type and shall be designed to have a low time constant to minimize voltage transients under severeloadchanges. The excitation voltage response ratio shall beat least 0.8.

- d) The rated current of the main exciter shall be at least 10% more than the exciter current and it shall have a 40% overload capability for 10 seconds.

6.10 Automatic Voltage Regulator

- a) An automatic high speed, dead band type voltage regulator shall be provided complete with all accessories. The regulation system shall be provided with equipment for automatic and manual control.
- b) The regulator shall regulate the output voltage from generator current and potential signals. Series compounding transformer shall be provided to enable maintaining adequate terminal voltage in the event of terminal faults. Alternatively, excitation system shall be provided with arrangement for field forcing. Contractor shall co-ordinate suitably the protection relays for generator with the operational characteristics of automatic voltage regulator, especially under short circuit conditions.
- c) In the event of any fault e.g., over voltage/ high bearing temperature/ high winding temperature or an external fault, the AVR shall remove the excitation voltage to the alternator. An emergency trip shall also be provided.
- d) Voltage regulation and steady state modulation shall be within + 1% of the line voltage with manual voltage adjustment capability within +5%.
- e) Necessary equipment for field suppression and surge protection shall be provided.
- f) The response time of the exciter and the generator shall be properly matched to avoid hunting.
- g) AVR system shall be provided with equipment for automatic and remote operation /control as required/as per manufacturer's standards.
- h) Necessary equipment shall be furnished for the following:-
 - I. To prevent automatic rise of field voltage, in case of failure of potential supply.
 - II. Circuit to assure correct division of reactive power for parallel operation. The excitation and voltage regulation shall be designed to cause necessary de excitation in case of short circuit. Cross current compensation circuit shall be provided.
 - III. Any other item not included/ specified but is a standard design of the manufacturer.

6.11 AMF panel

AMF Panel with bypass system complete with relays, timers, set of CTs for metering & protection and multi-function meter to indicate currents, phase, and line voltages, frequency, KVA, power factor, KWH & provision for overload, short-circuit, restricted earth fault, under voltage control, control cabling from AMF panel to diesel engine and elsewhere if required, all complete and interlocking including the following:

- a) Suitable numbers and appropriate capacity 4 pole motorised electrically operated draw out with cradle type 3 position ACB/ MCCB with electronic release for O/C & E/F and shunt trip..
- b) AUTO Transfer arrangement of required capacity.
- c) Auto/Manual/Test/Off selector switch, Protection for under and over voltage phase reversal (2 nos Over voltage relay, 2 Nos. reverse power relay and 2

Nos. under voltage relay).

- d) 3 Sets of current transformers accuracy for protection and 15VA Class-I for metering.
- e) Energy analyser unit to indicate current, Voltage (L-N & L_L), kW, kVA (Phase & Total), Frequency, KWH, PF. and all other parameters as required.
- f) Indicating lamps for load on mains and load on set shall be provided.
- g) MCBs for instruments Battery charger, complete with transformer /rectifier, D.C. voltmeter and ammeter, selector switch for trickle, off and boost and current adjustment.
- h) Battery charging indication Main supply failure monitor, Supply failure timer, Restoration timer Control unit with three impulse automatic engine start/stop and failure to start lockout.
- i) Impulse counter with locking and reset facility.
- j) ON/OFF/Control circuit switch with indicator
- k) Low lubricating Oil trip indication
- l) Audio/Video annunciation for
 - i) High water temperature
 - ii) Low lubricating oil pressure
 - iii) Engine over speed
 - iv) Engine fails to start
 - v) Full load /maximum load warning
 - vi) Weak Battery Warning

6.12 Synchronization Panel

6.12.1 Operation of DG sets shall be monitored and controlled by PLC panel i.e., Programmable logic controller-based logic panel. Incase of mains failure, this logic panel shall control auto changeover from mains to DG Sets supply and interlocking of ACBs, auto synchronizing and autoload management functions along with annunciation for alternator control and protection.

6.12.2 The logic panel shall be provided with a total manual override facility. There shall be Smooth transfer of DG set operation from PLC to manual system & vice versa without any interruption/tripping. The logic panel shall be complete with all Auxiliary Relays, Timers, Contactors, Programmable logic controller, control wiring, interconnections etc. with 2.5sq.mm. FRLS PVC insulated, 1.1KV grade copper conductor wires.

6.12.3

Control Philosophy Automatic Start & Stop of Engine. The system should come in operation after sensing of grid failure and automatically control the start & stop of engines, depending on the predefined load setting in the PLC. In case engine does not start in the first cranking, two more auto commands should be given with proper intervals. Even then if engine fails to start, indication must appear on MMI (Man Machine interface). In the event the engines are under loaded i.e., load sensed is capable of being catered by less than the capacity of running DG sets then

command must be given to stop required number of excess DG sets after running idle for short duration. Provision to select no. of DG sets to be started and synchronised at no load to cope up with sudden load without tripping the DGs should also be inbuilt into the system.

The facility of synchronization shall be available in both Auto & Manual mode. In normal circumstances, the autosynchronisation will work, however due to any reason autosynchronisation fails repeatedly, the facility for closure of ACB must be available automatically. In manual mode, ACB will be closed by panel pushbutton.

6.12.4 Automatic Load Sharing

The load sharing shall be automatic, by sensing both active & reactive power.

6.12.5 Backup Protection

The system should have following inbuilt protection other than external relay synchronization panel:

Reverse power, Reverse KVAR, OverCurrent, Undervoltage, Overvoltage, Under frequency, Over frequency, synchro-check & earth fault relay except differential relay. Due to any electrical fault, PLC shall trigger the master trip relay. These PLCs will be best at core equipment using latest technology and of most rugged and reliable design. Since they shall be operating in the harsh & unfriendly environment of DG room, they will be suitable to operate trouble-free in those conditions. The chosen equipment should be able to withstand high temperature, humidity & voltage fluctuations, thus making it suitable for the operating conditions described above.

6.12.6 Sequence Of Operation

The following sequence of operation shall be achieved through PLC based logic panel in addition to hardware interlocks as well as software interlocks:

- a) Selection of any generator as a lead generator to achieve the uniform running hours of all generators.
- b) Three attempts to start the engine of lead generator. In case the engine fails to start or does not achieve the requisite speed within the predetermined time, PLC system declares engine of generator faulty. In this event PLC automatically selects next generator as the lead generator.
- c) The PLC system automatically selects starting sequence of other generators on the basis of the lead generator being selected by the operator.
- d) Before issuing close command to lead generator air circuit breaker, PLC checks that ACB of any other generator is not in close position. Then PLC system gives close command to lead generator ACB. The PLC system tries two times with interval of 5secs. To close the ACB. Simultaneously, It also gives starting command to next generator engine in queue depending upon load.
- e) The speed, excitation, frequency and voltage of incoming generator is controlled identically as per the lead generator starting sequence described above, except closing of ACB.
- f) When the lead generator KW crosses more than the 85% of rated capacity of DG set, the PLC system performs synchronization sequence for paralleling of generator prior to switching on of the ACB of 2nd generator and similar

sequence to be followed for other DG sets.

- g) The last incoming generator ACB is tripped when PLC system senses that the total load on the system is less than the specified load and stops the engine after 5 minutes of idle running.
- h) DG sets will start and stop automatically depending on the predefined load setting in the PLC & also all DG sets will operate in load sharing mode.

6.13 Exhaust stack height:

In order to dispose exhaust above building height, minimum exhaust stack height shall be 30m High or 3m above the building height, whichever is higher as per MOEF & CPCB requirements.

6.14 Performance

Voltage dip shall not exceed 20% of the rated voltage for any step load or transient load as per ISO8528(Part-1). The winding shall not develop hotspots exceeding safe limits due to imbalance of 20% between any two phases from no load to full load.

The generator shall preferably be capable of withstanding a current equal to 1.5 times the rated current for a period of not more than 15 seconds as required vide of IS4722:1992.

The performance characteristics of the alternator shall be as below:

Efficiency at full load	0.8 P.F. as per Super ECBC upto date
Total distortion factor	Less than 3%

- i. 10% overload One hour in every 12 Hrs. of continuous use.
- ii. 50% overload 15 seconds.

6.15 Painting

All steel surfaces, which are to be painted, shall be thoroughly cleaned, degreased and supplied with primer prior to assembly and shall be applied with two coats of epoxy paint shade RAL7032 as per IS5.

All castings shall be sand blasted, degreased and cleaned before painting as per manufacturer standards..

6.16 Foundation:

- a) Foundation should be designed considering safe bearing capacity of soil and DG set static and dynamic load. Anti-Vibration Mounts (AVMs) are provided to reduce generator set vibration and noise transmission to the surrounding structure.
- b) The depth of the foundation to be decided in consultation with the certified structural engineer depending on static and dynamic load of the DG set and soil condition.
- c) The length and breadth of foundation should be minimum 150 mm (6") more than acoustic enclosure size/base rails size
- d) Ensure that the concrete is completely set and hardened before positioning the generator set.

- e) The foundation elevation is to be minimum 150mm above finish ground level.
- f) DG Set foundation level to be checked with water level tube at frame mounting area and should be within ± 5 mm.
- g) Metal shims to be provided between DG frame and civil foundation to load DG Set uniformly.
- h) The AVMs of DG Set should be loaded uniformly for DG sets where AVMs are placed on foundation & below DG set base frame. Use shims below AVM resting area. Shim plate should be of 3 mm minimum thickness and to be used in multiple as required. Ensure that AVMS are loaded evenly.
- i) It is recommended to take services of structural Engineer for designing foundations and carry out seismic analysis if required.
- j) For cable laying, necessary trench shall be constructed as per site requirements. In case of cable termination at the top/busduct, the trench is not required but necessary supports are to be considered.
- k) In case of special requirement, civil foundation to be casted in isolation with building structure.

6.17 Cabling

- a) connection between alternator to AMF panel & AMF Panel to Essential panel shall be through bus-trunking. For exposed/ outdoor bus trunking protection requirement should be IP-55.
- b) Multi-core 2.5sq.mm copper cables shall be used for control wiring.
- c) It is recommended to support output cables on separate structure on ground so that weight of cables should not fall on alternator / base rail.
- d) External wirings, when provided for remote voltage/ excitation monitoring/ droop CT etc. shall be screened sheathed type. Maximum length of such wiring shall not exceed 5 meters.
- e) For proper terminations between links and switchgear terminals, the contact area must be adequate.
- f) The following situations should also be avoided as they lead to creation of heat sources at the point of termination:
- g) Point contact arising out of improper position of links with switch gear terminals
- h) Gaps between busbars/links and terminals being remedied by connecting bolt/stud. In such cases, the bolt will carry the load current. Normally these bolts/studs are made of MS and hence are not designed to carry currents.
- i) Adequate clearance between busbars / links at terminals should be maintained (IS 4232 may be referred to for guidelines).

6.18 System Operation:

Diesel-alternator sets function shall be as follows:-

6.18.1 Automatic Mode

While the normal mains supply is healthy, the diesel alternator set will be at rest and

the load will be supplied by the mains. The AMF system shall monitor the main supply voltage & when the main supply voltage drops below a certain preset value, the system shall sense these conditions & shall give automatic start command to the control systems. After a time, delay of 1.5 seconds from the main supply failure, the diesel engine shall start.

When the DG set attains its rated speed and voltage, a closing signal shall be given to the VCB of the DG set. When the voltage in the mains gets restored, its quality is monitored for about one minute and if proven satisfactory, the main supply breaker shall close automatically transfer the load from Diesel engine to the main supply at H.T. Panel. The set shall stop after idle running of one minute after restoration of main supply. The diesel alternator set reverts to its stand by conditions & it's ready to start should the mains supply fail again.

6.18.2 Manual Mode:

In a manual mode, it shall be feasible to start-up the generator set by the operator on pressing the start push button. Five attempts starting facility shall be operative for the start-up function. Alternator circuit breakers close and trip operations shall also be through operator only by pressing the appropriate button on the panel and closure shall be feasible only after alternator has built up full voltage. If the load is already on 'mains', pressure on 'close' button shall be ineffective. Engine shut down, otherwise due to faults, shall be manual by pressing a 'stop' button.

6.18.3 Test Mode:

When under 'test' mode pressing of 'test' button shall complete the startup sequence simulation and start the engine. The simulation will be that of mains failure. Sequence Auto & Manual Modes shall be completed. Engine shall buildup voltage but the set shall not take load by closing of alternator circuit breaker.

When the load is on the mains, monitoring of performance for voltage /frequency etc. shall be feasible without supply to load.

If during test mode, the power supply has failed, the load shall automatically get transferred to alternator. Bringing the mode selector to auto position shall shut down the set provided mains supply is ON. If the mains supply is not available at that time, the alternator shall take load.

6.19 Earthing

Neutral Earthing and Body Earthing shall be provided from the Structural Earthing to be done within the Service Building. Suitable size of copper strip may be used for the purpose of connecting the DG set with Structural Earth Connectors laid.

No. of Structural Earth Connectors required for this purpose shall be intimated to the Structural Earthing agency at the earliest. And the same may be confirmed during building construction. Test joints should be provided for testing the earthing as and when required.

6.20 Guaranteed Technical Specifications Required

Description	Capacity
Supply, installation, Testing & Commissioning of 'Silent Type Diesel Generating set as per CPCB IV + or better norms along with having Prime Power Rating of KVA as below, 415 volts at 1500 RPM, 0.8 lagging power factor at 415 V suitable for 50 Hz, 3 phase system & for 0.85 Load Factor, including testing at factory and site with fuel, load for test and other necessary arrangements Complete as per CPWD specifications, should have QR code which should contain drawing, test report OEM manual, Geo- Tag of manufacturing location, rating plate as per relevant IS Code etc. and consisting of the followings: (A) Diesel Engine: Turbo charged Diesel engine 4 stroke water cooled, multi cylinder, dynamically balanced fly wheel, electric start of suitable BHP at 1500 RPM suitable for above output of alternator at 40 Degree C, 50% RH & at 1000 Meter MSL , capable of taking 10% over loading for one hour after 12 hours of continuous operation. The engine will be with Electronic governor, Dry type Air filter with service indicator, first filling of engine fuel (after commissioning) lubricating Oil, Coolant and other consumables complete with all the required accessories, the Electronic governor shall be as per ISO 8528. The engine shall comply to the latest CPCB norms (CPCB IV + or better) and Conforming to BS 5514, BS 649, IS 10000, IS 10002, IS 13018 and as per CPWD specifications. (B) Engine mounted Instrument Panel fitted with and having digital display for following: (i) Start-stop switch with key (ii) Water temperature indication (iii) Lubrication oil pressure indication (iv) Lubrication oil temperature indication (v) Battery charging indication and Voltage indication (vi) RPM indication (vii) Over speed indication (viii) Low Lubrication Oil trip indication (ix) Engine Running Hours indication (x) Fuel Level (C) Alternator: Synchronous alternator rated of appropriate KVA, 415 volts at 1500 RPM, 3 phase 50 Hz, AC supply with 0.8 lagging power factor at 40 Degree C, 50% RH & at 1000 Meter MSL. The alternator shall be having Screen Protected Drip Proof (SPDP) enclosure IP23, brushless, continuous duty, dynamically balanced rotor, capable of taking 10% over loading for one hour after 12 hours of continuous operation, self cooled, self-excited and self-regulated through AVR conforming to IS13364 (Part 2)/IS: 4722/BS 2613 suitable for tropical conditions and with class- H insulation. (D) Base Frame & Foundation: Both the engine and alternator shall be mounted on suitable base frame made of MS channel with necessary reinforcement which shall be installed on suitable cement concrete foundation and vibration isolation arrangement as per recommendations of manufacturer. (E) FUEL TANK: Daily service fuel tank of suitable liters capacity as per CPWD Specifications, fabricated out of 3 mm thick M.S. sheet complete with all standard accessories and fuel piping between fuel tank and diesel engine with MS class 'C' pipes of suitable dia. Complete with valves, level indications & accessories as required as per specifications. (F) Exhaust System: Dry exhaust manifold with hospital type exhaust silencer	2 Nos. 500KVA capacity DG Set (1working +1 standby)

and catalytic convertor.

(G) Starting System: 12V/24V DC starting system comprising of starter motors: voltage regulator and arrangement for initial excitation complete with suitable numbers of batteries (180 AH capacity lead acid SMF type) as required as per specifications. The battery shall be housed inside the acoustic enclosure of DG Set.

(H) Acoustic and weather proof enclosure with arrangement for fresh air intake for cooling of the engine & alternator, extraction, discharging hot air in to the atmosphere and the temperature rise inside the enclosure, noise level outside enclosure. The acoustic enclosure connection/connection should be through suitable for bus-trunking. cable Such arrangements on acoustic enclosure should be water proof & dust-proof conforming to IP-65 protection. The enclosure shall be as per CPCB IV + or better norms etc. and as per CPWD specifications.

(I) AMF Panel: Free standing floor mounted IP 42 automatic mains failure control panel including auto by-pass, suitable for KVA as below for silent type DG set complete with relays, timers, set of CTs for metering & protection and energy analyser to indicate currents, phase and line voltages, frequency, power factor, KWH, Kilo Volt Ampere Reative Hour (KVARH), KVA (Phase & Total), KW & provision for overload, short circuit, restricted earth fault, under frequency, power (aluminium) and control (copper) cabling of suitable size upto 15 meter between AMF panel, LT Panel and DG Set including connection interconnection etc. as required, all complete and inter locking and communication/ Ethernet /RS485/SNMP port open protocol for BMS integration including suitable software, the panel shall be of DG Set OEM make etc. as per approved by Engineering in charge and including the following:

1. Suitable numbers and appropriate capacity 4 pole motorised electrically operated draw out with cradle type 3 position ACB/ MCCB with electronic release for O/C & E/F and shunt trip.
2. Auto/Manual/Test/Off selector switch
3. Protection for under and over voltage phase reversal (2 nos Over voltage relay, 2 Nos. reverse power relay and 2 Nos. under voltage relay).
4. 3 Sets of current transformers 15 P 10 accuracy for protection and 15 VA class-I for metering
5. Energy analyser unit to indicate current, Voltage(L-N & L_L), kW, kVA (Phase & Total), Frequency, KWH, PF.
6. LED Indicating lamps for load on mains and load on set
7. Fuse/ MCB for instruments
8. Battery charger, complete with transformer/ rectifier, D.C. voltmeter and am meter, selector switch for trickle, off and boost and current adjustment.
9. Main supply failure monitor
10. Supply failure timer
11. Restoration timer
12. Control unit with three impulse automatic engine start/stop and failure to start lockout.
13. Impulse counter with locking and reset facility.
14. ON/OFF/Control circuit switch with indicator
15. Audio/Video annunciation for
 - (i) High water temperature
 - (ii) Low lubricating oil pressure
 - (iii) Engine over speed
 - (iv) Engine fails to start
 - (v) Full load/maximum load warning
16. Protection for over/under Frequency, Loss of AC sensing, Over Current,

Unbalancing load with suitable number of relays and accessories 17. Maintenance notification based on Engine Run Hour & due date. 18. Load Management through PLC to achieve auto opening and closing of incomer breakers, bus coupler switching of essential panel, inter locking providing signal to AMF Panel for load status and AMF shall give command to DG Set to auto start / auto stop depending upon load status and requirement etc. and necessary hardware and software required to perform the operation shall be provided by the contractor including all control wiring.	

6.21 Testing at factory/Manufacturer's premises

6.22 Following tests shall be carried out at the manufacturer's works in the presence of Engineer-in-charge or his representative. DG sets and the auxiliaries shall be assembled at the manufacturer's works and the following tests shall be performed. Load test for 12hours at rated KW at DG set's KW rating followed by a 1hour on 10% overload (after continuous run of the 12Hours with fuel consumption).

- a) Engine starting time
 - b) B.H.P. as per OEM test Certificate to be attached.
 - c) Noise/ Vibration test
- Before each test, the engine shall be brought to a steady state under the conditions of the test. The alternator shall be subjected to the tests/test reports shall be provided as per relevant IS standards.

The alternator shall be subjected to following routine tests:

- a) Measurement of resistance of stator and rotor windings
- b) Insulation resistance of stator and rotor windings
- c) High voltage tests on stator and rotor windings
- d) Open circuit and short circuit tests
- e) Temperature rise test
- f) Regulation test
- g) Efficiency test
- h) Momentary overload test
- i) Vibration and noise level measurement

In addition to the above routine tests, temperature rise test on generator shall be conducted.

6.22.1 Tests at Site

After successful testing of the DG Set, a trial run at available load will be carried out for 120 Hours on each DG set individually. The DG Set will be operated and a log of all relevant parameters will be maintained during this period. The arrangement of staff for trial run/ running in period & fuel will be made by the successful tenderer. The contractor will be free to carry out necessary adjustments. The DG Set will be said to have successfully completed the trial run, if no break-down or abnormal/unsatisfactory operation of any component of the entire installation included in the scope of work of the contract, occurs during this period. After this the DG Set will be taken over by the department subject to guarantee clause of the contract.

6.22.2 Type Test Certificates

6.22.2.1 Copies of manufacturer's type test for the engine and the alternator of all ratings

shall be enclosed along with the dispatch of the DG sets. Test certificate shall be submitted in six (4) copies.

6.22.2.2 The test reports shall furnish complete identification of the data, including serial number of each equipment. The successful tenderer shall arrange staff/fuel/POL for test run at his cost. Inspection and Testing of DG sets shall necessarily be carried out at factory / manufacturer premises in presence of representative of the CPWD.

6.23 Drawings/Documents to be furnished on completion of Installation

6.23.1 Four sets of the following drawings shall be submitted by the contractor while handing over the installation to the Department. One set shall be laminated on a hard base for display in the DG set room/room where AMF panel is installed. In addition, drawings will be given in Compact Disc (CD):

- a) DG set installation drawings giving complete details of all the equipment, including their foundations.
- b) Line diagram and layout of all electrical control/ AMF panels giving switchgear ratings and their disposition, cable feeder sizes and their layout.
- c) Control wiring drawings with all control components and sequence of operations to explain the operation of control circuits in AMF panel /PCC.
 - i. Manufacturer's technical catalogues of all equipment and accessories.
 - ii. Operation and maintenance manual of all major equipment, detailing all adjustments, operation and maintenance procedure.

6.24 List of Relevant Indian/International Standards

ISO8528	Part-I-XI	Generating Set
IS10000 (Naturally Aspirated)	Part-I-XIII	Engines
BS5514	Part 1 5 979	Reciprocating Internal Combustion engines,
ISO-3046	Part (1-6)	Reciprocating internal combustion engines
BS649		Reciprocating Internal Combustion engines, performance, torsional vibrations.
(C) Alternator		
4889/BS -		For declaring efficiency of electrical machines.
IS4722-2001		Capability of machine to withstand overcurrent/overload.
IS-13364	Part I&II	Alternator-Voltage Regulation
IEC60034-1-1983		Rotating Electrical machines - Rating & Performance
(D) Acoustic Enclosure		

IS-8183		Insulation material for sound absorption.
ISO3744	2010	Acoustics-Determination of sound power levels of noise sources.
ISO8528	Part-10 2018(E)	Measurement of Air borne noise by enveloping surface method.
ISO9614-	1993Part-I&II	Requirement of grade-II. Accuracy for insulation.
(E) Control Panel/AMF Panel		
IS-21471962		Degree of protection.
IS-4230		H.V. testing for panel

226:1975	Structural steel (standard quality) (fifth revision)
800:1984	Code of practice for general construction in steel (second revision)
812:1957	Dimensions for hot rolled steel beam, column channel and angle sections (revised)
814:1991	Covered electrodes for manual metal arc welding of carbon and carbon manganese steel (fifth revision)
816:1969	Code of practice for use of metal arc welding for general construction in mild steel (first revision)
961:1975	Structural steel (hightensile) (second revision)
1030:1982	Carbon steel castings for general engineering purposes
1239(Part1) : 1990	Mild steel tubes, tubular and other wrought steel fittings: part 1Mild steel tube
1367 (Part 3 & 6)	Technical supply conditions for threaded steel fasteners
1730:1989	Dimensions for steel plate, sheet, strip and flats for general engineering purposes
1978:1982	Line pipe
1979:1985	High test line pipe
2002:1982	Steel plates for pressure vessels for intermediate and high temperature services including boilers
2009:1975	Method for calibration of horizontal and tilted oil storage tanks
2041:1982	Steel plates for pressure vessels used at moderate and low temperature
2062:1984	Weldable structural steel
2825:1969	Code for unfired pressure vessels
6392:1971	Steel pipe flanges
8500:1977	Weldable structural steel (medium and high strength qualities)
9595:1980	Recommendations for metal arc welding of carbon and carbon manganese steels

2.0. *COMMERCIAL AND ADDITIONAL CONDITIONS - DG SETs*

2.1. *Specification:-*

The work shall be executed as per CPWD's general specification for Electrical Works part-I (2023) & Part-II (2023) & Part-VII (2013) for DG Set Work, IE Rules, Indian Standards amended up to date and as per direction of Engineer-in-Charge. The additional specifications are to be read with above and in case of any variations, specifications given in the tender shall apply.

2.2. *Inspection by CEA & CPCB/SPCB:-*

After completion of the work, the contractor will offer the same for inspection of Central Electricity Authority, Central Pollution Control Board & State Pollution Control Board if required. The contractor will extend all help including test facilities to the representative of Central Electricity Authority, Central Pollution Control Board & State Pollution Control Board. In case the contractor fails to make desired facilities available during inspection, the department reserve the right to provide the same at the risk & cost of the contractor. The observation of Central Electricity Authority, Central Pollution Control Board & State Pollution Control Board which area part of agreement will be attended by the contractor promptly. The installation will be commissioned only after receiving clearance from Central Electricity Authority. Inspection fees of Central Electricity Authority, Central Pollution Control Board & State Pollution Control Board will be borne by the department however lesioning for inspection and getting clearance from the Central Electricity Authority, Central Pollution Control Board & State Pollution Control Board shall be done by the contractor. Nothing extra shall be paid for this.

- 2.3. The material required to be used in the work shall be got approved from the Engineer-in-charge before its use at site. The Engineer-in-charge shall reserve the right to instruct the contractor to remove the material which, in his opinion, is not as per specifications.
- 2.4. Contractor shall preserve the copies of invoices, test certificates, gate passes etc. To prove the genuineness of material/purchases. The responsibility of procurement, genuine material of specialized works shall rest with the contractor.
- 2.5. The contractor shall offer inspection call at factory premises before dispatch of DG set to carry out test as per CPWD specification & fuel charge & other charges of testing of DG set for 13 hours shall be borne by the agency. To & fro journey fare of the CPWD officers for inspection of DG set shall be borne by the department.
- 2.6. The contractor shall submit the following after award of work:
 - (i) Submission of GA drawing of DG set for approval
 - (ii) Written commitment from OEM/OEA to supply the DG Sets and delivery

schedule as per requirement of department.

- (iii) Certificate from OEM/OEA or authorized service provider of engine manufacturer of satisfactory installation and commissioning of DG Set after completion of the work.
- (iv) The defect liability period shall be reckoned from the date of handing over of the installation to the department.
- (v) An undertaking that mandatory free service shall be carried out during the Defect liability period as per this agreement by the authorized service provider.

C-7 UPS System

7.0 Technical Specifications of UPS

7.1 The scope of work includes Planning, design, supply, installation, testing and commissioning of Online Modular type UPS system with required battery banks. Minimum Capacity of UPS shall be minimum 100KVA Modular UPS (inN+2combination) with parallel Redundant with minimum 30 Minutes Backup with maintenance free batteries. Suitable battery capacity and quantity shall be provided for each UPS and Battery Size Calculation should be submitted by the contractor for approval by Engineer-in-charge. Energy Efficiency Requirements at 100% Load shall be as per Super ECBC 2017 to provide continuous, uninterrupted power comprising. These technical specifications shall be read along with the General Conditions for all E&M works given under subhead C-B.

7.1.1 The capacity of UPS is indicative only. The agency shall design a suitable capacity with calculations and get it approved by Engineer-in charge. This Specification describes a three-phase, online, continuous operation, solid-state uninterruptible power supply system (UPS). The UPS shall operate as an active power control system, working in conjunction with the building electrical system to provide power conditioning and online power protection for the critical loads. The following loads shall be considered for designing the capacity of the UPS.

a) Lighting loads of the Admin cum Laboratories building	:25%
b) Electrical load for all laboratories of the Admin cum Laboratories building	:100%
c) Lighting loads of staircase, Toilets, Substation Building, Meeting Rooms, Kitchen.	:100%
d) Power Loads/Equipment Load of Computers CCTV, Access Control, FA & PA System	:100%

7.2 Standards:

The UPS shall comply to IEC 62040-UPS Systems-Part 1 to 4 to fulfil General and safety requirements, Electromagnetic compatibility (EMC) requirements, Method of specifying the performance and test requirements, Environmental aspects—Requirements and reporting.

7.3 System Description

7.3.1 The UPS shall be provided with separate feeds for rectifier/inverter and static bypass switch. Each single-UPS unit shall operate in double-conversion mode. The UPS shall be of the double conversion on-line topology with power factor corrected inputs. It shall be a VFI-type UPS made up of the components, described in detail. The system shall be designed with N+2 modules. So, as to support full designed Load even after breakdown of 2 modules.

7.3.2 The UPS shall be housed in a freestanding self-contained cabinet with casters and shall contain the following breakers. The mechanical structure of the UPS shall be

sufficiently strong and rigid to withstand handling and installation operations without risk. The sheet metal elements in the structure shall be protected against corrosion by a suitable treatment, such as zinc electroplating, epoxy paint or equivalent.

- a. Unit input breaker(UIB)
- b. Static switch input breaker(SSIB)
- c. Unit output breaker(UOB)
- d. Maintenance bypass breaker(MBB)

7.3.3 Installation access shall be from the backside of the system. The UPS system shall contain a bypass static switch and a display. The UPS shall be designed for forced air cooling. Air inlets shall be provided from the front and top of the UPS enclosure. Air exhaust shall be from the top portion of the unit.

7.3.4 The UPS battery shall be sized for required KVA for 30 minutes backup. The UPS shall have a short circuit withstand capability of 10kA. The UPS shall contain an Emergency Power Off (EPO). The UPS shall be with minimum Level 3 inverter topology.

a) AC Input Characteristics:

- i) Input voltage : 415Vac, 3-phase and 4-wire
- ii) Input voltage range : 305-477V
- iii) Input power factor : >0.98
- iv) Total harmonic distortion : Less than 3%
- v) Frequency : 40-65 hertz.

b) Output Characteristics:

- i) Output Voltage : 415 volts AC 3-phase and 4-wire
- vi) Frequency : 50 hertz, ± 0.5
- ii) Voltage Stability : $\pm 1.0\%$ for balanced load, $\pm 2.0\%$ for unbalanced load.
- iii) Output voltage harmonic distortion:
 - <2% at 100% linear load.
 - <5% at 100% non-linear load.
- iv) Power Factor : 1 (Unity) at the rated KVA.
- v) Over load capability
 - : 110% for 1 Hour.
 - : 125% for 10 minutes.
 - : 150% for 1 minute.
- vi) Output power factor: (1 Unity)
- vii) Efficiency : not less than 93.8% (With 100% load)
- ix) Audible noise at full load : Less than 60dB at 1 meter

7.4 System Components

7.4.1 Rectifier

The UPS shall include an active power factor corrected, Insulated Gated Bipolar Transistor (IGBT) rectifier. Pulse Width Modulation (PWM) current control shall be used. Digital Signal Processors (DSP) shall be used for all monitoring and control tasks. Analog control is not acceptable. The input current limiter shall be designed to charge batteries at 20% of the UPS output rating, Provide

regulation with mains deviation of up/down to $\pm 15\%$ of the nominal input voltage. The battery charging voltage shall be compensated against temperature variations (battery temperature compensation) to always maintain optimal battery float charging.

The rectifier shall correct power factor to maintain an input power factor of 0.98 lagging to unity at 75 percent or above load levels to ensure generator compatibility and avoid reflected harmonics from disturbing loads. The Rectifier shall produce a sinusoidal input AC current on each phase with low harmonic content.

7.4.2 Batteries:

The battery technology shall be Valve regulated sealed lead acid (VRLA-AGM) batteries. The battery charger shall be equipped with a temperature probe to enable temperature compensated charging and shall adjust the battery float voltage to compensate for the ambient temperature.

Battery voltage shall be battery temperature compensated as outlined in the rectifier section above. The battery charging circuit shall remain active when the Power factor controller operates normally. Batteries shall be supplied with suitable MS powder coated battery bank rack, flexible connectors, and all standard accessories.

7.4.3 Inverter:

The inverter shall consist of fast switching IGBT modules. The inverter shall be a minimum Level3 inverter topology. Inverter shall be PWM controlled using DSP logic. Analog control shall not be acceptable. The inverter shall be capable of providing the specified precise output power characteristics while operating over the battery voltage range.

7.4.4 Static by pass switch:

The static switch shall consist of fully rated Silicon Controlled Rectifiers (SCRs). Part rated SCRs with contactor device are not acceptable.

The static bypass switch shall automatically transfer the load to by pass input supply without interruption after the logic senses in one of the following conditions:

- a) Inverter overload beyond rating.
- b) Battery runtime expired and bypass available.
- c) Inverter inoperable.
- d) Control system inoperable.

The static bypass switch shall automatically transfer from bypass to the Inverter when the Inverter is active (on). The static bypass switch shall be equipped with a manual means of transferring the load to bypass and back to inverter.

7.4.5 Isolator Transformer (Optional):

As optional, the UPS shall be equipped with dedicated isolation transformer for the bypass line, to guarantee the full isolation and independency of the Neutrals of the input line and the output UPS line.

7.4.6 Mechanical:

- a) The UPS shall be housed in a free-standing cabinet with casters.

- b) The cable entry shall be from the back of the UPS.
- c) The UPS shall meet ingress level of minimum IP20.
- d) User replaceable dust filter shall be provided with the standard cabinet.
- e) The critical components i.e., PCBs shall be confirmedly coated

7.4.7 Microprocessor-Controlled Logic:

Complete UPS operation shall be provided using microprocessor-controlled logic. Operation and parameters shall be firmware-controlled, thus eliminating the need for manual adjustments or potentiometers. The logic shall include self-test and diagnostic circuitry such that a fault shall be isolated down to the printed circuit assembly or plug-in power assembly level. Diagnostics shall be performed via a PC through the local diagnostics port on the UPS.

7.5 Display and Control panel

- 7.5.1 The UPS shall include a standard control and indicator panel with backlit LCD display and a keypad consisting of push button switches with choice of languages for indication of UPS status, metering, battery status, alarm/event log, and advanced operational features. LED mimic diagram. The mimic diagram: shall enable display of installation parameters, configuration, operating status and alarms and indication of operator instructions for switching operations(i.e., bypass).

The UPS shall provide an audible alarm that can be stopped using the user interface. If a new alarm is sensed after the original alarm has been silenced, it shall reactivate the audible alarm.

It shall be possible to display the following measurements: INPUT

Voltage (Vac), per phase
Current (Aac), per phase
Frequency (Hz)

Power (kVA) OUTPUT

Voltage (Vac), per phase
Current (Aac), per phase
Frequency (Hz)

Power (kW), per phase
Load (%), per phase

BYPASS

Voltage (Vac), per phase
Frequency (Hz)

INVERTER

Voltage (Vac), per phase
Frequency (Hz) AC/DC
(Rectifier) Voltage (Vdc)

BATTERY

Voltage (Vdc), Current (Adc)
Type (Ah) Autonomy (minute,%)

Log of time-stamped events shall store in memory and make available, for automatic or manually initiated recall, time-stamped logs of important status changes, faults, and malfunctions, complete with an analysis and display of trouble shooting procedures.

7.5.2 The following LED status indications shall be shown on the UPS front

- a) Load:
 - 1) UPS output is on.
 - 2) Overload on UPS output or output has shorted.
 - 3) UPS output is off.
- b) Battery:
 - 1) Battery is charging.
 - 2) Battery is discharging.
 - 3) Battery is inoperable.
 - 4) Battery low voltage.
 - 5) Battery and battery charger are normal.
- c) Bypass:
 - 1) Load supplied by bypass source.
 - 2) Bypass source is unavailable or static bypass switch is inoperable.
 - 3) Bypass voltage is out of tolerance.
 - 4) Bypass source is normal.
- d) Rectifier:
 - 1) Rectifier is working correctly mains is normal.
 - 2) Rectifier is inoperable.
 - 3) Mains is unavailable.
 - 4) Rectifier is off.
- e) Inverter:
 - 1) Load supplied by inverter.
 - 2) Load not supplied by inverter; inverter is in operable.
 - 3) Load supplied by inverter, but an inverter alarm is present.
 - 4) Inverter is off.
- f) Push Buttons/User Controls:

For control of UPS in addition to the push buttons on the system, necessary arrangement shall be available for remote communication.

7.5.3 Full load testing without external load bank:

The UPS shall have an inbuilt feature to test itself at 100% loading, continuous without any external load bank on the site. If this feature is not available, Contractor shall provide an external load bank with the input and output breakers and cables for full load and overload testing of UPS.

7.5.4 Software and connectivity:

The Ethernet Web/SNMP Adaptor shall allow one or more network management systems (NMS) to monitor and manage the UPS in TCP/IP network environments. The management information base (MIB) shall be provided in MIB formats. The SNMP interface adaptor shall be connected to the UPS via the RJ45 serial port on the standard communication interface board.

7.5.5 Remote UPS monitoring:

- a) The UPS shall be equipped with provisions for remote emergency power off and dry contact input that shall be used to command UPS shutdown remotely. One USB/RS232 connector with serial output shall be provided for field diagnostics.
- b) Remote UPS Monitoring shall be possible through a standard Modbus protocol RS485 port.

7.5.6 Modes of operation: The UPS shall operate as a non-line system in the following modes:

- a) Normal mode: The inverter and the rectifier shall operate in an on-line manner to continuously regulate the power to the critical load. The rectifier shall derive power from the input source and supply DC power to charge the battery. The rectifier supplies the inverter with DC current while the charger simultaneously floats charges the battery. The load is continuously supplied with dependable electrical power by the inverter.
- b) Battery mode: Upon failure of the input source, the load shall continue to be supplied by the inverter without any switching. The inverter shall obtain its power from the battery. There shall be no interruption in power to the load upon failure or restoration of the input source.
- c) Static bypass mode: The static bypass switch shall be used for transferring the load to bypass supply without interruption to the critical power load in case Inverter overload exceeds its rating or Inverter failure. This shall be accomplished by turning the inverter off. Automatic re-transfer or forward transfer of the load shall be accomplished by turning the inverter on. The static bypass transfer switch shall have the following over load characteristics:
 - i. 1000 percent of UPS output rating for one cycle
 - ii. 150 percent continuous.
- d) ECO mode: In ECO mode, the UPS shall use static bypass mode as the preferred operation mode under predefined conditions. In case of a failure of the input source, the UPS shall transfer to battery mode.
- e) Maintenance bypass mode: The UPS shall be provided with a maintenance bypass breaker (MBB) to supply the load directly from the mains supply. A manual static transfer shall be initiated from the UPS control panel by turning the UPS inverter off.
- f) Auto-restart mode: When the UPS is configured to auto-restart, the UPS shall automatically restart after end of discharge and restoration of the input source.
- g) Battery recharge: Upon restoration of the input source, the UPS shall simultaneously recharge the battery and regulate the power to the load. The UPS system shall ensure equal sharing of the total load between the various parallel-connected units.
- h) The UPS shuts down and should not transfer to the bypass mode when a short

circuit occurs on the output of the unit. After the short circuit removed, the UPS shall operate normally again.

7.6 Technical Specification for Batteries for UPS Applications.

The battery bank shall be with VRLA-AGM type batteries of suitable capacity, designed for 30 minutes backup at full load capacity of the UPS. Battery sizing calculations shall be submitted by the contractor before supply of batteries. A suitable MS powder coated stand shall be provided for battery bank. The dimensions of the complete battery bank to be so designed, that it occupies less space.

Nominal capacity	Nominal capacity of the battery is defined in terms of Ampere Hour (AH) capacity. The rating assigned to the battery shall be the capacity expressed in ampere hours(Ah) stated by the manufacturer obtainable when the battery is discharged at the 20-hour rate to an end cell voltage of 1.75V at 25degC.
Nominal Voltage	12Volts per module.
Applicable Standards	JIS8702, IS1146
Float life	9 Years designated life.
Discharge characteristics	The battery offered shall be capable of delivering the following currents for the specified durations: a) 2C current for a duration of 10 minutes b) 1.58 C current for a duration of 15 minutes Where C = Rated capacity of the battery

8. Standards

The UPS shall comply to the following minimum standards:-

8.1 Safety:

- (i) IEC62040-1:2008-06, 1st edition Uninterruptible Power Systems (UPS)-Part 1: General and safety requirements for UPS
- (ii) EN62040-1:2013-01, 1st edition amendment 1

8.2 EMC/EMI/RFI: IEC62040-2:2005-10, 2nd edition Uninterruptible Power Systems (UPS) - Part 2: Electromagnetic compatibility (EMC) requirements

8.3 Performance: IEC 62040-3: 2011-03, 2nd edition Uninterruptible Power Systems (UPS) - Part 3: Method of specifying the performance and test requirements

8.4 Environmental: IEC62040-4:2013-04, 1st edition Uninterruptible Power Systems (UPS) - Part 4: Environmental aspects – Requirements and reporting

9 Project conditions

9.1 UPS Environmental requirements

9.1.1 Operating ambient temperature: 0°C to 45°C

9.1.2 Relative humidity : 0 to 95%, non-condensing.

9.1.3 Operating altitude with node-rating for Babugarh Hapur.

C-8 VRV/VRF BASED AIR CONDITIONING SYSTEM (Heating and Cooling)

The work shall be carried out as per the following Specifications for Air Conditioning works and generally in accordance with the following:

- a. CPWD General Specifications for Air conditioning works-2024, amended upto date.
- b. CPWD General Specifications for Electrical Works Part I Internal-2023, amended upto date.
- c. CPWD General Specifications for Electrical Works Part II External- 2023 amended upto date.
- d. ASHRAE Handbook

SCOPE OF WORK

This part involves design, supply, installation, testing and commissioning of **VRF system (for Heating & Cooling) for Admin cum Laboratories Bldg at ICAR-CIRC, Babugarh, Hapur (UP)** as per design calculation & as per guidelines issued by ASHRAE, ISHRAE, BIS, CPWD Specifications, NBC 2016, and the requirement of ICAR-CIRC and additional specifications.

Area to be Air conditioned: -

1) All the rooms and Laboratories in

Admin cum Laboratories Bldg except corridor, toilets, lift lobby, Reception, Waiting area, Store rooms.

2) Canteen/Dining areas of block.

The Capacity of VRV system for heating and cooling shall be based on heat load calculation of the Admin cum Laboratories Bldg. Design shall be carried out for peak Winter, Summer and Monsoon as per outdoor ambient temp of ICAR-CIRC, Babugarh, Hapur (UP) campus mentioned below.

Outside Design Condition:

Winter : - 5 degree C (Temperature)

Summer: 49 degree C (Temperature)

Relative Humidity and Monsoon data to be taken from prevalent meteorology data for ICAR-CIRC, Babugarh, Hapur (UP) area.

Inside Design condition:

Winter : Temperature 21+/-1 degree C, 30% RH

Summer: Temperature 24+/-1 degree C, 50-55% RH

Scope of work includes design, capacity selection, model selection, supply, installation, testing And commissioning of all the components of VRV/VRF system:

Scope of works also includes the following:

1. Preparation of heat load calculation of AC area and selection of the indoor and outdoor units

and all equipment of VRV system **considering derating of equipment at design condition** in consultation with the CPWD as per design data and approval of the same from Engineer in charge.

2. Preparation of equipment and piping layout, their location and approval of the same from Engineer in Charge.
3. Planning and designing of LV side i.e. indoor unit sizing, plumbing, piping etc. as per the structure and with co-ordination to other services and approval of the same from engineer in Charge.
4. Designing of LT Panel and control panel and its cabling network from Substation/feeder pillar to various equipment.
5. Submission of the data sheet and catalogue of the various equipment's in support of their design.
6. All the design, drawings, data sheets, catalogue has to be get approved from Engineer in charge before supplying the material at site.
7. Ventilation of the service area like sub-station etc., toilets and Non-AC area shall be provided as per NBC guidelines.
8. For Kitchen ventilation, dry scrubber system shall be provided.
9. For every room, individual indoor unit shall be provided.
10. In Hostel Rooms indoor high wall units (Hot & cold) of required capacity shall be installed if false ceiling is not provided. In case of false ceiling in room, one way cassette unit (Hot & cold) to be provided.
11. In dining area ductable cassette units of required number and sizes or four way cassette units as decided by Engineer in charge, shall be installed.
12. Diversity shall be 100% for indoor and outdoor capacity
13. Drain pipe shall have insulation with required size of Nitrile rubber and must have cladding with Aluminum foil.
14. Drainage would be terminated at nearest Toilet area as per direction of Engineer in charge.
15. Centralized control console remote shall be provided at office of each block to control the indoor units from single location.
16. Remote control with all accessories shall be provided with all units.
17. Suitable arrangements shall be provided/ducting to protect the fans of outdoor units froms now fall or other kinds of damaging material during extreme conditions as per direction of engineer in charge.
18. Due care shall be taken to maintain the aesthetic of the building.
19. Outdoor unit shall be installed at ground floor/terrace depending upon site condition.

TECHNICAL SPECIFICATION:

OUT DOOR UNITS

The outdoor unit shall be factory assembled, weather proof casing constructed from heavy gauge mild steel panels and coated with baked enamel finish. The unit should be completely factory wired, tested with all necessary controls:

- a) The outdoor units shall have multiple 100% inverter driven thematically sealed scroll compressor, Each outdoor module shall have at least two inverter driven scroll compressor for capacity control and more reliability. Minimum 2 compressors shall be provided for 14 HP and above module.
- b) The outdoor unit shall be suitable for heating and cooling.
- c) Proper duty cycling shall be ensured to prolong the life of the compressor.
- d) The outdoor unit shall be modular in design and should be allowed for side by side installation.
- e) The unit shall be provided with its own microprocessor control panel.
- f) The outdoor units should have anti-corrosion paint baseplate for easy mounting of unit.
- g) 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 there by achieving energy savings.
- h) The outdoor unit should be fitted with low noise, aero spiral design fan with aero fitted grill for spiral discharge airflow to reduce pressure loss and should be fitted with DC fan motor for better efficiency. The unit should also be capable to deliver 55 Pa external static pressure to meet long exhaust duct connection requirement.
- i) The refrigerant used shall be ecofriendly i.e.R410A or better.
- j) All the brazing joints in ODI should be coated with anticorrosive coating at or should be supplied with anti corrosive coating.
- k) The unit shall deliver the rated capacity at AHRI Conditions and work even at 50°C ambient temperature without tripping.
- l) The unit shall be suitable to work on 400V+/-10%,3Phase,50Hz AC power supply.
- m) The COP at AHRI conditions shall not be less than 3.1 and IEER not less than 6.5.
- n) The unit shall be filled with first charge of the refrigerant and ready for use as required.
- o) All the required vibration isolation, foundation etc shall be covered.
- p) The entire operation of outdoor units shall be through independent remotes of indoor units. No separate Start/ Stop function shall be required.
- i) The condenser fins of Outdoor unit should have Hydrophyllic &Anticorrosive coating from factory.

COMPRESSOR

The compressor shall be highly efficient either 100% inverter driven scroll compressor and capable of inverter control. The inverter compressor shall change the speed in accordance to the variation in cooling or heating load requirement.

All outdoor units shall have multiple steps of capacity control to meet load fluctuation and

indoorunitindividualcontrol.Allpartsofcompressorshallbesufficientlylubricatedstockforced lubrication or as per manufacturer standard process.

REFRIGERANT CIRCUIT

The refrigerant circuit shall include liquid & gas shut-off valves and a solenoid valves at condenser end. The equipment must have inbuilt refrigerant stabilization control for proper refrigerant distribution. All necessary safety devices shall be provided to ensure the safety operation of the system.

SAFETY DEVICE

All necessary safety devices shall be provided to ensure safe operation of the system. Following safety devices shall be part of outdoor unit : high pressure switch, fuse, fan drive overload protector, fusible plug, over load relay, overload protection for inverter.

OIL RECOVERY SYSTEM

Unit shall be equipped with an oil recovery system to ensure stable operation with long refrigerant piping lengths. The system must be provided with oil balancing circuit to avoid poor lubrication or as per manufacturer standard practice.

INDOOR UNIT

Indoor units shall be cassette type/Hi-wall/ductable. Each unit shall have electronic control valve to control refrigerant flow rate respond to load variations of the room. In case of centralized control, it shall be set by liquid crystal remote controller. The unit includes prefilter, fan section & DX coil section. The cassette unit and ductable unit should have drain pump in built in it.

COPPER 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.

REFRIGERANT PIPING

All refrigerant piping for the air conditioning system shall be as per table given below 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 joining 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 of 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>	Thickness in mm	Insulation Thickness
1	6.4mm	1.2mm	19mm
2	9.5mm	1.2mm	19mm
3	12.7mm	1.2mm	19mm
4	15.86mm	1.2mm	19mm
5	19mm	1.2mm	19mm
6	22.2mm	1.2mm	19mm
7	25.4mm	1.2mm	19mm
8	28.58mm	1.2mm	19mm
9	31.8mm	1.62mm	19mm
10	34.9mm	1.62mm	19mm
11	38.1mm	1.62mm	19mm
12	41.27mm	1.62mm	19mm

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.

PIPE INSULATION

a) Refrigerant pipe Insulation

The whole of the liquid and suction refrigerant lines including all fittings, valves and strainer bodies, etc. shall be insulated suitable size indicated in table with elastomeric nitrile rubber.

b) Drain Pipe Insulation

Drain pipes carrying condensate water shall be insulated with

6mmthickelastomericnitrilerubber insulation.

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.

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 etc
- 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. Continuous recording over a specified period, or ambient wet and drybulb temperatures under varying degrees of internal heat load and use and occupation in each zone of each part of the building.

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 refrigerant. Additional charge shall be added as per refrigerant piping at site. All the units shall be suitable for operation with 400V $\pm$ 10%, 50Hz $\pm$ 3%, 3Phase supply for outdoor units & 230V $\pm$ 10%, 50Hz $\pm$ 3%, 1Phase supply for indoor units.

Noise level of outdoor units shall not exceed 63dB(A) at a distance of 1.5m from the unit INDOOR UNITS.

i) **Cassette type indoor units (4way/1way air throw type).**

- (a) These units shall be installed between the bottom of finished slab & top of false ceiling.
- (b) Unit shall have provision of connecting fresh air without any special chamber & without increasing the total height of the unit (320 mm maximum).
- (c) The unit must have in built drain pump, suitable for vertical lift of 750mm.
- (d) Unit must be insulated with sound absorbing thermal insulation material, Polyurethane foam. The sound pressure level of unit at the highest operating level shall not exceed 46dB (A).
- (e) The unit must have drain pump kit . The drain pump must be suitable to lift drain upto 750mm from the bottom of the unit.
- (f) 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 as per the direction of engineer in charge.

The unit shall be supplied with following from the factory

- Operation Manual
- Installation Manual
- Paper pattern for installation
- Drain hose/Clamp metal/Washer fixing plate/Sealing pads/Clamps/Screws/Washer for hanging bracket/ Insulation for fitting.

ii) 1WayCassette type indoor units.

- (a) The compact cassette unit should perfectly fit to ceiling and match the standard architectural modules, without the need to cut ceiling tiles.
- (b) The flaps fold tightly against the ceiling when operation stops so that the ceiling is affected only lightly even if air conditioning is installed.
- (c) Designed for simple & easy installation and maintenance. It should be slim in design only 268mm height even when an electrical box is located inside the unit.
- (d) The unit must have rain pump kit if. The drain pump must be suitable to lift drain up to 750 mm from the bottom of the unit.

iii) Concealed duct type units

- (a) These units shall be ceilings suspended with suitable supports to take care of operating weight of the unit, without causing any excessive vibration & noise.
- (b) The cold air supplied by these units will be supplied to the area to be air conditioned, through duct system specified in the tender.
- (c) 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.
- (d) The Sound Pressure level of unit at the highest operating level shall not exceed 38 dB (A), at a vertical distance of 1.5m below the units with duct connected to the unit.
- (e) The unit must have provision of adding drain pump kit if required & specified. The drain pump must be suitable to lift drain up to 1000 mm from the bottom of the unit.

iv) Wall Mounted Units.

- a) Wall mounted units must be compact & stylish design that does not detract from the décor of the room.
- b) 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.
- c) The unit must have provision of adding drain pump kit if required & specified. The drain pump must be suitable to lift drain up to 750 mm from the bottom of the unit.
- d) The sound pressure level of unit at the highest operating level shall not exceed 46dB(A).
- e) Refrigerant control in the indoor unit shall be through Electronic Expansion Valve.

PC BASED CENTRAL CONTROLLER (IF REQUIRED)

The contractor has to provide PC based central controller for controlling (ON/OFF, scheduling, lock/unlock, swing control, temperature setting, error detection) all indoor units (256) and monitoring of corresponding outdoor units from one central location.

REFNET JOINTS/HEADER JOINTS

Supply & installation of the Y-Joint/Ref-net separation refrigeration pipe joints and header in the appropriate orientation to enable correct distribution of refrigerant. The Distribution Joints should be factory insulated with close cell nitrile rubber tubular sections of class O fire rating.

FACTORY FABRICATED DUCTS

The ducting shall be fabricated from coils. The thickness of the sheet for rectangular ducts for GSS / Aluminium shall be as follows:

Maximum size of Duct	Minimum sheet thickness	
	GSS	Aluminium
750mm and below	0.63	0.80
751mm to 1500mm	0.80	1.00
1501mm to 2250mm	1.00	1.50
2251mm and above	1.25	1.80

The maximum length of each duct piece shall not exceed 1200 mm. Cut sheets shall not be used other than elbows or for ducts having a size bigger than factory available sheet size. All ducting shall be with ductmate type flanges and no C& SS joints will be acceptable.

The slip-on flanges shall be with roll formed GI sections. The corner pieces shall be suitable for inserting into the hollow web of the slip-on flange. The slip-on flange shall be fixed by clinching or by pop riveting to have a rigid joint. The spacing shall not exceed 150mm. Self-tapping screws are not acceptable. Recessed groove shall be provided in the slip-on flanges and corner plates for the proper seating of gaskets.

The corner piece shall be secured by electro galvanized carriage bolts with flange nuts. The gaskets shall be of self-adhesive, microcellular, crosslinked polyethylene foam type. The gaskets shall be non-toxic, permanently semi-soft and formulated for HVAC/ Pharmaceutical/ Clean room/ Food grade applications.

The ducts shall be of medium pressure type having a pressure of 2000 Pascal's (Class II ducts) and the leakage shall be as per SMACNA/DW143 standards. The ducts shall be provided with cross breaking having a span not exceeding 400mm. The slip-on flange shall have thickness of

0.6 mm for ducts up to a maximum size of 500 mm; 0.8 mm for ducts having a size between 501mm and 750mm; 1.0mm for ducts having a size of 751mm to 900mm; 1.25mm for ducts having a size of 901mm to 1200mm and 1.5mm for ducts having sizes higher than 1201mm. The width of the flange shall be 29mm for ducts having a maximum size of 750mm and 39mm for higher sizes.

The duct section shall reach right up to the end of the slip-on flange. After installation of the slip-on flange and corner plates, sealant shall be applied only at the interface of the duct corner edge. Care shall be taken to ensure that corners completely clear the duct edges and the corner piece shall not sit on the duct corner edge.

The gaskets shall be 10mm wide and 4.5mm thick for ducts having a pressure class up to 500 Pascal. For a pressure class above 501 Pascal, gaskets shall be 15 mm wide and 6mm thick shall be used. Care shall be taken to ensure that gasket is properly seated in the groove of the slip-on flange and corner plates in such a way that the gasket commences midway between the corner.

The gasket shall be applied in one piece and joined at the starting point with a butt joint. The

gasket shall cutover the corners in an arc, protruding slightly into the airstream at the corners. The carriage bolt shall be tight enedus ingaratchetor as panner. Longer duct lengths shall be aligned by passing a wire through the small round holes on the corner plates. Cleats shall be inserted over the slip-on flanges on all the sides using a special crimping tool.

The spacing between the cleats shall not exceed 150mm. The ducts shall be bolted directly on the top corner pieces with threaded rods anchored to the ceiling using a bracket having a slot for minor lateral adjustments. Wherever specified slotted channel/angle iron supports shall be provided.

The support rod shall be galvanized and fully threaded having a minimum diameter of 10 mm for duct size up to 750 mm and 12 mm for sizes above 751 mm. The anchor fasteners shall also be the same size of the rods. Wherever support rods require joints the smallest rod length shall not be less than 300 mm.

The galvanized steel slotted rail shall have a thickness of 1.6 mm for ducts of size up to 750 mm and 2.4mm for sizes above 751mm but below 1500mm. For sizes above 1501mm 40 x 40 x 5mm angles shall be used. The spacing between supports shall not exceed 2000mm for ducts having a maximum size of 1500 mm and 1200mm for higher sizes. Additional supports for bends, elbow, collars etc. shall be used as required.

FLEXIBLE DUCTS

Where specified in the tender, flexible ducts shall be used for connecting the supply diffuser and exhaust diffuser plenum to the ducting. A double lamination of tough polyester shall encapsulate a steel helix to form an air tight inner core. The double layer core shall be wrapped in a thick blanket of fibre glass insulation and sheathed in a rugged and durable tri-directionally reinforced metalized polyester jacket. The ducts shall be complete with

Accessories such as saddles traps for supports and worm drive clips for termination to the rigid metallic duct collars.

Single skin aluminium flexible ducts shall be made of a triple lamination of aluminium foil, polyester and metalized polyester film permanently bonded to a coated spring steel wire helix. The PVC flexible ducts shall be fire retardant type. PVC flexible ducts shall be used for connecting the toilet exhaust plenums to the ducts or connecting the exhaust ducts in the case of laboratories. The ducts shall have pressure rating of 1500Pa.

Acoustic lining shall be provided inside the ducts as per requirement with 15mm thick open cell nitrile rubber insulation material having acoustic properties. The insulation shall be wrapped with RP tissue and the same shall be secured to the ducting using GI bolts and nuts, plate and bitumen washers with 24 G perforated aluminium sheet having at least 60% perforations. Alternatively pop up type saddled clamps may also be used. The clamps shall be fixed to the ducts by adhesive.

DUCT INSULATION

Supply air ducting exposed to atmosphere or in the non-air conditioned area shall be insulated with 15mm thick closed cell synthetic foam insulation with thermal conductivity not more than 0.032W/mk. Ducts running in the return air path shall be insulated with 15 mm thick insulation with the insulation type similar to supply air ducting. All the ducts shall be covered with factory laminated 26G aluminium foil. The surface of the duct shall be cleaned with a wire brush to remove dirt and dust and the insulation stuck to the ducting using water based adhesive as per recommendation of the OEM.

The duct surface shall be cleaned and thick coat of bituminous primer applied. When the insulation is till tacky, a blanket of insulation material is applied, so that it sticks to the ducts completely. All the joints shall be sealed with 75 mm wide self-adhesive aluminium tape as recommended by the OEM. To further ensure that the insulation is laid tightly on the duct ,nylon packings trap shall be wrapped around the duct at a spacing of not less than 600mm along the length of the duct. The insulation shall be finished with black paint having matt finish.

Acoustic lining shall be provided inside the ducts as per requirement with 15mm thick open cell nitrile rubber insulation material having acoustic properties. The insulation shall be wrapped with RP tissue and the same shall be secured to the ducting using GI bolts and nuts, plate and bitumen washers with 24 G perforated aluminium sheet having at least 60% perforations. Alternatively pop up type saddled clamps may also be used. The clamps shall be fixed to the ducts by adhesive.

C-9 Solar Water Heating System

9.0 Technical Specification of Solar Water Heating System

This specification covers Design, Engineering, Manufacture, Installation, Testing and Commissioning of **4000 Ltr Solar Water Heating System for Admin cum Laboratories Building & Farmers training Hostel**. However, the minimum, Solar Water Heating System of capacity shall be provided for Labour Complex including NICU, PICU, Kitchen, Canteen, CSSD, ICUs and other areas as per client requirements.

System shall comprise of solar flat plate collector, collectors stand assembly, SS316 Stainless Steel insulated hot water storage tank with closed circuit heat exchanger and various other components. Suitable Number of Flat Plate Collectors should be installed for each Solar Water Heating system. Each Flat Plate collector should be of at least 500 LPD capacity. These technical specifications shall be read along with the General Conditions for all E&M works given under subhead C-B.

9.1 Solar flat plate collector

Solar flat plate collector shall have BIS approval and as per IS:12933 (Part-1&2) with up-to-date amendments, various components shall be as under:

9.1.1 Cover plate

Cover plate shall be tempered/ toughened glass of thickness 4.0mm (min) conforming to section-1 of IS: 12933 (Part-2)/2003. The solar transmittance of the cover plate shall be minimum 82percent at near normal incidence. The glass shall be free from bubbles and rough surface.

9.1.2 Collector Box:

Collector box shall be made of Aluminium sections only. Type, grade, size, workmanship and finish of the material used shall be as per section-2 of IS:12933(Part-2)/2003. The minimum thickness of Aluminium shall be as under:

- i) Channel section for sides: 1.6mm
- ii) Sheet for bottom 0.7 mm
- iii) Support for glass retaining: 1.2mm
- iv) Sheet for entire body: 1.0mm

9.1.3 Absorber:

Absorber shall consist of riser, header and sheet for absorber. Type, grade, size, workmanship and finish of the material used shall be as per section-3 of IS:12933(Part-2) / 2003. Sheet for absorber shall be made of copper only. Riser and header assembly designed for working pressure upto 2.5 kg/Square Cm, shall be tested for leakage at a minimum hydraulic pressure of 5 kg/Square Cm.

9.1.4 Collector box insulation:

Insulation shall be provided at back and sides. Thermal resistance (R) of insulation

material shall be minimum 0.96 square meter. degree C/W for back insulation and minimum 0.48 square meter. degree C/W for side insulation. This shall be derived after determining the thermal conductivity (K) value at 100 degree C mean temperature in accordance with IS: 3346. Collector box insulation shall conform to sec.4 of IS:12933(Part-2)/2003. Aluminium foil shall be used for covering the back as well as side installation.

9.1.5 Gaskets and Grommets:

Gaskets and Grommets shall conform to sec.5 of IS:12933(Part-2)/2003.

9.2 Insulated hot water storage tank:

The thickness of the water storage tank shall be uniform.

9.2.1 Material:

Insulated hot water storage tank shall be non-pressure type and made of SS316 grade stainless steel of IS:1570 (Part-5)/1985 (Reaffirmed 2004), TIG/MIG welded, minimum sheet thickness shall be 16SWG. The storage tank shall be well insulated and large enough to hold/store about two day's supply of hot water.

9.2.2 Insulation:

Solar water heating system shall be insulated with 100mm thick Rockwool, 48Kg/m³ density, 22 SWG Aluminium cladding. Alternatively, 50 mm thick CFC free thermal grade PUF insulation, 32Kg/m³ or higher density may be used. PUF insulation could be pre-extruded type fitted with FRP exterior cladding or alternatively injection moulded in a welded steel tank and PPE endcap.

9.3 Tank stand assembly & Collector stand assembly:

Shall be made of MS angle of size (min) 40mmx40mmx5mm duly pre-treated and stove enameled with black colour paint. Alternatively, tubular structure with powder coating could also be provided. The structure should be designed in such a way that it will take less space and will withstand wind load up to 200 km/hour.

a) Electrical backup

For 500 LPD- minimum 3-4 KW

Suitable capacity Electrical control panel containing MCCB/MCB, contractors, Multifunction meter, Auto thermostat cut-off, FRLS PVC insulated copper conductor wiring and other items as necessary for electrical back-up shall be provided.

Heat Exchanger of SS 304 material of coil type or any other suitable type for thermosyphon operation complete in all respects with all accessories as required shall be provided.

9.4 System interconnection piping:

The Contractor shall provide

a) Providing and fixing Polyethylene -Aluminium-Polyethylene PE-ALPE

Composite Pressure Pipes conforming to IS-15450, U.V. stabilized with carbon black having thermal stability for hot & cold-water supply, capable to withstand temperature upto 80°C, including all special fittings of composite material (engineering plastic blend and brass inserts wherever required) e.g., elbows, tees, reducers, couplers & connectors, accessories, fittings etc., for hot water piping at terrace and clamps at 1.00 meter spacing. This includes testing of joints complete as per direction of the Engineer-in-charge

- b) ISI marked, medium class GI pipes of IS:1239 of suitable size inclusive of all accessories, fittings and necessary supports for connecting Cold water tank with Solar Water Heating System.
- c) ISI marked valves of gunmetal shall be provided.
- d) Suitable capacity SS304 makeup water tank along with piping and valves as required shall be provided.
- e) Temperature Gauge: Dial type, duly calibrated and suitable for temperature range from 0 degree C to 120 degree C and shall be provided.
- f) Other components essential for completeness of the system as per tender specifications.
- g) Contractor shall submit general arrangement drawings clearly indicating parts of the system (such as solar flat plate collectors, collectors stand assembly, internal and external piping, tank stand assembly, various valves, pressure gauges, temperature gauges, water meter etc.) and their fixing arrangements.
- h) The contractor shall supply instruction manual containing following details:
 - I. The Contractor shall furnish complete and satisfactory type test reports for each size / type of solar flat plate collector as per contract specification from any govt. laboratory. Type test reports shall include all the tests listed in IS:12933 amended upto date.
 - II. Civil work for foundation, grouting etc. Of the system complete as required is in the scope of this work. While erecting the equipment at terrace, contractor shall make sure no damage is done to waterproofing and civil structure, location at which grouting is required shall be sealed with high quality waterproofing compound. Installation shall be as per guideline issued by MNRE/Manufacturer's standards, whichever is stringent.

9.5 Guaranteed Technical Specifications Required

Description	Capacity
SOLAR WATER HEATER (FLAT PLATE TYPE COLLECTOR) Supply, Installation, Testing & Commissioning of Flat Plate collector (FPC) Solar Water Heating System comprising of solar flat plate collector ISI Marked made of copper sheet/copper tube, absorber toughened glass cover and aluminum extruded channel confirm to IS: 12933 (Part 1,2,3&5). The system shall have temperature gauges, strainer, water meter 2 nos., cold and hot water tank. The system shall have suitable electric backup complete with control and power wiring etc., as following.	4000 Ltr

1. Cover plate: cover plate shall be toughened glass and thickness of 4.0 mm (min) conforming to section -1 of IS: 12933(pt-2)/2003 the solar transmittances of the cover plate shall be minimum 82 percent at near normal incidence. 2. Collector box: collector box shall be made of aluminum sections. The type grade, size, and finish of the material used shall be as per section-2 of IS: 12933 (pt-2)/2003: the minimum thickness of aluminum shall be as under: 1. Channel section for sides 1.6 mm 2. Sheet for bottom 0.7 mm 3. Support for glass retaining 1.2 mm 4. Sheet for entire body 1.0 mm The insulation of collector box shall be minimum 0.96 m² OC/W for back insulation and minimum 0.48 m square degree c/w for side insulation conform to sec. 4 of IS 12933 (pt – 2) / 2003.(b) Gaskets and grommets: gaskets and grommets shall conform to Sec. 5 of IS 12933 (pt-2)/ 2003. 3.Absorber Shall Consist of riser, Header and Sheet for absorber. The Diameter of header shall be 25.4 + /-0.5mm and thickness 0.71mm. The Diameter of riser shall be 12.7 + /-0.5 mm and thickness 0.56mm and made of copper only. The distance between the risers from center to center shall be 120mm. type grade, size , workmanship and finish of the material used shall be as per section-3 of IS : 12933 (pt -2) /2003 the sheet for absorber shall be of copper sheet 34 gauge/copper tube (at least 10 nos.) 4.Riser and header assembly designed for working pressure up 245 k pa (2.5 kg/ cm square) shall be tested for leakage at a minimum hydraulic pressure of 490 k pa (5 kg/ cm square). Sheet for absorber shall be made of copper only. Type Grade, size, workmanship and finis of the material used shall be per Section -3 of IS: 12933 (pt -2) /2003. 5.HDPE/LDPE cold water tank and hot water tank shall be dully elected on MS angle /channel duly painted with dual coats of enamel paint. The overall structure of solar collector plate module shall be design to with stand wind velocity of 100 kms /hr (minimum) or more as per site. 6.Hot water tank : The tank capacity shall be minimum 1.25 time the rated capacity of system. Inner tank material shall be stainless steel SS 316, as per IS 1730 GRADE SS304-2B. Hot water shall be insulated with high density injected PUF insulation: 50 mm, of 50 mm thickness between inner and outer tank ensures maximum heat rotenone ever season. 7. Suitable nos. ISI Marked electrical heaters along control panel, MCCB, with all protections, and all safety provisions so as to achive 600C temperature rise in an hour. The range of thermostat shall be upto 800C.	

9.6 Warranty

All the solar water heating system shall be warrantied for a minimum period of 5 years from the date of installation and commissioning against any manufacturing and design defects.

C-10 LAN System

10.0 Technical Specifications of LAN & Wi-Fi

10.1 The brief scope of work shall include Planning, design & preparation of drawings ,supplying, installation, testing & commissioning of LAN and Wi-fi networking cabling system and subsystem components like OFC/CAT6A cables, termination hardware,supporting hardware,necessarysoftware,licenses and other required to supply, and to install a complete cabling infrastructure for the entire campus with backbone and Wi-fi switches. The total system has to be supplied, installed, tested and commissioned in complete manner to have a fully functional system, as required. If any item required to make the scheme functional, is not specifically mentioned in the scope and specifications, the same is deemed to be included within the scope of this tender.These technical specifications shall be read along with the General Conditions for all E&Mworks given under subhead C-B.

10.1.1 General Scope

- a. The LAN, Wi-Fi network system shallbe designed with 100G/40G/10G/1G fiber backbone with 100% redundancy at Core level switch and fiber backbone. The network shall be used for other services like IP-PABX system,CCTV system, AVsystem, Video conference system.
- b. Agency shall design the sizes of fiber optic cables, capacities of Coreswitches, Distribution switches, Access switches, Wi-Fi Access Points, required firewall, suitable size racks, required hardware and software including licenses for all the buildings of the campus as per requirement.
- c. Earthing system shall be an integral part of the telecommunications wiring system. In addition to helping protect personnel and equipment from hazardous voltages, the Earthing system shall reduce the effect of electromagnetic interference (EMI) to and from the telecommunications wiring system. Earthing system shall meet the IE/NEC requirements and practicesor local authorities or codes.
- d. Suitable Data Centre shall be established in Admin cum laboratries Building, which comprises of LAN Core Switche sand shall accommodate IP-PABXserver, CCTV server are deemed to be part of this sub head and included in the scope of work.

10.1.2 Internal LAN, Wi-Fi network.

- a. The Internal LAN,Wi-Fi network system shall consists Main routers,Firewalls, Coreswitches with 100% redundancy at fire wall, distribution switches, access switches,suitable size racks,Wi-Fi indoor access points,required hardware, software with licenses (for not less than 5years from the date of completion and taking over ofthe whole project),Cat 6A cabling for all data points, IP-PABX points, CCTV points,video conferencing. The further details on IP-PABXsystem, CCTV & and video conferencing refer respective subheads of this tender document.
- b. The Rack Panels shall comprise of jack/Patchpanels, Network switches, patchcords,power supply units,Cooling Fans,Wire managers, LIUs,Trans-receivers, Fiber patchcord etc.of individual buildings/Blocks/floors shall be provided as per requirements and specifications.

- c. Every floor shall have suitable no. of floor-standing/wall-mounted racks with suitable no. of switches in each wing where the CAT-6A cabling from the respective floor data points shall terminate. The contractor shall ensure that the maximum length from the switch to the data point including the patch cords etc. Does not exceed 80m. There shall be 20% redundancy on each switch. Each floor rack shall be connected to the Server Room Main racks through backbone Optical Fiber cable and links. Each rack shall have dual linkage from the different server racks.
- d. High speed Data Networking system is to be provided in the campus. Work shall include all passive and Active components including Core Switch, Distribution Switch, Access Switch (L2, L3 Switches), Firewall, and NMS/SD. The Local Area Network should be a three tier Architecture, Both Core Switches connectivity To distribution switches on 100G/40G/10G with redundant fiber cables and from distribution to Access switches on 10G/1G with redundant fiber cables. The Local Area Network System shall have all the main devices in redundancy mode Like Redundant Core Switches, Redundant Firewalls, Redundant Wi-Fi Controller Redundant Routers.
- e. The server shall be connected to Core Switch, Redundant core in Active-Active mode (Active-active clustering is a data resiliency architecture in which client workloads are distributed across two or more nodes in a cluster to keep your data safe and available in the event of an unexpected component failure) Core Switch with switching capacity of 6.4 Tbps with 32 QSFP28 ports from day 1, dual hot-swappable internal power Source and Core switch to Distribution Switch between Connectivity Minimum 40G and switch shall be through Optical Fiber cable.
- f. The Server shall have Firewall protection, Band width management & required client Access license.
- g. The Rack Panel/computer hub at various floors shall be connected to Main rack of the building/ block with Fiber Optic Cable through conduit or raceways on surface/recess.
- h. 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, labeled with ferrules on both ends and documented at all locations.
- i. 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 through out the network. Devices and services that shall run on the passive network shall include, but not limited to, the following:
 - i. Wired LAN access
 - ii. Wireless LAN access
 - iii. Voice communications servers and IP/SIP endpoints
 - iv. IP-based CCTV/Surveillance Cameras

10.1.3 Inventory for both internal and external(Minimum):

The data outlets, in general, shall be provided as per inventory and drawings proposed.
The LAN network is to be provided in

- I. Admin cum Laboratories Building
- II. Farmers training Hostel
- III. Substation & Services Building
- IV. STP/ETP Room

All the above building networks shall be inter connected.

10.1.4 The Minimum Inventory of LAN system is as follows:

----- Inventory will be prepare by agency -----

The above inventories are indicative only, the agency has to design and submit the inventories as per requirement and get them approved before execution at site.

10.1.5 The specifications for items in this section, applie so the following:

- a) Single mode, multi-mode fiber optic cable (OM4) and associated components such as distribute on shelves, LIUs ,pigtails and patch cords.
- b) Category6Acables and associated components such as distribution shelves ,patch panels, patch chords, Information Outlets, face plates etc.
- c) Networking Racks—for termination of networking cables.

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

- a) Do not deform the cable sheath, specifically when using cable fasteners or ties to secure the cable to a support or hardware
- b) Do not pull fiber optic cables over existing cables. The friction could be excessive and causecable damage. The cables may also be comeentangled, resulting indamage to the fiber optic cable.
- c) Do not exceed minimum (installed and long-term) bend radius. (The minimum bend radius varies with the cable diameter. Consult the appropriate Cable specification.)
- d) Do not pull the cable around sharp corners, such as support brackets.Provide additional crush /mechanical protection in high-risk environments.
- e) 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 waterlines.

10.1.7 Passive Components:

- a) All Copper & fiber components should be from the same OEM.
- b) All product Data Sheets shall be available on the OEM's public website, the same will be also referred to when evaluating the technical submission.
- c) All factory test reports of the Copper/Fiber component hard copies to submitted with the material supply.
- d) There should be minimum 25-year extended product warranty and Application Assurance for complete channel.
- e) The copper panels shall be upgradeable to intelligence in the field at a later stage with the Intelligent Upgrade Kit. The upgrade shall be performed without network disruptions, without the removal of patch cords.
- f) Certified Partner should submit Manufacturer Authorization Form from OEM
- g) All Single Mode FO Cables, Patch cords and Pigtails should be made up of Bend Insensitive Fibers
- h) All the copper cables, Patch cords, Fiber Patch cords should be LSZHonly
- i) 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.
- j) The Cat 6A cable installation measurements shall be done through Penta or fluke scanning with standard parameters and shall have the OEM certification for the installation of all the components.
- k) The optical fiber splicing for connecting in LIU or any where in the campus shall be the part of installation of fiber.
- l) 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.
- m) After installation & OEM certification, Commissioning of the passive components shall be completed.

10.1.8 Active Components

Campus LAN Network shall be designed considering highly available & scalability. Network must have fast converge, self-healing itself without human intervention and have minimal disruption in services to withstand any one of component, link etc. failures.

The component providing the redundancy should also provide additional benefits, such as load balancing. To the network during normal operations. This objective can be achieved by using mechanisms such as Virtual Switching/Virtual Port Channel/MLAG, and routing protocols that can load-balance across multiple paths. Current Network shall be designed using a 3-tier architecture. The overall physical architecture of campus LAN backbone network shall consist of below elements.

- a) Core Layer: The core layer shall be responsible for aggregating all the traffic residing and flowing in the below distributed layer or network. The core switch will be hosted in the Data Centre that will provide connectivity between Wi-Fi traffic, surveillance, VOIP & user applications hosted inside the DC and field devices installed/ positioned in the campus network. The coreswitch will be installed in redundant manner, with redundant & hot-swappable fan & Power supplies. The multiple corering will connect to DataCentre & will be foundational network over multiple or single of 100/40/10Gbps link using single mode fiber.
- b) Distribution layer: It acts as distribution node in overall hierarchy of the network. This layer will be on 100/40Gbps ring minimum for north bound uplinks. This node will terminate the aggregation node ring with at least 10 Gbps speed from day one. South bound port will be on 1G and will down link to Access Layer. The Distribution switch will be installed in redundant manner, with redundant & hot-swappable fan & Power supplies.
- c) Access Layer: These switches shall be configured with multiple VLANs for sending traffic to/from Distribution node. These switches shall be used to provide wired connectivity to all end user end point layer devices like IP CCTV Camera, Laptop, Desktop, Access point & IP Phones. Access Layer switches should have capabilities to provide a convenient way to save and share common configurations. To enable features and settings based on the location of a switch in the network and for mass configuration deployments across the network. All the end point devices will be connected over 1Gbps speed and uplink to Distribution layer over 10 or 25Gbps.
- d) WAN connectivity and other components:
Internet Links shall be terminated at internet routers. This shall be either from NKN or Service Provider or both. Routers are proposed in high availability and scalable to support 10Giga Internet Band width. Each router shall have redundant Power supply.

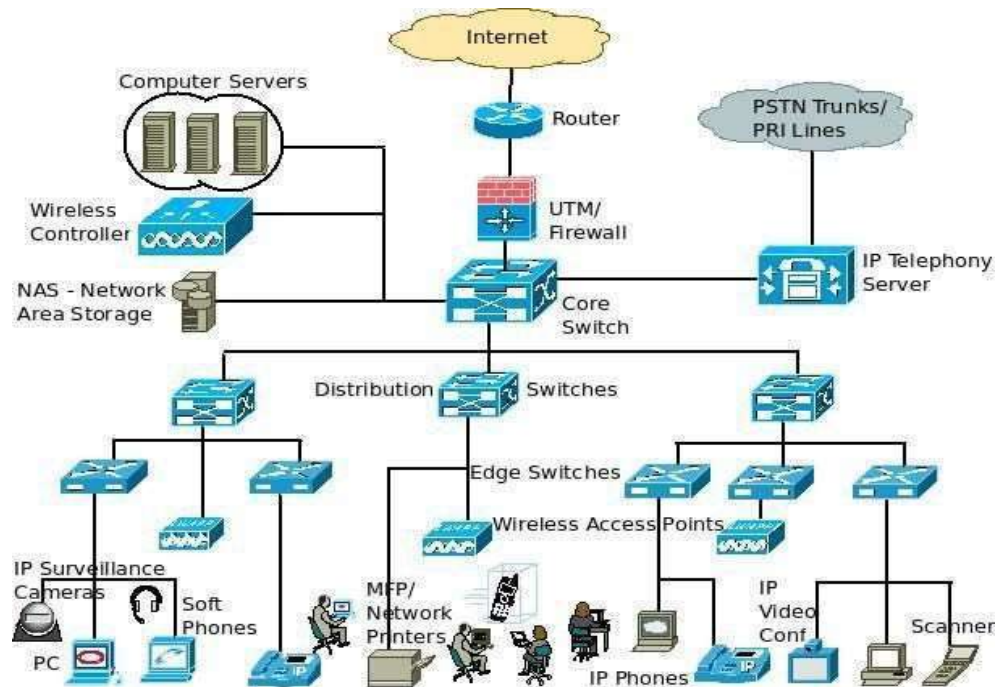
10.2 Wireless Network:

- a) Wireless network shall be based on latest bandwidth (802.11a/b/g/n) compliant and supporting multi users covering various indoor and latest bandwidth (802.11ah) compliant for outdoor locations or better.
- b) All Access points shall be managed by centralized wireless controller placed in campus Server room. This wireless controller shall be configured in high availability to avoid any downtime.
- c) Indoor Access points will be powered on via POE+ access switches. Outdoor access points may power on via any source as per feasibility and site survey.
- d) Network Manager to manage both switching and wireless network devices spread across network shall be noted.
- e) Wireless access points & Controller for Wi-Fi connectivity should have radios to support 2.4Ghz and 5Ghz band in a 4X4:4Mu-MIMO configuration with support for 802.11a/b/g/n/ac. Controller should be AI driven on premise or cloud-based controller. The controller should be based on Micro Services based Architecture. The solution should support 802.11ac primarily.

10.3 Network Security

- a) Network security can go beyond conventional anomaly detection by harnessing the power of network traffic flow data. Real-time situational awareness of all the users, devices, and traffic on network shall allow to respond to threats quickly and effectively. Thus, it can detect and protect against a wide range of attacks with continuous monitoring and intelligence. Traffic flow analysis for all connected devices to proactively get details of security threat vectors. This shall include details like IP address of sender/receiver, along with basic parameters like time, date, and size of network transaction.
- b) Central Authentication, Authorization and network device management server shall be placed in HA with required number of licenses. Next Generation Firewall must be deployed in redundancy with multiple segment based on user traffic flow and exposure to internal and external internet traffic.
- c) DNS based security to block malicious destinations before connection is established and stop malware before it enters LAN network.

GENERAL ARCHITECTURE:



10.4 Specifications for Structured Cable and Components:

1. CAT6A Unshielded I/O for Rack Side

Parameters	Specifications
Type	Modular Jacks shall meet and exceed channel specification of ANSI/TIA/EIA-568-C.2 Category 6a and ISO/IEC 11801:2002/Amd 1:2002 Ed2 when used as a component in a properly installed UTP channel.
Front Connection	RJ 45 : 50uin Gold plated contacts over Nickel
Rear Connection	Copper alloy, Gold plated contacts over Nickel or IDC
Connector Body	PBT glass reinforced UL94V-0 or Plastic
Accessories	Jack should support uniform hassle free termination technology and be able to ensure performance in each termination without dependency on expertise of technician.
Termination Interface	Front Mated Connection: 750 Cycles Min.
	Rear Mated Connection: 20 Cycles Min.
IEEE Specification (PoE)	IEEE 802.3bt type 3 and 4 (up to 100W)
	Cisco UPOE (up to 60W) and Power over HDBase-T (up to 100W)
Performance tests	Modular Jacks shall be tested for performance to ANSI/TIA/EIA-568-C.2
Guaranteed Bandwidth	Min. 500 MHz or higher Guaranteed Bandwidth for 100 MT Channel Link
Approvals	UL Listed, UL2043 Air Handling Spaces
UL Rating	UL 94V-0
Other Specifications	UL 1863, IEC 60603-7, FCC part 68-F
RoHS	EU Directive 2002/95/EC Compliant
Feature	The jacks shall not have an integrated spring shutter as the shutter malfunctions and causes operational issues in Panel.
Operating Temperature	-10° to 60°C
Dielectric Strength	1,000 V RMS @ 60 Hz for 1 minute (Signals to Ground)
Termination Process	Termination of cable on IO through Universal Termination Tool to minimize any manual termination like punch down. All the four pairs should get crimped and cut together with the help of the tool. Pairs should not be separated in termination process to avoid any cross-talk issue at Jack. Tool-less jack is not required because the tool-less jack is installer dependent, whereas the termination using a tool has consistent terminations ir-respective of the installer. Jack and Plug should be interchangeable without re-crimping/re-termination of connector.
Cat6A Jack	It should be covered under 25 year warranted solution from OEM.
Third Party Test Report	Enclose 4 Connector ETL/UL/3P Test Report ANSI/TIA – 568 Cat6 6A, ISO/IEC 11801 (Class Ea), EN 50173 (Class Ea) and IEEE 802.3-2012.

2. 24 Port Unloaded CAT6A Patch Panel

Parameters	Specifications
Type	- 24 Port 1RU Unloaded Straight Patch Panel - 19" rack mountable. - Patch panels Ports should be individually replaceable & Consistent port-to-port performance.
Ports	24 Ports in 1RU and 48 Ports in 2RU
Cable management	Panel shall have in-built cable manager at the rear end
Height	1U (1.75")
Feature	The jacks shall not have an integrated spring shutter as the shutter malfunctions and causes operational issues in panels.
Storage Temperature Range	-40Deg C to +70 Deg C
Operating Temperature range	-10Deg C to +60 Deg C
Color and Material	Black Color SPCC Steel Frame Material with ABS Front Plastic Panel
RoHS	EU Directive 2011/65/EU (ROHS II)

3. CAT6A Unshielded Field Mount RJ45 Connector/Termination Plug for Indoor

Parameters	Specifications
Type	Cat6A UTP Field Mount Plug, TIA Category 6A, ISO Class E
Front Connection	RJ 45 : Gold plated contacts over Palladium/Nickel
Connector Body	Polycarbonate - UL94V-0 or Plastic
Accessories	Jack should support uniform hassle free termination technology and be able to ensure performance in each termination without dependency on expertise of technician.
Termination Interface	Front Mated Connection: 750 Cycles or Better
	Rear Mated Connection: 20 Cycles or Better
IEEE Specification (PoE)	Power Over Ethernet (PoE) IEEE 802.3at type 1 and 2 (up to 30W), IEEE802.3bt/D1.7 type 3 and 4 (up to 100W), CISCO UPOE (up to 60W), Power over HD Base TTM (up to 100W)
Termination Pattern	Category 6A - TIA 568.C.2, Category 6A - ISO/IEC 11801:2002 Ed.2
Guaranteed Bandwidth	500 MHz or Better Guaranteed Bandwidth for 100 MT Channel Link
UL Rating	c(UL)us Listed
Other Specifications	UL 1863, IEC 60603-7, FCC part 68-F, UL 2043 Air Handling Spaces
RoHS	EU Directive 2002/95/EC Compliant
Operating Temperature	-10°C to +60°C
Dielectric Strength	1,000 V RMS @ 60 Hz for 1 minute (Signals to Ground)
Termination Process	Termination of cable on Plug through Termination Tool to minimize any manual termination like punch down. All the four pairs should get crimped and cut together with the help of the tool. Plug and Jack should be interchangeable without re-crimping/re-

	termination of connector.
Cat 6A Plug	Cat6A Plug Solution for Wi-fi/CCTV should be covered under 25 year warranted solution from OEM.
Third Party Test Report	Enclose 2 Connector Direct Attach ETL/UL/3P Test Report ANSI/TIA – 568 6A, ISO/IEC 11801 (Class Ea) and EN 50173 (Class Ea)

4. CAT6A IP20 Field Mount RJ45 Connector/Termination Plug

Parameters	Specifications
Type	Cat6A STP/UTP Field Mount Plug, TIA Category 6A, ISO Class E
Front Connection	RJ 45 : Gold plated contacts over Palladium/Nickel
IP 20	The transmission plug performance should be CAT 6A/Class EA and must be IP 20. The termination plug should have a wiring label for TIA 568A/B. The termination plug should have the capability for the solid wire of 22~26
Connector Body	Nickel plated zinc alloy diecast
Accessories	Jack should support uniform hassle-free termination technology and be able to ensure performance in each termination without dependency on expertise of technician.
Termination Interface	Front Mated Connection: 750 Cycles or Better Rear Mated Connection: 200 Cycles or Better
IEEE Specification (PoE)	Power Over Ethernet (PoE) IEEE 802.3at type 1 and 2 (up to 30W), IEEE802.3bt/D1.7 type 3 and 4 (up to 100W), CISCO UPOE (up to 60W), Power over HD Base TTM (up to 100W)
Termination Pattern	Category 6A - TIA 568.C.2, Category 6A - ISO/IEC 11801:2002 Ed.2
Guaranteed Bandwidth	500 MHz or Better Guaranteed Bandwidth for 100 MT Channel Link
UL Rating	c(UL)us Listed
Other Specifications	UL 2043 Air Handling Spaces
RoHS	EU Directive 2002/95/EC Compliant
Operating Temperature	-40°C to +70°C
Dielectric Strength	1,000 V RMS @ 60 Hz for 1 minute (Signals to Ground)
Termination Process	Termination of cable on Plug through Termination Tool to minimize any manual termination like punch down. All the four pairs should get crimped and cut together with the help of the tool. Plug and Jack should be interchangeable without re-crimping/re-termination of connector.

5. CAT6A Unshielded Patch Cords (1/2 Meters)

Parameters	Specifications
Type	Modular Cord shall meet and exceed channel specification of ANSI/TIA/EIA-568-B.2 Category 6a and ISO/IEC 11801 2nd edition (2002) & Amendment 2 (2010) up to 500 MHz when used as a component in a properly installed UTP channel. It should also comply to EN 50173-1 (2002) & EN 50173-1 Amendment 1 (2009).
Conductor	Stranded copper, 7/26AWG
Insulation	Foam Polyethylene/PE
Plug Boot	Clear boot with PVC material, Snaggles
Plug Housing	Polycarbonate (PC)
Plug contact blade	Phosphor bronze plated with 1.27um gold over 2.54um nickel undercoat
Insertion Life	750 Cycles or Better
Operating/Storage Temperature Range	-20 to +60 Deg C
Guaranteed Bandwidth	500 MHz or Better Guaranteed Bandwidth
Sheath Material	LSZH
Flame Rating	IEC 60332-3-22 or higher
Outer Diameter (Nominal)	6.1 ± 0.3 mm

6. CAT6A U/UTP Cable for Indoor

Details	Specification
Type	23 AWG Solid Bare Copper, Unshielded Twisted 4 Pair, Category 6A, confirming to TIA 568.2.D, Class EA - ISO/IEC 11801:2002
Conductors	Solid Bare Copper 23 AWG
Insulation	Polyolefin/Polyethylene
Jacket	LSZH jacket complying to: Acid Gas Emission pH per IEC 60754-1 : ≥ 4.3 Acid Gas Conductivity per IEC 60754-2 : ≤ 10µs/mm Smoke density IEC 61034-2 : ≥ 60% Light Transmittance Flame Test: IEC 60332-1 Third Party Test Report of above parameters needs to be enclosed with bid.
Pair Separator	+ Shape Spline
Suitable Applications:	Premise Horizontal Cable, 10 Gigabit Ethernet, 100BaseTX, 100BaseVG ANYLAN, 155ATM, 622ATM, NTSC/PAL Component or Composite Video, AES/EBU Digital Audio, AES51, RS-422, Noisy Environments, PoE
Guaranteed Bandwidth	500 MHz for 100 MT Channel
Packing	Box of 305 meters
Cable Nominal	7.2 mm

Outer Diameter	
Max. Delay Skew	45 ns @ 100M
Bend Radius (Installation)	50 mm
Maximum Conductor DC Resistance:	DCR @ 20°C (Ohm/100 m) < 8.0
Cold Bend Test	-30°C x 4 Hrs, No Crack
Third Party Verification for Cable	Cable ETL Test Report for compliance to 61156-5 as referenced in ISO/IEC 11801-1 for Min. 500Mhz or Higher Cable ETL Test Report for Alien crosstalk for ANEXT, AFEXT, PS ANEXT. Cable ETL Test Report for testing at elevated temperature of 40 Deg C and 60 Deg C respectively min. 500 Mhz or higher for IL, Propagation Delay and Delay Skew All above test reports to be submitted along with bid
Nom. Mutual Capacitance	Capacitance (nF/km) < 56
Nom. Velocity of Propagation	67 % or Better
Temperature Range Operation	-20 Deg C to +60 Deg C
IEEE Requirement	IEEE 802.3bt Type 1, Type 2, Type 3, Type 4
RoHS	Yes
ETL Tested	4 Connector Channel as per TIA 568.2.D. Channel Test Report should have 5.0 dB or more Headroom in Four Connector Channel - margin of NEXT (worst Case) & 10.0 dB or more PS ACRF Margin for the entire frequency range of 1-500 MHz.
Test Report	Enclose ETL 4 Connector Channel Test Report as per ANSI/TIA-568.2-D Category 6A Standard.

7. CAT6A Double Jacket U/UTP Cable for Outdoor

Details	Specification
Type	23 AWG Solid Bare Copper, Unshielded Twisted 4 Pair, Category 6A, confirming to TIA 568.2.D, Class EA - ISO/IEC 11801:2002 , Double Jacket Outdoor Cable
Conductors	Solid Bare Copper 23 AWG
Insulation	Polyolefin/Poylethylene
Jacket	Inner Jacket – PVC Outer Jacket – PE with Sunlight/UV Resistant
Pair Separator	+ Shape Spline
Suitable Applications:	Premise Horizontal Cable, 10 Gigabit Ethernet, 100BaseTX, 100BaseVG ANYLAN, 155ATM, 622ATM, NTSC/PAL Component or Composite Video, AES/EBU Digital Audio, AES51, RS-422, Noisy Environments, PoE
Guaranteed Bandwidth	500 MHz for 100 MT Channel
Packing	Box of 305 meters

Cable Nominal Outer Diameter	8.2 +/- 0.5mm mm
Max. Delay Skew	45 ns @ 100M
Bend Radius (Installation)	50 mm
Maximum Conductor DC Resistance:	DCR @ 20°C (Ohm/100 m) < 9.5
Max. Mutual Capacitance	Capacitance (pF/m) < 56
Nom. Velocity of Propagation	67 % or Better
Temperature Range Operation	-30 Deg C to +60 Deg C
IEEE Requirement	IEEE 802.3bt Type 1, Type 2, Type 3, Type 4
RoHS	Yes

8. 6/12/24 Core Single mode OS2 Armored Gel Free Outdoor Fiber Cable

Details	Specification
Cable	6, 12, 24 optical fibers Single mode OS2 G652.D, Gel free Water blocking yarn in loose tubes (6f/T), Multi Loose Tube Design with FRP central strength member, Cable core is filled with water blocking yarn and bind with water blocking tape, CSTA armor, Single HDPE jacket (black)
Application	Cable should be suitable for Structured (premises) wiring systems: For outdoor use in structured (data) wiring systems such as industrial backbone, campus backbone, building backbone (riser). Suitable for direct burial. Easy to install in ducts, tunnels and trenches.
Jacket	Black HDPE - High Density Polyethylene
Tube Construction	Multi Loose Tube with 6 Fiber per Tube, Gel Free. Tube Color to be Blue, Orange, Green, Brown, Grey, White.
Rip cords	No. of Rip cords : 2 or more
Optical Properties	Core: 9.1 +/- 0.4 μ m Cladding: 125 +/- 0.7 μ m Loose Tube fibres (secondary coating): $\varnothing$ 250 $\pm$ 15 μ m 1310 Wavelength (nm) : 0.35 Attenuation max. (dB/km) 1550 Wavelength (nm) : 0.25 Attenuation max. (dB/km) Zero Dispersion Wavelength : 1300 – 1324 nm Core-Clad Concentricity Error : $\leq$ 0.5 μ m Clad Non-Circularity : $\leq$ 0.8 % Cutoff Wavelength : $\leq$ 1260 nm PMD (ps/km) : $\leq$ 0.15 Point Loss @ 1310nm & 1550nm : 0.05 dB Refractive Index @1310nm : 1.4670 Refractive Index @1550nm : 1.4675
Warranty & Putup	Std. delivery length: 2000 $\pm$ 105m Minimum Warranty: 25 years.
Temperature Range	Operating Temperature Range: -40°C to +70 °C

	Installation Temperature Range :- 30°C to + 70°C Storage Temperature Range : - 40°C to + 75°C	
Physical Properties	Bending radii tube (Installation & Operation) : 20 x OD mm Max. Tensile Strength Installation (Short Term): 2700 N Max. Crush Resistance Installation (Short Term): 4400 N/100mm Nominal Cable OD :11.7 mm RoHS for Outer Jacket Buffer Tube Material : PBT – Polybutylene Terephthalate	
	Impact Resistance :	6.62 N.m, Passes as per IEC 60794-1 E4
	Cable Twist :	10 cycles, Passes as per IEC 60794-1 E7
	JacketUV Resistance :	Cable UV stabilized
	Water Penetration :	3m sample length and 1m water tank height for 24h, Passes as per IEC 60794-1 F5
	Repeated Bending :	35 cycles, Passes as per IEC 60794-1 E6
	Temperature cycle test :	-40°C to 70°C, Passes as per IEC 60794-1 F1
Qualification Standards	IEC 60793, ANSI/ICEAS-87-640, Telcordia GR 20, IEC 60794-1, EIA/TIA-455	

9. **6/12/24/48/96 Fiber Port 1U Rack Mount LIU (Fully Loaded)**

Details	Specification
Fiber Interface Unit	Fiber Patch Panel Typically used in Server rooms, Network rooms, Data Centers and Small offices Can be mounted directly on any 19" rack or cabinet. It should be able to accommodate a variety of Fiber connectors and terminated to fiber cables using Splicing or other methods.
Type	Fiber LIU should be 1U (1.75"), 19 Inch Rack Mount.
	6/12/24/48 Fiber Port should be available in 1U Rack Mount LIU.
	96 Fiber Port should be available in 2U Rack Mount LIU.
	LC Type Connectors will be required.
Features & Compatibility	Each 1U LIU should be able to accommodate atleast 48 fibers in LC type connectors. 2U LIU 96 fiber LC
	6/12/24/48 Fiber Splice trays should loaded in LIU with Pigtailed, Splice Tubes, Min. 2 x PG13.5 Gland, Cable Ties and Velcro Straps for upto 48F
	Panel Material – Powdered Coated Steel
	Operating Temp Range: -10°C to +60°C
	Storage Temp Range: -40°C to +70°C
	EU Directive 2011/65/EU (ROHS II)
Pigtails Parameters factory loaded in Panel	LC - Simplex, Single mode OS2, Min. 2 Mtr, 0.9mm Tight Buffer

Standard	Optical Fiber Pigtail should comply with TIA 568.3-D
Optical Performance	Insertion Loss of ≤ 0.30 dB
Optical Performance	Return Loss of ≥ 55 dB
Connector Standard	IEC 61754, TIA 604
RoHS	EU Directive 2011/65/EU (ROHS II)

10. 3 Meters SM Duplex Patch Cord (LC-LC Type)

Details	Specification
Type	2mm Duplex Zipcord or Better Singlemode OS2
Outside Diameter	(Duplex): 2.0mm or Better
Jacket Material	LSZH
Length	3 MT
Cable Crush	500 N/100mm
Insertion Loss	≤ 0.30 dB
Return Loss	≥ 55 dB
RoHS Certified	Yes
Cable/Connector	IEC 61754, TIA 604, TIA 568.3 D, IEC 60793-2-10, IEC 60793-2-
Flame Standard for	IEC 60332, IEC 60794-2-50, IEC 60754, IEC 61034
ANSI/TIA	ANSI/TIA-568.3-D (shall be mentioned in datasheet)

11. Joint Closer bamboo Type suitable for 96 Fiber

Details	Specification
Material	Outside PP closure body, inside ABS splice tray
Sealing structure	Mechanical sealing
IP standard	IP 68
Dimension (mm)	531 x 185
Cable Ports	1 Oval + 4 Round Port
Temperature	-40 + 60
RoHS Certified	Yes

Warranty:

Owner seeks warranty for the installed cable plant from the OEM equipment supplier. Bidder shall ensure that the OEM norms for supply, installation, testing and documentation as specified by the OEM supplier shall be adhered to, provided those are in line with TIA / EIA standards and Owner requirement specifications. The warranty shall be provided by the OEM vendor. The duration of the warranty shall be for a minimum of 25years and shall cover the system performance, application assurance and the costs of the supply of components and installation.

10.5 Specifications Of Active Components:

Sl. No	Detailed Technical Specifications
A	Solution Requirement
	The Switch should support non-blocking Layer2 switching and Layer3 routing
	There switch should not have any single point of failure like power supplies and fans etc. should have 1:1/N+1 in built level of redundancy
B	Hardware and Interface Requirement
	Switch should have the 32x40G/100G QSP 28ports
	Switch should have 16GB DRAM and 64GB Flash/Storage
	Switch should support Configuration roll-back and checkpoint
	Switch should support for different logical interface types like loopback, VLAN,SVI/RVI, Port Channel, multichassis port channel /LAG etc.
	100K IPv4 route sand 32k IPv6 route sentries in the routing table or better
	The switch should support hardware-based load sharing at wire speed using LACP and multichass is ether channel/LAG
	Switch should support minimum 6.4Tbps of switching capacity
C	Layer 2 Features
	Spanning Tree Protocol (IEEE802.1.D,802.1W,802.1S)
	Switch should support minimum 200,000 no. of MAC addresses
	should support 64 Nos. of link or more per Port channel (using LACP) and support 64 number of ports per Link Aggregation Group
	Support for broadcast, multicast and unknown unicast storm control to prevent degradation of switch performance from storm due to network at tacks and vulnerabilities
D	Layer 3 Features
	Switch should support all physical ports to use either in Layer2 orLayer 3 mode and also should support layer 3 VLAN Interface and Loop back port Interface
	Switch should support static and dynamic routing like Static,OSPF and BGP
	Switch should provide multicast traffic reachable using PIM-SM and SSM

E	Availability
	Switch should provide gateway level of redundancy in IPv4 and IPv6 using HSRP/VRRP
	Switch should support for BFD or Fast Failure Detection
F	Quality of Service
	Switch system should support 802.1P classification and marking of packet CoS, DSCP etc.
	Switch should support for different type of QoS features for real time traffic differential treatment using WRED and SPQueuing
	Switch should support Flow control of Ethernet ports to control traffic rates during congestion by allowing congested nodes to pause link operation at the other end for receiving traffic as per IEEE802.3x
G	Security
	Switch should support for deploying different security for each logical and physical interface using Port Based access control lists of Layer-2 to Layer-4 in IP V4 and IPv6 and logging for fault finding and audit trail
	Switch should support control plane i.e., processor and memory Protection from unnecessary or DoS traffic by control plane protection policy
	Switch should support for AAA using TACACS+/Radius
	Switch should support to restrict end hosts in the network. Secures the access to an access or trunk port based on MAC address. It limits the number of learned MAC addresses to deny MAC address flooding
	Switch should support for Role Based access control (RBAC) for restricting host level network access as per policy defined
	Switch should support to prevent edge devices in the network not administrator's controlled from becoming Spanning Tree Protocol root nodes
	Switch should support unicast and/or multicast blocking on a switchport to suppress the flooding of frames destined for an unknown unicast or multicast MAC address out of that port
H	Manageability
	Switch should support for RMON/II
	Switch should provide remote login for administration Telnet, SSHv2

	Switch should support for management and monitoring status using different type of Industry standard NMS using SNMP V2 and V3
	Switch should support for basic administrative tools like Ping and traceroute
	Switch should support central time server synchronization using Network Time Protocol NTPV4
I	IPv6 features
	Switch should support for IPv6 connectivity and routing required for network reachability using different routing protocols such as OSPFv3, BGP+etc.
	Should support router distribution between these protocols
J	Safety and Compliances
	Switch should be IPv6 Certified
	Switch Should be Common Criteria /NDPP/NDcPP certified
	OEM should be leader in Gartner data centre latest report.

10.6 Distribution Switch

Sl. No.	Detailed Technical Specifications
	Architecture
1	Switch fabric capacity-1.2Tbps
2	Switch forwarding rates–1000Mbps
3	24x1G/10Gigabit Ethernet ports scalable to 40x1/10G and 4x40G Ports with required optics
	Connectivity
4	802.3ad based standard port/link aggregation, Jumbo frames, storm control
	Switching features
5	Support at least 20000 ARP entries and 120K MAC Address
6	Should support 64LAG groups and up to 16 ports per LAG.
	L3 Features
7	Support for 64K IPv4 and 64K IPv6 routes and 24K multicast routes

8	Layer3 routing protocols like Static, RIP, OSPF, RIPv3, OSPFv3 from day1
9	Should support L3 VPN, BGP
10	IGMPv1, v2,v3, IGMP snooping, PIMSM, MSDP
	DC features
11	Data center bridging exchange, IEEE802.1Qbb
12	Enhanced Transmission Selection (ETS)
13	Data Center Bridging Exchange Protocol
14	Should support VXLAN
	Security
15	Control plane denial-of-service (DoS) protection
16	Filtering based on source and destination address
17	Support for various ACL/filters like port based, VLAN based and routed filters/ACL
	Quality Of Service
18	Minimum 8 number of hardware queues per port
19	802.1p, WRED
	Management
20	SNMPv1,v2,v3,RMON enabled, SSH, telnet, CLI and should have out of Band Management port
21	Switch should support port mirroring feature for monitoring network traffic of a particular port/VLAN.
22	Extended ping and trace route, Configuration and Image roll back.
23	Switch should have internal Hot Swappable redundant Power supply
24	Should have redundant cooling FANS
	Certifications
25	Switch should be ROHS compliant, WEEE, EN55022 Class A and CISPR
26	Switch should be IPv6 Logo Certified
27	Switch Should be Common Criteria/NDPP/NDcPP certified
28	OEM should be Leader in Gartner latest reports Data Centre

10.7 Access PoE Switch

Sl. No.	Detailed Technical Specifications
1	Minimum 24x 10/100/1000 Base-TPoE+ and 4 x 1/10G ports. (With required transceiver modules)
2	1 U Rack mountable and should provide stacking of minimum 9 switches with 140Gbps of dedicated stacking/equivalent bandwidth (All the stacking accessories should be included from day 1).
3	The Switch should have 2GB DRAM and 2GB internal Flash
4	240Gbps or higher Backplane capacity and minimum 190Mpps of forwarding rate
5	Should support non-blocking hardware architecture
6	All interfaces should provide wire speed forwarding for both Fiber and copper modules
7	Support for at least 2000 VLANs & 32k MAC address
8	Should support IGMP snooping v1, v2 & v3
9	Should support static IP routing and should be upgradable to support OSPF and PIM
10	Switch should support 8 hardware queues per port
11	Dynamic Host Configuration Protocol (DHCP) snooping
12	Switch should support LLDP capabilities
13	Should support IP Source Guard, DAI and IPv6 Security feature like IPv6 RA Guard and IPv6 Neighbor Discovery Inspection
14	Should support Secure Shell (SSH) Protocol and Simple Network Management Protocol Version 3 (SNMPv3).
15	Switch needs to have console port for administration & management
16	Management using CLI, GUI using Web interface should be supported
17	FTP/TFTP for upgrading the operating System
18	Should support Energy Efficient Ethernet
19	IEEE 802.1x support

20	IEEE802.1D Spanning-Tree Protocol
21	IEEE802.1p class-of-service (CoS) prioritization
22	IEEE802.1Q VLAN
23	IEEE802.3 10BASE-T specification
24	IEEE802.3u 100BASE-TX specification
25	Switch should have internal redundant power supply and Hot swappable fans
26	Switch should be able to support management via CLI, Web interface
27	SNMP v1, v2, v3
28	Switch should be manageable through both IPv4 & IPv6.
29	Switch should be UL-UL60950-1, FCC Part 15, VCCI Class A, EN55022, EN55024, EN300386, CAN/CSA 22.2 No. 60950-1, RoHS Complied.
30	Switch Should be Common Criteria NDPP/NDcPP certified

10.8 ITAM

Sl.No	Specifications	
1	Web Appliance Hardware	Rack based Intel Core i7 or better, 3.20GHz w/HD Graphics
		Memory 32GB 4x8GB DDR4 2666MHz
		Minimum 1TB SATA/SSD Drive
		Integrated NIC
		COTS Compliant
2	Web Appliance Software	
	Items	Capture specifications, warranties, Serial Numbers, MAC Addresses, IP info, what other H/W relates/connects to this H/W, item status, event logs, assignees
	Software	Specifications, License information
	Locations	Location of each asset building, floor, room, rack, rack row, row depth

	Contracts	Define custom contract types, like support & maintenance, SLA, etc. Track contract events.
	Tags	Multiple tags for items and software. You may use tags for grouping according to usage, budget, owner, importance, etc.
	Files	Attach documents to every main object Entity (Items, Software, Invoices, Contracts)
	Racks	Display rack layout with items assigned to each rack row. (Supports multiple items/ rack row).
	Print labels	Print label stickers for tag all your assets, with or without barcode, from phones and laptops to cooling units and UPS. Easily define new label paper layouts through the GUI.
	Backup	Get a full back up of the installation and data. Ability to restore
	Page Print Support	All screen pages/lists/reports print-outs possible without menus, scrollbars and other clutter.
	Interface Translations	Translation file support
	LDAP support	Pull user list for item assignment from an LDAPURL

10.9 Indoor Access Point/Outdoor

Sl. No	Specification
1	The Access Point proposed must have radios to support 2.4Ghz and 5Ghz channels with 802.11acWave-2,4X4:4MU-MIMO with a through put of upto 2.5Gbps.
2	Should come with standard Mounting Brackets
3	Access point should have a Gigabit link that can support at least 1Gbps of throughput.
4	Should be capable of Band Steering
5	Should support Way finding within covered areas to start with.
6	Should not require any calibration for configuration of BLE location-based messaging
7	AP should support encrypted data transmission between user and also to cloud management plat form
8	Should support virtual BLE technology
9	Should support automatic RF optimization
10	WIPS/WIDS detection of rogue and honey pot Access Point detection,

11	Should be able to limit per SSID or per user based, uplink or downlink band width
12	Should be based on the platform of Artificial Intelligence
13	Should have following compliances:- UL60950-1CAN/CSAC22.2No.60950-1 FCCPart15.247,15.407,15.107,and15.109RSS247ICES003
14	Artificial Intelligence Support from wireless access point to Switching end.

10.10 Wireless Controller (Wi-Fi Controller)

SN	Specification
1	Should have a Artificial Intelligence (AI) driven,Cloud based Controller
2	The Solution should support 802.11ac primarily and should be backward compatible to 802.11n/a/b/g. The solution should also support 802.11ax as per requirement.
3	The solution should support Location Based services via Bluetooth low energy and should also support Asset Tracking.
4	The solution should support Guest Portal
5	The solution should support WIPS, Rouge AP detection and Honeypot AP detection
6	Should be able to provide insights based on Time to connect, Successful connect, coverage, capacity, AP Uptime ,Roaming and throughput.
7	should be able to integrate with various authentication mechanism including the RADIUS servers, etc.
8	Should support Dynamic Packet capture to enhance troubleshooting.
9	Should support upto16SSIDspers AP and the cloud controller should be scalable to handle a round 5000APs or more in future
10	Should have a virtual assistant to trouble shoot deeper and facilitate investigation of existing or future issues in the Wi-Fi network

11	Must be able to limit per SSID based uplink or downlink Bandwidth
12	Must be able to limit per user-based uplink or downlink band width
13	Must be able to provide per application bandwidth limit as well
14	The per application-based Bandwidth limit should be applicable on Home Grown or Organization specific applications as well
15	Pre-staging of APs should be possible to have zero touch provisioning
16	Should support bulk configuration based on templates
17	Should be able to handle interference and shift the communication on another channel automatically if, needed
18	Should be able to create access policies based on various groups/ labels/ subnets
19	Should be able to extend AP Ito integrate with other systems as well.
20	Network Switching should also Artificial Intelligence (AI) driven,

10.11 NMS

SN	Minimum Requirement	Specification
1	IT infrastructure Monitoring	Proposed Network Management system shall monitor key metrics like availability to measure SLA's. Following are key functionalities that are required which will assist administrators to monitor network faults & performance degradations in order to reduce own times, increase availability and take proactive actions to remediate & restore network services.
2		The proposed tool should be able to monitor various operating system parameters such as processors, memory, files, processes, file systems, etc. where applicable.
3	Device Discovery	The proposed solution must automatically discover management elements connected to the infrastructure and map the connectivity between them. Solution should provide centralized monitoring console displaying network to pologymap.
4	Audit	The system should be able to clearly identify configuration changes and administrators should receive an alter in such cases

5	Dash boarding	The system should provide complete and up-to date picture of the managed environment. Should have capability to received discovery and to pology information from multiple automated discovery sources on a near real time basis Solution should provide a consolidated event dashboard of the entire IT environment covering virtualization technologies, third-party products, applications, servers, storage, networks
6		Accept Data from a variety offormats ,provide preconfigured connectors and adapters, Ability to define Adapters to data source in a visual manner without coding.
7	Reporting	Proposed solution should provide Customizable reporting interface to create custom reports for collected data
8		The System must use advanced root-cause analysis techniques,discovered topology data and policy-based condition correlation technology for comprehensive analysis of infrastructure faults.
9		Solution should support effective root cause analysis, support capabilities for investigating the rootcauses of failed service levels and must make it possible to find the underlying events that cause the service level contract to fail.
10		The proposed tool should integrate with network performance management system and support operating system monitoring for various platforms supplied as part of the solution
11	Web Appliance Hardware	Rack based Intel Quad Core Processor or better, 3.20GHz, Memory 32GB4x8GB DDR4RAM or Higher 2666 MHz, Minimum 1 TB SATA /SSD Drive, Integrated NIC

10.12 NETWORK ANALYZER

SN	Minimum Requirement	Specification
1	Network performance	Network performance tool should provide Network bandwidth usage, Packet loss rate, Interface error rate, High CPU or memory utilization, Number of tcp Connections is anomaly high for this day of

		The week, Aggregate through put of core routers is low.
2	Network Monitoring	Proposed Network Tool shall monitor key KPI metrics like availability to measure SLA's. Following are key functionalities that are required which will assist administrators to monitor network faults & performance degradations in order to reduceowntimes, increase availability and take proactive actions to remediate & restore network services.
3	Network Discovery	The proposed solution must automatically discover network elements connectedto the infrastructure and map the connectivity between them. Solution should provide centralized monitoring console displaying Network topology map.
4	Network Health	The solution should provide monitoring of Link is down,System status is in warning/critical state, Device temperature is too high / too low, Power supply is incritical state, Free disk space is low, Fan is in critical state, No SNMP data collection
5	Configuration changes	The proposed solution should provide capability of monitoring new device added or removed Network module is added, removed or replaced, Firmware has been upgraded, Device serial number has changed, Interface has changed to lower speed or half-duplex mode
6	Dash boarding	The system should provide complete and up-to date picture of the Network. Should have capability to received discovery and topology information from multiple automated discovery sources on a near Realtime basis Solution should provide a consolidated event dashboard of the entire IT networks
7	Reporting	Proposed solution should provide customizable reporting interface to create Custom reports for collected data
8		The System must use advanced root-cause analysis techniques, discovered topology data and policy-based condition correlation technology for comprehensive analysis of infrastructure faults.

9		Solution should support effective root cause analysis, support capabilities for investigating the root causes of failed service levels and must make it possible to find the underlying events that cause the service level contract to fail.
10		The proposed tool should integrate with network performance management system and support operating system monitoring for various platforms supplied as part of the solution
11	Web Appliance Hardware	Rack based Intel Quad Core Processor or better,3.20GHz,Memory32GB4x8GBDDR42666MHz,Minimum1TBSATA/SSDDrive, Integrated NIC

C-11 –EPBAX System.

11.0 Technical Specifications of IP Based EPBAX System

11.1 IP Telephony Network

The scope of work covers Planning, Design, preparation of Drawings, Supply, Installation, Testing and Commissioning of IP Based EPBX of initial capacity of 1000 Telephones & expandable up to 2000 telephones shall be located at server room. All the Telephones in the Complex will be IP Based and will use the existing LAN Network for the communication within the complex (inside buildings & in between buildings) as well as for outside the complex. All Rack Panels of Individual buildings shall be connected to Central PABX (private automatic branch exchange) system through Optical Fiber Cable IP based voice communication system with PRI (Primary Rate Interface) Trunklines (30channels) with clip facility for minimum 500 IP users license for 5 Years. The outlets areas per the approved drawings. These technical specifications shall be read along with the General Conditions for all E&M works given under subhead C-B.

- a. IPPABX is proposed in redundant manager for campus locations to support voice and high-definition video calling supporting latest authentication, communication and encryption protocols and Solution supports industry standards.
- b. Two types of phones will be deployed across campus as per end user requirements. One is basic feature phone for all users and Executive phones for Scientists /senior staff.
- c. The scope of work also includes the provision of the IP based telephones in the following buildings:
 - I. Admin cum Laboratories Building
 - II. Farmers Training Hostel
 - III. Sub Station
 - IV. Security Gate
- d. RJ45 Telephone socket outlet switch suitable IP Phones instruments shall be provided in all blocks/buildings at convenient locations, as required. CAT-6A wiring shall be provided in recessed/surface conduits/raceways from each telephone point upto the Rack panel (Patch Panel & Switch) at each floor or nearest Rack Panel of all buildings /Blocks. The Maximum length of the CAT-6A cable shall be 75m. The cabling work shall be covered under LAN sub-head.
- e. The Rack Panel (comprising of jack/Patch panels, Network switches, patch cords, power supply units, Cooling Fans, Wire managers, LIUs, Trans receivers, Fiber patch cord etc.) of individual buildings/Blocks shall be connected to the main IPPBX Server Rack & IP based Operator console with optical Fiber cables to be laid underground in trench/DWC Pipe of suitable size.
- f. The IP based PBX system is to be provided in the above buildings with wiring outlets as per the Approved drawings/Inventory. All the building telephone networks shall be interconnected.
- g. The Scope and purpose are to provide the voice to all the users within the campus

including IP based operator console, In-skin Voice mail for all the users & access to call outside the campus through analog trunks or PRI (Primary Rate Interface) trunks via local service provider.

- h. The system should have minimum 8 port in-sk invoice mail to play the user defined message during the incoming call through the analog or PRI (Primary Rate Interface) trunk.
- i. The hardware & software required for the system including IP Phones. Servers, gateways, workstations, IP based Operator console, racks, online UPS, Access switches, gateways for analog as well as PRI trunks will be in the Contractor's scope.
- j. It will be the responsibility of the Contractor to make the entire system fully functional as per the specifications. Contractor shall consider any equipment/ devices required to make the system functional if not mentioned here with.
- k. The project is on design and build basis and must cover the entire campus and building. Every individual staff should have telephone facility to communicate within the campus & outside the campus.



11.2 Tentative inventory for the IP-PABXpoints:

11.3 Technical Specifications of IP-EPBAX System

S No	Technical Qualitative Requirements/ Specifications
	Redundant Industry Standard Server based on IP at core with hot stand by configuration. Each System should be expandable up to 15000 Extensions with single server and up to 100,000 in network mode.
<u>1.System Architecture</u>	
1.1	The telephony system should be designed with IP at the core Server & Gateway type communications system, allowing fully distributed IP solutions across data networks. The system will be call servers based and it should support traditional TDM or mixed IP-TDM or full 100% IP configurations, telephony, gateway, end points & all telephony application should be from same OEM & PRI card should not be installed in any PC / Server
	It should support the following devices :-
	(i) <u>IP Communication Devices</u> e.g. IP Phones, Video Phones, Multi media PCs, SIP phones, Softphones or H.323 terminal devices etc.
	(ii) <u>Legacy TDM communication devices</u> (Digital and analog 2 Wire telephone instruments with Caller-ID
1.2	The <u>call control servers should be fully redundant solution</u> The solution must provide geographical redundancy by separating the servers over LAN/WAN. I.e. if the server in the main data center fails, the other server, which is installed at geographically different location over LAN/WAN should take over the entire communication network load.
1.3	<u>Call control server / appliance should be Intel based hardware</u> with necessary configuration to support the desired expandability.. The offer system must consist of two separate servers deployed in redundant mode. The call servers should be of the same OEM make and must be rack mountable. This is required so that there is uniform support available for the entire solution including Call Servers, Media Gateways etc.
1.4	The system should be capable of supporting analog and IP Telephones. Necessary licenses for the asked users should be enabled from day-1. However, the IP EPBAX system should have the capability to scale up to 15000 users to achieve the future capacity on the same hardware that is supplied as part of this RFP.
1.5	The system should manage CAC (Call Admission Control) mechanisms to optimize the usage of the bandwidth in the WAN for multi-site configurations.
1.6	The system should be capable of supporting a very high traffic and should support a Busy Hour Completion (BHCC) of 2, 50,000 per hour.
1.7	The IP PBX should be day one ready with full telephony Feature/Functionality, all necessary hardware should be provisioned from day one for this. Full SIP (able to connect 3rd Party SIP Phone & SIP Trunk (Public & Private) capability. The main functions of SIP capability should provide SIP networking (Public & private) and support SIP endpoints in a converged communications network.
1.8	All the users to be managed in a single database,
	which is managed centrally, no multiple databases & bundling of Telephony system will not consider to meet Specification & scalability.
1.9	The voice network architecture and call control
	functionality should support both SIP & H.323.
1.1	The system should be based on server gateway
	architecture with external server running on Linux OS.
1.11	The system should be able to operate with SIP compliant device and it should be able to support internal gatekeeper for the same.
1.12	The SIP proxy, SIP registrar should be inbuilt in the system and should support open SIP stack compliant hard phones or soft phones also.
1.13	IPv6 support from day one & The quoted model should be TEC approved. Vendor to submit TEC approval certificate along with the bid.

1.14	The offered system should be equipped with redundant media gateways that can be placed in different geographic locations to offer availability of minimum 50% of trunk circuits.
1.15	The system should support for voice encoding using following standards:-
	(i) G.711
	(ii) G.729A
	(iii) G.722
1.16	Call Switching. Internal calls : Based on the G.711 uncompressed PCM standard.
1.17	The System should support Network Time Protocol V4.1.2 (RFC 1305) to synchronize the system date/time of network devices.
1.18	IP EPBAX should Support built-in ACD to achieve future requirement.
1.19	The offer system should be provided with at least 30 built in DSP resources without adding any additional modules.
1.2	VoIP Support. System should support VoIP solutions as an integral part of the system.
	(i) The system should be fully compliant to VoIP standards like H.323 (or equivalent) and SIP (Session Initiation Protocol). Vendor to give clear compliance for the requested standards.
	(ii) The system should be able to operate with any H.323 (or equivalent) /SIP compliant device and it should be able to support internal gatekeeper for the same.
	(iii) The SIP proxy, SIP registrar should be inbuilt in the system and should support any open SIP stack compliant hard phones or soft phones.
	(iv) System should support the QOS features for the VOIP implementation. It should be compliant with both QOS standards (Layer 2 – 802.1 p/q) and Layer 3- Diffserv/TOS).
1.21	IP v6. IPv6 support from day one. Solution should support dual stack environments. The quoted model should be TEC approved. Vendor to submit TEC approval certificate along with the bid
1.22	The proposed system should Support Automatic Route Selection (ARS) and Least Cost Routing (LCR) features to route the calls based on priorities related to user profile and network availability, along the most cost-effective path. This service should be transparent for users and irrespective of the physical carrier connection.
1.23	Should provide a cloud-based, enterprise-grade, Communication Platform thus delivering a collaborative business application extending features viz. Instant Messaging/Telephony Presence, click to call (dial by name, answer, release), Call Log, P2P Audio/Screen Sharing. The same should be included in BoQ for all extensions
1.23.1	Cloud based UC should have the following UC features
	- Customizable Logo
	- Local Administrator
	- User self-enrolment & profile management
	- Instant Messaging / Presence
	- Peer to Peer Audio / Video / Screen Sharing
	- Minimum 1GB storage space
	- Team/Group with minimum 20 users
1.23.2	Telephony Services of the UC solution should support
	- Click to call, dial by name, answer and release
	- Call logs
	- Presence management
1.24	The system must support an IP Softphone application that allows the users to manage their calls from a PC or MAC/iPhone/iPAD/Android. This user must have access to the full set of telephony services without any degradation. The voice should be manage by the multimedia resources of the PC.
1.25	Offered solution must support at least 200 remote media gateways

<u>2. System Security</u>	
2.1	The System must support Syslog services for both internal and external command and configuration control accounting with a minimum of 30 day history.
2.2	The Call Server must be provided adequate protection from possible virus, worm and Trojan infestation
2.3	The Call Server must be provided adequate protection from possible virus, worm and Trojan infestation points such as internal e-mail servers and they must be updated every month. In case customized hardened linux distributions are being provided this clause will not be applicable.
2.4	The password and access control must include at least :-
	(i) Management console access to be provided by dual role based authentication (one of user rep and one of administrator rep).
	(ii) Management console access must allow only access to level of viewing of running configuration and status of current configurations and sys logs.
	(iii) For any configuration changes again a dual role based authentication system for write access fully integrated with the management console application for carrying out the authorized configuration changes must be provided.
	(iv) Logs of all activities to include configuration change, housekeeping activities and any other action on the system grouped user wise and specifying the time of activity must be available for each day.
	(v) Account access authentication/ restriction using external RADIUS/ LDAP
2.5	Media Gateways should not host services such as proxy, FTP or local dynamic routing except those required for software Up-gradation /backup etc. to prevent exploitation in Distributed Denial of Service attacks.
2.6	IP Phones should not support direct, external initiated, connections via HTTP, telnet, FTP, TFTP or any other protocol as means to prevent distributed Denial of Service attack exploitation, except those required for software Up gradation/backup etc.
2.7	IP Phones must support 802.1x (EAP-MD5 or better) for authentication and access control to the network, this mechanism must allow the user to be connected to the call server once he has passed the authentication process, not before.
2.8	The system should have the capability to, based on standard mechanism (such as 802.1Q and DHCP), assign automatically the corresponding voice VLAN number to the IP station clients during IP station initialization, allowing for the separation of voice and data traffic at IP station.
2.9	Support for Commercial grade encryption security with minimum 128 bit key security for both signaling and voice with in a node for all IP subscribers – IP subscriber communications.
2.1	Support for Commercial grade secrecy with minimum 128 bit key encryption security for both signaling and voice for inter-node communication between same type of exchs over IP trunks in which all traffic between analog/digital/IP over the IP trunk must be encrypted for both signaling and data.
2.11	The system should incorporate IPtables software firewall for traffic filtering
2.12	All management traffic between a remote console/session and the call server must be secured.
	(SSHv2 for secure sessions, TLS1.2 for secure HTTP session, SFTP for file transfer, LDAPS for directory access)
<u>3. System Management</u>	
3.1	Should provide a dedicated management server/platform that will be based on the latest technologies. This server should support a minimum of five or more clients having different access rights to the applications.
3.2	The management platform must provide a client Graphical User Interface (GUI) as well as a web based interface to allow the administrator to manage the system from any PC with an browser based web interface over HTTPS
3.3	The management platform must provide different levels for accessing the system based on the role being played by the user who is accessing the system. The administrator should have the highest authority
3.4	The management platform should provide the following tasks, as per the ask :-

3.5	(i) <u>Configuration and programming</u>
	(aa) Services, users, categories and all system parameters and features.
	(ab) Provide centralized management in local or remote environments of a single system or a network.
	(ac) The network manager will be able to quickly and easily edit, create or delete any subscriber profile/network object by the use of import/export functions and multiple operations.
	(ii) <u>Faults and Alarms management</u>
	(aa) All the incidents and fail reports generated by the system itself informing date, hour and severity.
	(ab) This module must be able to centralize the alarms and Events of the System and give colors according to the severity level of the alarm.
	(ac) Notify an alarm depending on the severity level sending an e-mail or activating a script performing a specific action.
	(ad) Register and generate statistics for the alarms and events in the network on a daily basis.
	(iii) <u>Fault diagnosis</u> Generate reports and graphics about the statistics of the alarms.
	(iv) <u>Accounting</u> of all external calls generated by the users including cost, date, hour. Must provide different options to group the monitoring of the calls (cost center, extension number, trunk, user, city/area associated to dialed numbers). IP PBX system should have buffer of last 2500 tickets of call details in case of Call billing system/ management system failing
	(v) <u>Directory module</u> It shall be possible to provide display equipped voice terminals with access to system directory on digital and IP phones. Should also support exchange directory access via web browser. This must be LDAP compatible and the exchange directory should be supported for all users via web browser thus allowing click to call features to the users.
	(vi) <u>Call Metering and Accounting</u> The log of local to local call should be supported. The log of local to trunk call in both directions (incoming as well as outgoing) should be maintained in the exchange in the hard disk. Should support Malicious Call Trace.
	(vii) <u>Reports</u> The management platform must allow the administrator to generate reports and graphics of the activity per period of time in terms of traffic, accounting and alarms and giving the possibility to generate statistic of all this analysis. Those reports must be predefined but the option to personalize the reports must be also available. These reports should be exportable in HTML, pdf, excel and TXT formats.
	(vii) <u>Monitoring Module</u> which allows the administrator to easily monitor the accounting thresholds of the users of cost centers in graphical interface and must allow to send an e-mail or an alarm in case of threshold crossing.
<u>4. System Survivability</u>	
4.1	The system should offer maximum availability, with the switchover of call control processing functions to an alternate or redundant processor in the event of significant fault. The redundancy scheme should conform to the model used in most computer systems: the complete "mirroring" of the information (both static and dynamic data.) The switch over between 2 call servers in LAN (L2 network) or WAN location (L3 Network) <u>should not interrupt existing and established communications</u> to include all analog, digital, hard, soft and Video IP Phones. The complete set of programs and software modules must be duplicated in real time. In case of failure of the main Server (hardware or software), the standby Server (emergency mirror) must take over the control of communications instantaneously.
4.2	Centralized Licensing Structure - The offered platform should have centralized licensing structure where a user license (Analog, digital, IP) can be used anywhere in the telephone network like main site or the various geographically displaced site with RLU Media gateway
4.3	Remote Media Gateway should support survival mechanism that allows them to maintain minimum number of the telephony services for their users, in case of failure in the WAN links where the signaling with the call server drops. In case of failure in IP connectivity with central EPBAX system the remote unit should work for a minimum duration of 30 days. Once the IP

	connectivity between remote unit & central EPBAX system is restored back, the remote unit shall work with central EPBAX system.
4.4	The management platform must provide a backup mechanism for all critical system information in a both manual and an automatic/schedule archival and a Disaster Recovery Mechanism.
4.5	Replacement of cards 7.1.14 All the peripheral cards (Extension card, Trunk Card, ISDN PRI Card, etc) should be Hot Swappable, i.e. It should be possible to replace any peripheral card even when the system is in the working state
4.6	All the tone generation and tone detection should be local to the gateway.
4.7	The operating system of EPBAX should be reliable and should be protected against loss / alteration of memory due to power failure / unauthorized command or due to any other faulty condition The system should support Auto Restore of data in case of Power Failure; No Manual intervention should be required and all Features and facilities should be working on Power Restore.
4.8	The call server should support the two or more different Geographically locations more than 10 Kms in the network.
4.9	Life Cycle of entire exchange system being provided should be minimum Five years, 1 year warranty & 5 year AMC support
4.1	<u>OEM should have Technical Assistance Center based in India with Toll free number</u>
<u>5. Physical</u>	
5.1	Call Server Should support expansion up to 15000 subscriber ports.
5.2	System should have minimum 09 universal slots in single cabinet/chassis for trunk and TDM extension interfaces
5.3	Media Gateway should have modular architecture with the ability to stack multiple gateways in a single location. One or more such stacks should be placed in each location under the same Core Server control. System should work on 230V AC or 48V DC
5.4	<u>Environmental Conditions</u>
	The equipment offered shall be capable of maintaining its guaranteed performance when operating continuously for 24 hours a day and 365 days a year under the following environmental conditions:- MTBF Document to be provided
	(i) Operating temperature : 0 to 40 degree C.
	(ii) Storage -5 degree C to +45 degree C.
	(iii) Humidity 20% to 80% without condensation
<u>6. System Features</u>	
6.1	Numbering Scheme The IP PBX should be suitable for up to 8-digit extension numbering scheme. This numbering scheme should be flexible. System should also allow mixed numbering scheme.
6.2	The system should provide distinctive ringing for internal calls, junction calls, auto call backs
6.3	The system should support the attribution of an external number DDI or individual line or a bundle head to a trunk, a bundle, an attendant, a group of attendants, a subscriber, a group of subscribers or virtual equipment. The unanswered DDI communication can overflow, to Attendant or attendant group, Local subscriber, Network subscriber, Voice mailbox.
6.4	The proposed system should support automatic route selection (ARS) and least cost routing (LCR) features to route the calls based on priorities related to user profile, tariff, and network availability, along the most cost-effective path. This service will be transparent for users and irrespective of the physical carrier connection.

6.5	Voice guidance Telephone features to be offered as standard.
6.6	DTMF and Busy Tone Resources As many busy tone detectors are to be offered as the number of trunks.
6.7	<u>Basic Telephone Features</u>
	(i) Abbreviated dialing, Appointment reminder, Automatic call-back on busy trunk/bundle/network link, Automatic DISA, user authentication, call forwarding unconditional on busy/no reply to extension, hunting group, Voice mail, operator etc.
	(ii) Immediate forwarding Call pick-up. Call parking, Call waiting indication/ voice prompt.
	(iii) Calling line identification restriction for internal calls, Camp on busy telephone/hunting group, Controlled private call by Pin code and password.
	(iv) Do not disturb, Dynamic call baring General night service Hunting group (fix head cyclic, longest idle time, parallel)
	(v) Internal/external music on hold internal/external inquiry call individual hold instrument locking to prevent the outgoing.
	(vi) 28 Party Meet-me Conferencing, Mastered conference allowing a group of up to 29 users to be connected with each other, or to perform announcement on loud speaker of prerecord or live message
	(vi) Last internal/external number redial, Personal code modification, Store and redial external number, Transfer in conversation on free/busy telephone.
6.8	CLI coming in from ISDN PRI trunks should be displayed on Analog Telephones, Digital Telephones and IP Telephones.
6.9	<u>External Holding Tone</u> The offered system should be ready to accept music on hold from an external PC of CD player.
6.1	When all attended consoles are engaged, the external caller shall be informed of this situation by voice message. The call should be routed to the least loaded operator.
6.11	System should support embedded Call Center with 5 agent, 1 supervisor and MIS Reporting, to address future requisites:
	- Configuration of the call routing and distribution rules
	- Real-time supervision of the agents
	- Real-time observation of the traffic
	- Production of statistics in an Excel compatible file
<u>7. System Network Support</u>	
-	-
7.1	Should Support Q SIG standards over IP/ TDM/ WAN trunks.
	(i) Heterogeneous, open numbering plan.
	(ii) Calling/Connected Line Identification Presentation and Restriction.
	(iii) Calling/Connected Name Identification Presentation and Restriction.
	(iv) Call Forwarding Unconditional, Busy, No Reply ,Call Transfer.
	(v) Call Completion to Busy Subscriber, on No Reply, call Offer.

7.2	The system should have options to network over any of MPLS, IP, ISDN
7.3	The system must support the following external telephony interface signaling:-
	(i) E1 CCS PRI
	(ii) E1 CAS (R2 MFC)
	(iii) ISDN PRI (ETSI)
	(iv) Analog Loop Start and Ground Start
8. Voice Mail Features	
8.1	Voice Messaging system must be software based and fully integrated to the call server and should not require external server to be hosted. Card based or 3rd party Voice Mail solution are not Acceptable/Disqualified
8.2	Voice Messaging system must be manageable from the system management platform
8.3	Answering or answering with date stamp - The system should provide voice mailbox holders with the choice of two functions: answering the messages or answering them with a date stamp
	When a call is forwarded to the voice messaging system, the box holder will be able to chose between two personalized announcements. If the personal announcement has not been recorded, the standard system announcement will be substituted automatically.
	Recording of calls conversation - The IP/Digital holder of a voice mailbox must be able to take advantage of this service to record internal or external calls. Recorded calls will receive the same service as messages that have been left by callers.
	Forwarding of voice mail messages - The box holder will be able to send a copy of previously received messages to other boxes (with or without requesting acknowledgement of receipt).
	Call by name - To provide universal access, it must be possible to select a voice mailbox by its name by using the telephone dialing keypad. The caller will be guided in this operation by voice prompts.
	The notification of messages must be on: LED/icon on the phone, Voice Guide
	The voice messaging systems must provide silence detection to avoid recording of blanks at beginning or end of recording
	The System should allow distribution lists for message broadcast
	Additionally, the voice mail system must provide the following features: Record of standard Greeting, Record of alternate greeting, Record Name, Urgent delivery option, Skip Greeting, Confirmation to send recorded message, Visual user interface with sensitive keys on large screen phones, Autoplay of unheard/new messages, Delete messages, Save messages, Reply messages.
9	<u>Analog Subscriber card.</u>
	Should have 08/16 or more ports
	Each port should support CLIP features (FSK or DTMF)
	Loop Resistance >1100 ohms
10	<u>Digital Subscriber card.</u>
	Should have 08/16 or more ports
	Each port should support CLIP features (FSK or DTMF).
	Loop resistance > 400 Ohms
	Provide digital ports for connecting digital telephones
11	<u>SIP/IP Telephone (Type-1)</u>
	Display: 128 x 64 B&W graphical display

12	Display 2 Line keys (Line 1/2) with LED, Backlight, Viewing area: (2.1x1.0 inches)
	Ethernet 10/100 connectivity for LAN and PC
	802.3AF Power over Ethernet (PoE) - Class 1
	2 SIP account keys
	• Conference key - Local 3-party conference
	• Redial key
	• Transfer key
	• Hold key
	• 4-way navigation and OK key
	QoS
	• QoS: 802.1p/Q tagging
	• (VLAN), Layer 3 TOS, DSCP
	• Call log (1000), local contacts (1000)
	• G.722, OPUS, iLBC
	• G711 (A-law and Mu-law), G.729AB
	• VAD (Voice Activity Detection),
	• Comfort Noise Generation (CNG)
	• Acoustic echo cancellation
	• DTMF: In-Band, RFC2833, SIP INFO
	• Hearing Aid Compatible (HAC)
	• SIP V2: RFC 2474, 2833, 3261, 3263,
	• 3264, 3265, 3550, 4566, 5359, 6086
	• Static IP and DHCP
	• IPv4/IPv6
	Phone should be from same EPBAX OEM.
	SIP/IP Telephone (Type-2)
	Number of pixels: 120 x 50 pixels or better, black & white, white backlight
	Full-duplex speakerphone, acoustic echo cancellation
	At least 3 soft keys on both sides of the display
	Four-way navigator.
	Hands free and group listening modes
	Numeric to alpha keypad: To switch
	to alpha character and perform
	dial-by-name,
	Direct access to text and voice mailboxes via dedicated key with message signaling LED.
	Headset plug RJ-9
	Dial pad and call/redial/release key/ 2 Programmable Keys
	Power over Ethernet (IEEE 802.3af) Class 1 Support
	Gigabit Ethernet 10/100/1000 connectivity for LAN and PC
	Wideband G722, G711 (A-law and Mu-law), G729 AB, Voice activity detection (VAD)
	Support DHCP and static IP
	QoS support: IEEE 802.1p/Q VLAN tagging, Layer-3 TOS, DSCP
	• Wideband G722
	• G711 (A-law and Mu-law), G.729AB
	• VAD (Voice activity detection),
	• Comfort noise generation (CNG)

	• Acoustic echo cancellation
	Phone should be from same EPBAX OEM.
13	SIP/IP Telephone (Type-3) Display: 3.5 inch color, 240 x 320 pixels or better effective display area Gigabit Ethernet 10/100/1000 connectivity for LAN and PC Class 1 Power over Ethernet (IEEE 802.3af), Energy Efficient Ethernet 802.3 az support Full-duplex speakerphone, acoustic echo cancellation OPUS Codec, Wideband G722, G711 (A-law and Mu-law), G729 AB, voice activity detection (VAD), comfort noise generation (CNG) Support DHCP and static IP QoS support: IEEE 802.1p/Q tagging (VLAN), Layer 3 TOS, and DSCP Optional Magnetic Alphabetic Keyboard Operating Temperature: - -5C to +55C. Ipv4/IPv6 support Phone should be from same EPBAX OEM.
14	<u>IP Telephone for Operator (Type-4)</u> Display: 3.5 inch color, 240 x 320 pixels, effective display area size 70.08 x 52.56 mm², LD Backlight, Ambient light sensor, back shell busy light indicator Gigabit Ethernet 10/100/1000 connectivity for LAN and PC Class 1 Power over Ethernet (IEEE 802.3af), Energy Efficient Ethernet 802.3 az support Full-duplex speakerphone, acoustic echo Cancellation Support for Wideband BLUETOOTH handset Opus Codec Wideband G722, G711 (A-law and Mu-law), G729 AB, voice activity detection (VAD), comfort noise generation (CNG) Support DHCP and static IP QoS support: IEEE 802.1p/Q tagging (VLAN), Layer 3 TOS, and DSCP IEEE 802.1 AB/LLDP-MED client (IPv4/IPv6, automatic VLAN acquisition, PoE management, inventory information) It should be possible to expand the attendant set capacity with additional Expansion module Magnetic alphabetical keyboard, Adjustable foot stand ranging from 25° to 60° Phone should be from same EPBAX OEM.
	PC Based Attendant consoles
	a) system should support PC Based Attendant consoles:
	• A professional Multimedia Attendant Console to efficiently manage calls and information on a Windows based PC. • It should be IPV6 compliant
	b) The attendant console must provide following dedicated keys to managing call flow:
	• Store and redial • Redial • Cancel consultation (inquiry)

	• Release call
	• Broker call
	• Call selected party
	• Answer internal call
	• Transfer/hold call
	• End of dialing
	• Next call
	c) Additionally, a set of Programmable Keys with LEDs must be also available on the console to program other optional services. The Tenderer must describe the kind of services that can be programmed for the keys for each type of attendant console.
	d) The Multimedia Attendant Console option must support to run on Microsoft Windows OS: Windows 7 (32- and 64-bit), Windows 8/8.1 (64-bit), or Windows 10 (64-bit) operating system. The PC must not be dedicated solely to this application and must be able to handle telephone applications and business software simultaneously. The attendant console color screen must allow the operator to take advantage of user interface based in, icons and buttons to activate the different functions.
	e) The console should be associated with any IP Phone for voice communication
	f) In case of PC failure the attendant should still be able to handle calls through IP Phone
	g) This attendant application must be LDAP compliant. To permit access to company directory servers or databases, or ODBC databases (Oracle, Access, Excel, etc.), to allow call/dial by name and directory pop-up in an attendant console window.
	h) The IP PBX must also provide an application for the operator to monitor the telephone status of the following objects:
	• IP and analog phones
	• Attendant consoles
	• Fax
	• Hunt groups
	• Trunk groups
	• Trunk lines
	i) The following services must be available:
	• Override - The attendant can bypass forwarding or do not disturb modes on a phone
	• Called Party Call Resources - When the called party is busy or does not answer, the following call resources should be available on attendant keys:
	o Callback request
	o Text message
	o Voice mail
	o Associate
	o Assistant
	• The attendant should be able to send mini text messages to IP/Digital users with display:
	o Programmed message
	o Pre-programmed message completed by entering digit: date, hour
	o Pre-programmed message completed by any variable part (text and digits)
	o Fully programmable message (twenty characters maximum)
	• Call Pick-up
	• Transfer on no Answer
	• Transfer on Busy
	• Barge-in on Busy or Partially Busy
	• Three-party Conference
	o An attendant must be able to set up a three-party

	conference, and then transfer the conference to another user.
	• Trunk Assignment with/without Restriction (Transfer with Privilege) - This feature enables an attendant to transfer a trunk and public dial tone to an internal user. The user can then dial an external number with or without restriction. The attendant can request the call charges at the end of the call.
	· Call Transfer to other Attendant
	· Chained Call
	· Charging Recall
	• Phone Reservation - This feature allows the attendant to reserve a phone to, for example, transfer an important external call.
	• Class of Service - The attendant console (in idle state) must be able to change the class of service for any phone.
	• Public Trunk Access Restriction - The attendant console (in idle state) must be able to change the public trunk access and restriction for any phone.
	• Input of Directory Name in Phone Book - The attendant console can create or modify directory names in its personal phone book.

C-12 CCTV System

12.0 Technical Specifications IP Based CCTV System:

- 12.1 The brief scope of work shall include Planning, design & preparation of drawings, obtaining approvals from the department and Supply, Installation, testing & commissioning of IP based CCTV system on centralized OFC network back bone If any item required to make the scheme functional, is not specifically mentioned in the scope of services, the same is deemed to be included with in the scope of this tender. These technical specifications shall be read along with the General Conditions for all E&M works given under subhead C-B.
- i. The IP based CCTV system shall be designed based on centralized OFC backbone network with suitable PTZ, Bullet , Dome cameras to monitor &supervise the designated common areas of buildings, Corridors, staircase, and common areas. Entrance and Exit gates, Entrances of all buildings, internal roads, road junctions, parking lots, etc., for security purpose, as well as record and inform officials on unwanted, untoward incidents. It is also essential to have recorded images to be stored at least for min90days of all critical areas (around 30%of total area) to facilitate investigations of are ported incidents and 30days for all non-critical areas.
 - ii. The cameras will cover important points in campus and internal areas of buildings. The system will be designed to cover the areas keeping in view the security requirement in consultation with the Engineer-in-Charge.
 - iii. The CCTV and Surveillance System shall control and monitor from hospital building in the Campus as per requirement. All the buildings shall have IP Based Dome Cameras, Bullet Cameras and PTZ Cameras for surveillance. The types of cameras & locations of various Cameras indicated here in are minimum to be provided. However, during detailed designing ,if required and found necessary, the type/rating of the Cameras shall be upgraded.
 - iv. The hardware required for the system including Servers VMS, Recording, Workstations, Monitors, Cat6A cables & Patch Cables to connect the camera to nearest PoE enabled LAN point, Cables, connectors, conduits, power supplies etc.are in the scope of work.
 - v. The complete LAN networking required for the CCTV & Access Control System are common for data and shall be covered in LAN, Wi-fi Networking subhead.
 - vi. Entire system must be designed by keeping am in of 20% Buffer in system capacities for VMS Servers, Recording Servers, Storage, Network, and all the equipment.
 - vii. Multiple NVRs (N + 1) shall be designed for the CCTV System with each NVR capacity of 64 Channel with redundant facility.
 - viii. Each Counselling room of the hospital shall be provided with CCTV Camera with Audio recording facility along with 128GB memory card.
 - ix. The contractor shall provide the STQC compliance certificate for CCTV camera and other allied equipments.

12.1.1 External CCTV system

- i. The IP based CCTV system shall be designed based on centralized OFC backbone network with suitable PTZ, Bullet cameras to monitor & supervise the designated external areas viz. Entrance and Exit gates, internal roads, road junctions, parking lots, etc. for security purpose, as well as record and inform officials on unwanted, untoward incidents.
- ii. It is also essential to have recorded images to be stored at least for min 90 days of all critical areas to facilitate investigations of a reported incidents and 30 days for all non-critical areas.
- iii. The cameras will cover important points in campus and internal road junctions, entrance and exit gates, entrance porticos/porch of all buildings. The system will be designed to cover the areas keeping in view the security requirement of the ICAR-CIRC authorities.
- iv. All the cameras shall be with IP-66 Housing with Junction box, Industrial Grade Switches etc. with weatherproof housing. The existing LAN network switches shall be used for CCTV connectivity.
- v. Network connectivity for cameras having distance more than 75 meters, shall be on optical fiber. Suitable provision shall be provided to connect with existing LAN infrastructure. The power supply to LAN switches and Monitors will be on UPS. The video recording shall be non-embedded based recording server with video management software.
- vi. For Camera Monitoring and Control, required number of 65-inch Full HDLED Monitors shall be provided. All the cameras shall be live on using monitors. One shall not have more than 36 camera 6x6 Grid. Min 02 concurrent workstation license shall be offered and no of Work stations and Monitors shall be got approved from Engineer-in-charge.
- vii. Suitable poles for fixing the external CCTV cameras are in this scope. All the OFC cables and Cat-6A cables are to be laid in trenches with suitable size DWC pipe, is in the scope of the contractor.
- viii. Trays are provided for the run cable trenches which is with in supply of the contractor.

12.1.2 Internal CCTV system

- i. The IP based CCTV system shall be designed based on centralized OFC backbone network with suitable Bullet, Dome cameras to monitor & supervise the designated common areas of buildings like entrance lobbies, corridors, lift lobbies etc.
- ii. It is also essential to have recorded images to be stored at least for min 90 days of all critical areas to facilitate investigations of a reported incidents and 30 days for all non-critical areas.
- iii. Network connectivity for cameras having distance more than 75 meters, shall be on optical fiber. Suitable provision shall be provided to connect with existing LAN infrastructure. The power supply to LAN switches and Monitors will be on

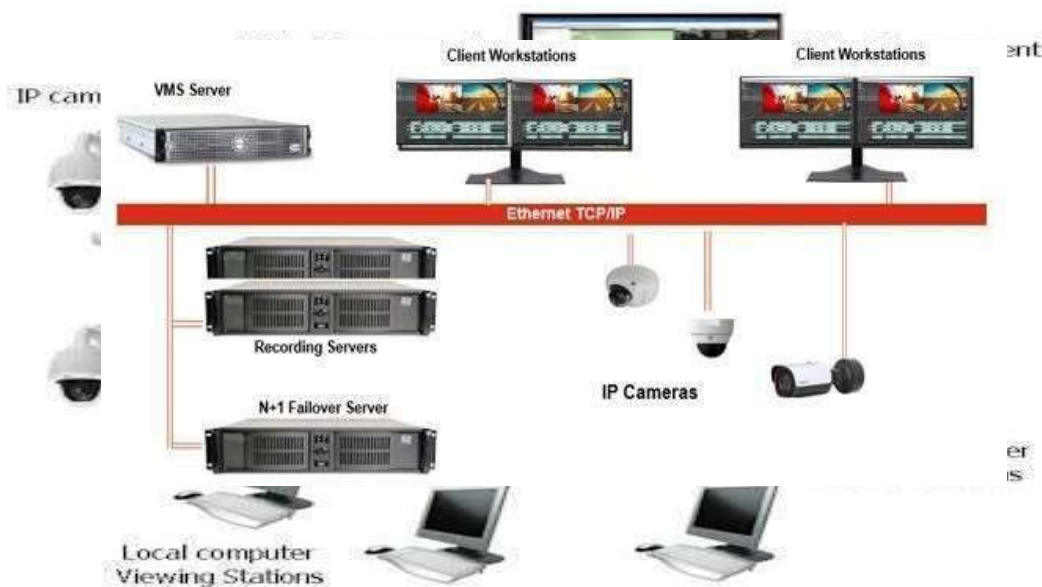
UPS. The video recording shall be non-embedded as recording server with video management software.

12.1.3 Specifications

- This part covers the specifications of CCTV cameras, multiple NVR etc. which are used in the system. The brief specifications areas follows:
- All equipment and materials used shall be standard components that are regularly manufactured and used in the system.
- All systems and components shall have been thoroughly tested and proven in actual use.
- Motion detection CCTV cameras shall record video based on sensitivity to movement.

The typical connections of equipment are shown in below figures:

Fig-1



12.2 Technical Specifications:

12.2.1 Dome Camera

	Features	Specifications
1)	Camera type	Dome
2)	Housing IP	IP66
3)	Impact Protection	IK10
4)	Camera resolution	2MP(1920×1080)
5)	Image sensor	1/2.8"or larger Progressive scan CMOS
6)	Min-illumination	Color 0.05lux @ F1.6 (AGCON); B/W 0.001 lux@ IRON
7)	Focal Length	2.7-13.5mmVarifocal Motorized
8)	Shutter Speed	1/3s~1/100,000s
9)	Multiple streaming	Quad Stream Main Stream 2 MP, 1080P (1920 x 1080), 720P (1280x720), Sub Stream 720P (1280x720),VGA (640x480),QVGA(320x240)
10	Frame Rate	30fps
11	Digital Zoom	Should have the capability to digitally zoomed in web browser by selecting the area using mouse
12	WDR	Yes
13	IR	Inbuilt IR LEDs with IR distance upto 40 mtrs
14	Day & Night	IR cut filter with auto switch
15	Day & Night Switch	Auto/Color/Black & white
16	Noise Reduction	3DDNR
17	Video Compression	H.265+/H.265/H.264+/H.264+/MJPEG
18	Bitr rate	32 Kbps to 8 Mbps
19	Image setting	Saturation, Brightness, Contrast, Sharpness, AGC, White balance adjustable By client software or web browser
20	Edge analytics Alarm Trigger	Motion Detection, sound detection, Video tampering alarm, Network disconnected, IP address conflicted, Illegal login, File upload via FTP or E-mail, SD/SDHC/SDXC recording at event triggers.
21	Protocols	TCP/IP, HTTP, DHCP, DNS, DDNS, RTP/RTSP, SMTP, NTP, HTTPS, FTP, PPPOE,

22	Security	IP address filter; complicated password; Authenticated user name and password
23	Privacy Masks	Should support at least 4 Zone, Rectangle
24	White Balance	Auto/Manual
25	Alarm I/O	1 Input/1 Output
26	Image Mirror / Image rotation / flip	Disable/Horizontal/Vertical/All
27	Audio compression	G711A, G711U
28	Audio I/O	Uni-directional.
29	Factory default	Should have the option of setting the Configuration to factory default except network settings.
30	Operating Temperature & RH	0°C ~+55° C/less than≤ 95%RH
31	Mobile Surveillance	Support mobile surveillance through app on android and i-phone
32	Certification	UL/CE/FCC, RoHs
33	System Compatibility	ONVIF profile S, G &T
34	Power	D12V/POE(IEEE802.3af)

12.2.2 Bullet Camera:

	Features	Specifications
1.	Camera type	Bullet
2.	Housing IP	IP66
3.	Camera resolution	2MP(1920×1080)
4.	Image sensor	1/2.8" or larger Progressive scan CMOS
5.	Min-illumination	Color 0.05lux @F1.6(AGCON); B/W0.001lux @IRON
6.	Focal Length	2.7-13.5mmVarifocal Motorized
7.	Shutter Speed	1/3s~1/100,000s
8.	Multiple streaming	Quad Stream Main Stream 2 MP,1080P (1920x1080),720P(1280x720), Sub Steam 720P (1280x720),VGA (640x480),QVGA(320x240)
9.	Frame Rate	30fps
10.	Digital Zoom	Should have the capability to digitally zoomed in web browser by selecting the area using mouse
11.	WDR	YES
12.	IR	Inbuilt IR LEDs with IR distance upto 40mtrs
13.	Day & Night	IR cutfilter with auto switch
14.	Day/Night Switch	Auto/Color/Black & white
15.	Noise Reduction	3DDNR
16.	Video Compression	H.265+/H.265/H.264+/H.264+/MJPEG
17.	Bit Rate	32Kbpsto8Mbps
18.	Image setting	Saturation, Brightness, Contrast, Sharpness, AGC, White balance adjustable by client software or web browser
19.	Edge analytics, Alarm Trigger	Motion Detection, sound detection, Video tampering alarm, Network disconnected, IP address conflicted, Illegal login, File upload via FTP or E-mail, SD/SDHC/SDXC recording at Event triggers.
20.	Protocols	TCP/IP,HTTP,DHCP,DNS,DDNS,RTP/RTSP,SMTP,NTP,HTTPS,FTP,PPPOE,

21.	Security	IP address filter; complicated password; Authenticated user name and password
22.	Privacy masks	Should support at least 4Zone Rectangle
23.	White Balance	Auto/Manual
24.	Alarm I/O	1 Input/1 Output
25.	Image Mirror/Image rotation/flip	Disable/Horizontal/Vertical/All
26.	Audio Compression	G711A ,G711U
27.	Audio I/O	Uni-directional
28.	Factory default	Should have the option of setting the configuration to factory default except network settings.
29.	Operating Temperature & RH	0°C~+55°C/lessthan≤95%RH
30.	Mobile Surveillance	Support mobile surveillance through appon android and i-phone
31.	Certification	UL/CE/FCC/RoHs
32.	System Compatibility	ONVIF profile S,G&T
33.	Power	D12V/POE(IEEE802.3af)

12.2.3 2MP Network IR PTZ Camera

S. No	Features	Description
	Camera type	IR PTZ
	Material	Metal
1.	No. of Pixels (H×V)	1920×1080(2MP)
2.	Housing IP	IP66, Surge and Voltage Transient Protection
3.	Impact Protection	IK10
4.	Certificate	CE, FCC, UL, BIS
5.	Active Pixels	1920x1080
6.	Scanning system	Progressive
7.	Image Sensor Type	1/2.8" or larger Progressive Scan CMOS/CCD
8.	Illumination	Color:0.05Lux@ (F1.6, AGCON) or better 0LuxwithIR
9.	Shutter Speed	1/1s to 1/100000s
10.	WDR	True WDR 120dB

11.	Digital Noise reduction	3 D
12.	Lens Support	4.25~4.8 mm to 117~136mm, 32x optical zoom, or better
13.	IR Range	Minimum 100m
14.	Presets	250 or higher
15.	Patrol	Min.8, up to 32 pre sets for each patrol
16.	Privacy Mask	24 programmable privacy masks or higher
17.	Pan and tilt Speed	Pan Speed Configurable, from 0.1°/s to 160°/s, Preset speed: 240°/s
		Tilt Speed: Configurable, from 0.1°/s to 120°/s Preset Speed: 200°/s
18.	Angle of View	H:65o -1.88o, V:39.4o-1.09o
19.	Movement Range	PAN: 360°end less
		Tilt: From-15° to 90°(auto-flip)
20.	Auto Pan Scan	Support
21.	Auto Tracking	Support
22.	Auto Resume after Power failure	Resume from home position
23.	Video Compression	H.265/H.264/MJPEG Support all
24.	Privacy Masking	Off/On (24 areas)
25.	Video Stream	Min. Triple Stream with configurable
27.	Video Analytics	Intrusion, Loiter, Line crossing, Unattended object, Missing object, Face detection
28.	Event type, Analytics supported	Video motion detection, system boot ,record notification, Camera tampering detection, Face Detection, Intrusion Detection, Trip Wire Detection, Entry Detection, Exit Detection, Alarm Input, Alarm Output,
29.	No. of Video streams	3
30.	Gain control	0 to 100%
31.	ROI	12 Zone
32.	Electronic Image Stabilization	Support
33.	1 st Stream	2M Patreal time 1920x1080 @50/60fps
34.	BLC, Defog	Support
35.	EIS	Support

36.	Local Storage	Micro SD /micro SDHC /micro SDXC slot supporting memory card form in. 512GB In the event of failure of connectivity to the network storage the camera shall record video locally on the SD card automatically. After the connectivity is restored, these recordings shall be automatically pulled by the network storage recorder such that no manual intervention is required to transfer the SD card-based recordings to network storage.
37.	Security	User authentication (ID and PW), Host authentication (MAC address); HTTP Sencryption; IEEE802. Ixport-based network access control; IP address filtering
38.	Standard	ONVIF (PROFILES, PROFILEG),ISAPI,CGI
39.	Remote Administration	Remote configuration and status using web-based tool
40.	SVC	Support
41.	System Update	Remote system update over Network using web client
42.	Protocol	IPv4/IPv6, HTTP, HTTPS,802.1x, Qos,FTP, SMTP, UPnP, SNMP, DNS, DDNS, NTP, RTSP, RTCP, RTP,TCP/IP,UDP, IGMP, ICMP, DHCP, PPPoE, Bonjour
43.	Communication Interface	10/100M Self-adaptive Ethernetport,1RJ45
44.	Simultaneous Live	Up to 20channels
45.	Smart Features	3D Positioning, PTZ Position Display, Preset Freezing, Power-off Memory
46.	Userbase/ Schedule Based	Preset/Pattern Scan/Patrol Scan/Auto Scan/Tilt Scan/ Random Scan/Frame Scan /Panorama Scan
47.	Pattern Scan	4 pattern scans ,record time over 10minutes for each scan
48.	Main Stream	50Hz:25fps(1920x1080,1280x960, 1280x720) 50fps(1920x1080,1280x960,1280x 720)
49.	Sub Stream	50Hz:25fps (704x576,640x480,352x 288)
50.	Third Stream	50Hz:25fps(1920x1080,1280x960,1280x720, 704x576, 640x480,352x 288)
51.	Alarm	2 input/1output
52.	Alarm Linkage	Alarm linkage with other relay devices

53.	Audio	1 input/1 output
54.	Temperature Range	0°C to + 55°C, Humidity 95% or less (non condensing)
55.	Power Supply	36 VDC and Hi-PoE

12.2.4 64 Channel NVR (Network Video Recorder):

S.no	parameter	Specification
1.	ANR	ANR technology to enhance the storage reliability when the network is disconnected
2.	HD Output	HDMI and VGA independent outputs provided
3.	VCA Detection	Supports multiple VCA (Video Content Analytics) events
4.	HDD Quota and Group Modes	Support
5.	Recording Bandwidth	400Mbps
6.	Outgoing Bandwidth	160Mbps
7.	HDMI/VGA Output resolution	HDMI: 4K(3840x2160)/30Hz, 1920x1080/60Hz, 1600x1200/60Hz; 1280x1024/60Hz, 1280x720/60Hz; 1024x768/60HZ VGA: 1920x1080p/60Hz, 1280x1024/60Hz; 1280x720/60HZ, 1024x768/60Hz,
8.	Audio output	1 CH
9.	Decoding format	H.265/H.265+/H.264/H.264+/MPEG4
10.	Recording resolution	Supports upto 8MP
11.	Capability	4-ch@4K or 8-ch@4MP
12.	Alarm Interface	4 input/1 output
13.	Network protocols	TCP/IP, DHCP, DNS, DDNS, NTP, SADP, SMTP, NFS, iSCSI, UPnP™, HTTPS
14.	SATA	2 SATA Interface
15.	Capacity	8 Nos x 8TB capacity for each HDD
16.	Two-way audio	1-ch, RCA
17.	Network interface	1 RJ-45 10M/100/1000Mbps Ethernet interface

18.	USB interface	1xUSB3.0,2xUSB2.0
19.	Power supply	12 VDC
20.	Consumption (without hard disk)	<50W
21.	Working	0° to +55°C
22.	Working humidity	10 to 90%
23.	Certificates	FCC/CE/UL & RoHS

12.2.5 Video Management Hardware Specification.

Sl.No	Parameter	Description
1.	Operating System	Windows ®Server IoT 2019 or better
2.	Database	Microsoft®SQL Server®2017 Express or better
3.	Processor	Intel®Xeon®E-22363.4GHz or better
4.	Processor Chipset	Intel®C246orbetter
5.	Memory	16GBDDR4
6.	OS Hard Drive	Dual(RAID1) 480GBSSDs for OS
7.	Network	2xGigabit Ethernet ports
8.	Video Card	Matrox G200 or better
9.	USB	2xUSB3.0
10.	Monitor Output	1xVGA
11.	Ethernet Port	2xRJ45
12.	Input Voltage	100~240VAC50Hz
13.	Temperature (Operating)	10°Cto55°C
14.	Relative Humidity (Operating)	10%~90%non-condensing
15.	Safety	CEEN60950-1:2006+A1:2010+A2:2013+A11:2009+A12:2011,EN62311:2008,IEC60950-1:2005ed2+A1:2009+A2:2013;UL60950-1,CAN/CSAC22.2No.60950-1-07
16.	Certificates	FCC,CE, UL& RoHS

12.2.6 VMS Software:

Sl. No	Parameter	Description
1.	Multiple subsystems Support	Various NVR's /Matrix Switcher sand 3 rd Party systems
2.	Architecture Support	Distributed Architecture (Parent- Child Topology)

3.	Camera Discovery	Auto
4.	Camera Type /Compression	Multiple Cameras ,Multiple Compression support
5.	Other System Support	Access Control, Intrusion, Video Solution
6.	Redundancy	1+1/N+M Fail over support
7.	Alarm Event	Pre-event and post event video display
8.	Playback	Smooth reverse and Synchronous playback across NVRs
9.	Sequential Playback	Incident management mode allows creating a package of clips multiple cameras at different times that can be played back sequentially
10.	Video Analytics	Support to be provided for all the video analytics
11.	Surrounding camera view	Surrounding cameras mode with presets, makes following subjects of interest simple and efficient by allowing the nearest camera of interest to be immediately in view
12.	PTZ Control	Innovative “One-Click” or “Mouse Drag”3D PTZ control
13.	Low Bandwidth	Enriched video viewing experience through intuitive video rendering engine optimizes CPU utilization by altering the video frame rate for low band width throttling
14.	GPURendering	GPU rendering support for H.264 and H.265 decoding upto 60 frames persecond (1080p camera)with smooth display on 4K monitors reduces the number of work stations needed For monitoring large sites with 30+cameras
15.	Monitor Control	Monitor control allows controlling all monitors from a single client (Monitor Wall control)
16.	Remote View	Remote monitor mode allows sharing and Controlling a remote monitor while still viewing locally
17.	VMS in VMS	Multiples VMS integration to be possible
18.	Privileges	Role-based operator privileges
19.	AD Support	Support for Active Directory user authentication
20.	E-Map	Web-based maps with drag-and-drop camera setup, easy cross-site navigation and HTML5 live video pop-up and instant playback, allow quick situational response

21.	Privacy Options	Body pixilation and blurring in live view to protect customer and employee privacy from abuse of surveillance data/4-Eye Dual user authentication for play back
22.	Cyber security Features	Enhanced password security — non-recoverable passwords, enforcing complex passwords, password expiry, and node fault passwords Addressed Unauthenticated/ Unauthorized channels Secured firewall configuration Secured Web client– Enabled HTTP Sand TLS1.2, and protection from CSRF and XSS attacks Restricted folder and Registry access to operators Secured Assemblies–Digital signing Secure communication with the Camera susing TLS1.2. encrypted video streams. Support for Digest Authentication in multicast stream between camera and VMS client

12.2.7 Workstation:

S. No	CPU Specifications	
1	Total Cores	4
2	Total Threads	8
3	Processor Base Frequency	3.40GHz or better
4	Cache	8MB Cache
5	Bus Speed	5GT/s
6	TDP	77W
	Memory Specifications	
1	Max Memory Size	32GB
2	Max No. of Memory Channels	2
3	Max Memory Bandwidth	25.6GB/s
4	ECC Memory Supported	No
	Processor Graphics	
1	Processor Graphics	Intel® HD Graphics 4000 or better
2	Graphics Base Frequency	650MHz
3	Graphics Max Dynamic Frequency	1.15GHz
4	Quick Sync Video	Yes
5	3D Technology	Yes
6	Flexible Display Interface	Yes
7	Clear Video HD Technology	Yes
8	No of Displays Supported	3

C-13 Audio Video / Conference System

13.0 Technical specifications

The scope of work includes Planning, design, preparation of drawings, supplying, installation, testing & commissioning of Audio-Visual System including Video Conference System in complete manner to have a fully functional system, as required. If any item required to make the scheme functional, is not specifically mentioned in the scope and specifications, the same is deemed to be included within the scope of this tender. These technical specifications shall be read along with the General Conditions for all E&M works given under subhead C-B.

13.1 Location and technical specifications of AV system and Video Conference system is mentioned below. For each location, necessary software shall be used to identify the type and quantity of equipment /item required.

13.2 AV system including Video Conference system shall run on UPS power ,which shall be drawn from the nearest UPS DBs.

a) AV system with video conferencing system shall be provided at MS Video Conference room

13.3 Technical Details of the AV System

S. No	Description	Technical Specification
	4K, Display TV85"/75"/55'	Professional display with IPS technology, 16:9 aspect ratio, 3840*2160 (4KUHD) native resolution, 300 nits' brightness, 178 x 178 degree viewing angle, hard coating (3H) minimum surface treatment, should be anti-glare treatment, should be 24 hours operational hours, should be usable in landscape or portrait modes, should have at least 2xHDMI, DP, Audio, USB3.0, should have RS232 C in/out, RJ45 In, IR receiver in ,pixel sensor in etc. complete.
	Column Loudspeaker	Passive Column Loudspeaker with min 12 X 2" Driver or better; RMS 120W @ 12 Ohms or better ; Frequency range : 120Hz – 20Khz ; Sensitivity 92 dB and Max SPL 113 dB; Beamwidth @1KHz : 174° x 9° (H X V) or better (Horizontal more is better; vertical less is better), Power Taps (100 V): 40W/20 W/10 W/ 5 W or better ; OEM Mounting Bracket to be Included, Construction : Aluminium, CE Certification or more.
	Amplifier for Column Speaker	Dual Channel power amplifier, RMS/AES power handling @ 4 Ω : 2 x 500 W, @ 8 Ohms : 2 x 300 W, @ 8 Ohm Bridge : 1 x 1000 W, Frequency response: 20 Hz - 20 kHz, Signal / Noise: > 90 dB, THD+N (@ 1 kHz): < 0.1%, Crosstalk (@ 1 kHz): > 70 dB, Technology: Class-D, Inputs sensitivity: 0 dB (1V RMS), Protection: DC Short circuit; Over heating; Over load; Signal limiting; Convection cooled, should be energy star rated, etc., CE Certification or more

	Ceiling Speakers	6.5" two-way coaxial thin edge ceiling loudspeaker, 100V transformer power taps : 24,12,6, watts, Conical dispersion : 145° or more, impedance : 8, low impedance RMS continuous power : 30watts, frequency range : 50 Hz - 20 kHz or better, frequency response : 60Hz - 20KHz or better etc complete required as per specifications.
	Wall Mount Speakers	Full range Passive wall mount loudspeaker with LF: 6" or better, HF : 1" or better having Frequency Response (+/-3 dB) : 65Hz - 20 kHz or better, RMS power : 60 W at 8 Ohms or better, Maximum SPL: 106 dB or better, Sensitivity: 89 dB or better, Dispersion : 120 degree X 120 degree or better, OEM mounting arrangement to be supplied. CE Certification or more IP Rating 55 or more
	Amplifier for Ceiling/Wall Speakers	Quad channel 4 Ohm energy-efficient amplifier - 4 x 80W - 70/100V or 4 Ohms, Class-D amplifier technology, Energy star certified, Signal / Noise > 100 dB, THD+N (@ 1 kHz) < 0.05% (1/8 rated Power), Crosstalk (@ 1 kHz) < 70 dB, Frequency Response ($\pm$ 3 dB) 110 Hz - 20 kHz, Technology Class-D, Protection DC Short circuit, Over heating, Over load, Signal limiting, Cooling Convection cooled, CE Certification or more
	Wireless Lapel Microphone	Digital Wireless UHF lapel microphone set with Rack receiver having 56 MHz or higher of switching bandwidth and equidistant spacing enables up to 90 channels or more along with 2,240 selectable frequencies for fine tuning. It should have auto scan feature for efficient connections to reduce time and effort. It should have min 100 meter transmission range. It should have omni-directional pick-up pattern, Sound pressure level (SPL) : 130 dB or more, System Latency : 1.9 ms, Dynamic range: 130 dB and frequency response: 20Hz-20000 Hz. The microphone system can be controlled through ios / Android applications via bluetooth. It should have 12 hours of operation life and more.
	Gooseneck Microphone	Wired mic 450mm Gooseneck microphone with a programmable microphone button (Toggle on/ off, PTM, PTT, and permanent on) and a bi-color LED ring for status indication. 450mm length, condenser capsule with cardioid pickup pattern, Frequency response: 50 Hz - 20 kHz, Maximum sound pressure level: 130 dB SPL, Connectivity: XLR 3M. It should have TTL-logic output for camera control feature. The OEM should have a minimum of 2 company-owned service centres in India.
	12 Channel Audio Mixer	12 input / 8 output audio mixer with on board effects, low noise performance having minimum 2-in /2-out USB audio play back and recording, USB Interface, Compatible with Windows 10 and Higher versions.

	Digital Signal Processor	Supply of Digital Signal Processor with a minimum of 14 or more microphone/line inputs that include phantom power and AEC. It should also have 8 or more line outputs, at least 2 channels of USB input and output for software video conferencing, The sampling rate should be 48kHz or better and the DSP should be expandable for port expansion. It should have a minimum of 64x64 Dante channels for digital audio transfer , should also have min 4 GPIO contacts .DSP must support with electrical features of THD+N (22Hz to 22kHz) : 0.002% (1kHz @ +4dBu); EIN : <125dBu, unweighted (20Hz to 20kHz); Dynamic Range : 110dB, unweighted; Propagation Delay 4ms; Crosstalk, input to input, 1kHz : <110dB; Phantom Power +48VDC up-to 100mA maximum; and compliant to FCC Part 15 B and conform to CE and ICES-003:7 safety requirements.. The DSP should support control with an app via iOS and Android devices or any third-party control system and also should be able to control TCP-IP devices. Additionally, it should have built-in filters, feedback suppression, and other necessary features as per specifications.
	VC Software	Software based Scalable Video Collaboration Solution to be supplied with 99% uptime; Capacity : The solution must support 1virtual Meeting room with minimum 100 participants joined from various devices based on iOS, Android, Mac or Windows Operating Systems.one additional webinar license must also be provided within the Package connecting 500 remote participants in a single session; Continuous presence of 49 on screen videos through PC and Mac during Meeting mode and 10 on screen videos during Class room and webinar Mode; Resolution: The solution must support 1080p,30fps,HD resolution; Protocols: The solution must support standard based Audio Video Codec system like H. 264 and G.711.
	Streaming Software	H.264 AV over IP Encoder with USB for record Video scaling at either input or output, allows seamless switching from any source, at Any resolution, to any display or projector, while preserving video fidelity. Device can still be powered locally from 12VD Call owing for easy rack- mountable. Should have RS-232 and IR ports for controlling 3rdparty devices. Unlimited Scalability HDMI output interface allows easy installation with local display such as desktop PC applications. Digital Video Input: HDMI, DVI-D, Dual-Mode Display Port (DP++),RGB/VGA, DVI-Dand Dual-Mode Display Port (DP++) are supported through a passive adapter Formats: HDMI, DVI -D (through adapter), HDCP content protection support, RGBHV, YPbPr Latency: Up to175ms at 30fps.Should have analog audio out (Stereo) HDMI OUT: HDMI video output (passive pass-through from HDMI IN) USB connector :One USB-A for audio/video stream recording.
	Wall Plate	Wall plate with Inputs 1 HDMI, 1VGA with Audio, 2K and 4Ksupport, HDTV Compatible, HDCP Compliant etc., complete as required.

Digital Podium	Digital Podium Consisting of 21"Interactive Monitor with Motorised Angle Adjustment, Electromagnetic Technology—Pen Touch, Switcher cum controller, Visualizer, - Full HD with PCI5 ,7thGen, 16GB RAM and 2TB Hard Disk.
Presenter	Professional presenter with cordless protocol cordless range 100 feet.
HDMI /VGA/Audio/Microphone/HD Base T Cable	HDMI/VGA/Audio/Microphone/HD Base T Cable for entire projection system, and as per site requirement.
Chairman /Delegate Microphone Unit	The chairman/Delegate unit's microphone should have 120° or higher audio pickup angle with 60-100cm or higher pickup distance. The body of the unit should be made of metal and not plastic so that the same is rugged and can be used for a long time. The Digital chairman/Delegate unit should have a Professional capacitive touch induction button for on/off and for priority functionality. It should have a 3.5mm headphone interface, which can be used as a meeting monitoring for participants, and can adjust the volume of the listening. The Table top microphone shall be equipped with twin-loudspeaker system guarantees a homogenous sound level in the meeting room. The cabling of the units, which is done by CAT6A cables and hidden connections can be optionally secured with strain reliefs for fixed installations. Microphone with hidden cable connections, cabling via RJ45 sockets Strain relief shall be available for fixed installations.

Item Description	Technical Specification
AV Control System	Supply, Installation, Testing and commissioning of AV Control System with control ports. Should have Quad Core processor / multicore CPU / Ultra-Fast processor, for faster processing and advanced automated system requirements. Should be able to control two rooms simultaneously, for future proof and backup purpose. Should have network security protocols Active Directory® service authentication, 802.1X network access control, TLS, SSH and HTTPS to ensure IT policies compliance. And need to be configured and shown during installation. Should be JITC/FIPS/NIAP certified. Should have BACnet communication protocol, which allow integration with third-party building management systems (HVAC, security, and other systems) over Ethernet. Should have minimum 2 GB SDRAM and minimum 8 GB flash memory Should have minimum, 8x IR/serial, 1x Bidirectional RS-422/485 port, 2x Bidirectional RS-232, 8x I/O, 8x low voltage relay. Should be TAA compliant / IC3S (Indian Common Criteria Certification) compliant / Common Criteria Should have ethernet port with TCP/IP, UDP/IP, DHCP, SSL, SFTP (SSH File Transfer Protocol), IPv4, IPv6. Device should have additional 1x LAN port supporting DNS server, port forwarding,

	for creating local control subnet for sensitive applications that require security, and which isolates devices from the local network. Compliance: UL, CE, FCC, RoHS/WEEE. (Additional BIS to be shared if applicable). Control processor & Touch Control interface should be from same OEM, and must not require any internet connectivity for configuration, programming and running. Should be shipped with license to control the room from PC/Laptop using UI.
AV Control System Button Panel	Supply, Installation, Testing and commissioning of wall-mounted AV Control System with control ports and customizable backlit buttons. Should be able to control two rooms simultaneously, for future proof and backup purpose. Should have network security protocols Active Directory® service authentication, 802.1X network access control, TLS, SSH and HTTPS to ensure IT policies compliance. And need to be configured and shown during installation. Should have BACnet communication protocol, which allow integration with third-party building management systems (HVAC, security, and other systems) over Ethernet. Should have minimum, 1x IR/serial, 1x Bidirectional RS-232 port, 2x I/O, 2x low voltage relay. Should be TAA compliant / IC3S (Indian Common Criteria Certification) compliant / Common Criteria Should have ethernet port with TCP/IP, UDP/IP, DHCP, SSL, SFTP (SSH File Transfer Protocol), IPv4, IPv6. Compliance: CE, FCC, RoHS/WEEE. (Additional BIS to be shared if applicable). Control processor & Touch Control interface should be from same OEM, and must not require any internet connectivity for configuration, programming and running. Should be supplied with custom engraved buttons as per room/customer requirement from OEM Should be shipped with license to control the room from PC/Laptop using UI.
AV Wired Touch Panel	Supply, Installation, Testing and commissioning of 10 Inch tabletop touch screen. Contrast: 1000:1 Resolution: 1920 x 1200 pixels Color Depth: 24 bit, 16.7M colors Brightness: 400 nits (cd/m²) Viewing Angle: Minimum ±80° horizontal, ±80° vertical Aspect Ratio: 16:10/16:9, Should have network security protocols Active Directory® service authentication, 802.1X network access control, TLS, SSH and HTTPS to ensure IT policies compliance. And need to be configured and shown during installation. Should be JITC/FIPS/NIAP certified. Should have minimum 2 GB RAM and minimum 16 GB Storage memory Should be TAA compliant / IC3S (Indian Common Criteria Certification) compliant / Common Criteria Should have ethernet port with TCP/IP, UDP/IP, DHCP, SSL, SFTP (SSH File Transfer Protocol), IPv4, IPv6. Compliance: UL, CE, FCC, RoHS/WEEE. (Additional BIS to be shared if applicable). Control processor & Touch Control interface should be from same OEM, and must not require any internet connectivity for configuration, programming and running. Should proximity sensor which wakes the screen without requiring any user interaction and trigger custom event from control system.
AV Over IP Encoder / Decoder Type 1.	Supply, Installation, Testing and commissioning of AV over IP Transceiver (Encoder/Decoder)

	Video Codec: JPEG2000 / OEM based high performance video processing Encoder Mode: Should have Input : 2x HDMI, 2x USBC (supporting Audio, Video, USB and 100w power), Output: 1x RJ45 & 1x SFP to be connected to decoder or network switch, 1x HDMI Loop output for confidence monitor/display. Decoder Mode: Should have Input: 1x RJ45, 1x SFP, Output: 1x HDMI Scaled. Scaled HDMI output having : Widescreen format selection (zoom, stretch, maintain aspect ratio, 1:1) Videowall Processing: Video wall processing up to 8 wide x 8 high, static or dynamic text overlay Should have control ports 2x IR, 1x Bidirectional RS-232 port, 1x RJ 45 for controlling third party devices, without the need to utilize, run any control cables from AV control system. Video Resolution: 4096x2160 @60 4:4:4, HDR10+, Dolby Vision video support. Audio Format: Dolby Digital®, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS®, DTS 96/24, DTS HD High Res, DTS HD Master Audio, LPCM up to 8 channels Content Protection: HDCP 2.3, AES-128. USB Port: 2x USB port for peripherals and HID (mouse, keyboard, or other USB 2.0 device, USB HID compliant device) Should have 1x Stereo line-level audio input / output (configured) Should have network security protocols Active Directory® service authentication, 802.1X network access control, TLS, SSH and HTTPS to ensure IT policies compliance. And need to be configured and shown during installation. Should be JITC/FIPS/NIAP certified. Should be TAA compliant / IC3S (Indian Common Criteria Certification) compliant / Common Criteria Should have ethernet port with TCP/IP, UDP/IP, DHCP, SSL, SFTP (SSH File Transfer Protocol), IPv4, IPv6. Compliance: UL, CE, FCC, RoHS/WEEE. (Additional BIS to be shared if applicable). Should be able to configure the device as Encoder / Decoder
AV Over IP Encoder / Decoder Type 2.	Supply, Installation, Testing and commissioning of AV over IP Transceiver (Encoder/Decoder) Video Codec: JPEG2000 / OEM based high performance video processing Encoder Mode: Should have Input : 1x HDMI + 1x USBA (BYOD/BYOM), Output: 1x RJ45 & 1x SFP to be connected to decoder or network switch, 1x HDMI Loop output for confidence monitor/display. Decoder Mode: Should have Input: 1x RJ45, 1x SFP, Output: 1x HDMI Scaled. Scaled HDMI output having : Widescreen format selection (zoom, stretch, maintain aspect ratio, 1:1) Videowall Processing: Video wall processing up to 8 wide x 8 high, static or dynamic text overlay Should have control ports 2x IR, 1x Bidirectional RS-232 port, 1x RJ 45 for controlling third party devices, without the need to utilize, run any control cables from AV control system. Video Resolution: 4096x2160 @60 4:4:4, HDR10+, Dolby Vision video support. Audio Format: Dolby Digital®, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS®, DTS 96/24, DTS HD High Res, DTS HD Master Audio, LPCM up to 8 channels Content Protection: HDCP 2.3, AES-128. USB Port: 2x USB port for peripherals and HID (mouse, keyboard, or other USB 2.0 device, USB HID compliant device) Should have 1x Stereo line-level audio input / output (configured) Should have network security protocols Active Directory® service authentication,

	802.1X network access control, TLS, SSH and HTTPS to ensure IT policies compliance. And need to be configured and shown during installation. Should be JITC/FIPS/NIAP certified. Should be TAA compliant / IC3S (Indian Common Criteria Certification) compliant / Common Criteria Should have ethernet port with TCP/IP, UDP/IP, DHCP, SSL, SFTP (SSH File Transfer Protocol), IPv4, IPv6. Compliance: UL, CE, FCC, RoHS/WEEE. (Additional BIS to be shared if applicable). Should be able to configure the device as Encoder / Decoder
8X8 HDMI Switcher	Supply, Installation, Testing and commissioning of 4K60 4:4:4 8x8 HDMI matrix Switcher Should have eight HDMI inputs and eight HDMI outputs Should have two stereo line-level audio output, to de-embedded audio from any of the eight HDMI inputs Video Resolution: 4096x2160 @60 4:4:4, HDR10+, Dolby Vision video support. Audio Format: Dolby Digital®, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS®, DTS 96/24, DTS HD High Res, DTS HD Master Audio, LPCM up to 8 channels Content Protection: HDCP 2.3 Should have network security protocols Active Directory® service authentication, 802.1X network access control, TLS, SSH and HTTPS to ensure IT policies compliance. And need to be configured and shown during installation. Should be TAA compliant / IC3S (Indian Common Criteria Certification) compliant / Common Criteria Should be controllable via RS-232/RJ45 via external control system, Web browser support Compliance: UL, CE, FCC, RoHS/WEEE. (Additional BIS to be shared if applicable).
Switcher Type 2	Supply, Installation, Testing and commissioning of 4K60 4:4:4 4x2-2 matrix Switcher Should have four HDMI inputs Should have two matrix output in pairs of HDMI and HDBT Lite/RJ45 output. (2x HDMI & 2x HDBT Lite/RJ45) Should have video scaling at output ports Should have two MIC inputs with +48VDC phantom power, two LINE inputs for audio Should have 2x stereo line-level audio outputs Video Resolution: 4096x2160 @60 4:4:4, HDR10+, Dolby Vision video support. Audio Format: Dolby Digital®, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS®, DTS 96/24, DTS HD High Res, DTS HD Master Audio, LPCM up to 8 channels Should be able to transport 4096x2160 @60 4:4:4 resolution upto 130 ft (40 m) on HDBT Lite/RJ45 port Content Protection: HDCP 2.3 Should have network security protocols Active Directory® service authentication, 802.1X network access control, TLS, SSH and HTTPS to ensure IT policies compliance. And need to be configured and shown during installation. Should be TAA compliant / IC3S (Indian Common Criteria Certification) compliant / Common Criteria Should be controllable via RS-232/RJ45 via external control system, Webbrowser support Should have automatic switching among the inputs (LIFO), priority routing assigned to each input. Should have a feature to upload an image to used as a background whenever active video content is not being displayed.

	Compliance: UL, CE, FCC, RoHS/WEEE. (Additional BIS to be shared if applicable).
HDMI Splitter	Supply, Installation, Testing and commissioning of 1:4 HDMI Splitter Should have one HDMI inputs Should have Four HDMI output. Video Resolution: 4096x2160 @60 4:4:4. Audio Format: Dolby Digital®, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS®, DTS 96/24, DTS HD High Res, DTS HD Master Audio, LPCM up to 8 channels Content Protection: HDCP 2.2 Should be TAA compliant / IC3S (Indian Common Criteria Certification) compliant / Common Criteria Should be simple plug and play, no programming or control system must be required for operation. Should have RJ45/USB/RS-232 port for firmware update and custom EDID management Compliance: UL, CE, FCC, RoHS/WEEE. (Additional BIS to be shared if applicable).
VC Codec for Microsoft Teams Rooms	1) SITC of customizable video conference room solution for use with the MICROSOFT TEAM Rooms intelligent communications platform. 2) It is preferable to convert native Teams room to native Zoom room system if the platform of user changes. 3) The collaboration hardware / codec provided should support Windows® 10 IoT Edition OS, 100/1000 Mbps Ethernet connectivity, minimum dual displays output and 10" Tabletop touch screen. 4) Tabletop Touch interface should be powered over ethernet for 24x7 use and which will be used for controlling the Microsoft Team calls and flexible room controls. 5) This hardware should enable integration with your choice of displays, cameras, speakers, microphones, mixers, switchers, and audio-conferencing interface (or speaker phone) 6) Engine should have 2 x output to be connected to 2 displays, 1 Input for sharing wired content during the call, USB 2.0 and 3.0 supported multiple ports for accessories connectivity like camera, DSP, speakerphone etc. 7) The touch screen offered with this package should be able to operate Microsoft Teams Room call Control features, also provide control of room lighting, shades, thermostats, and other equipment used in addition with the control system. It should also have USB-C port and USB-A port for BYOD / BYOM / USB Passthrough feature built in for users to use their own UC conference platform from laptop without rebooting the device. 8) Package should be provided with necessary required cables, converters, POE, additional accessories, and components to be included to meet the said functionality. 9) It should support IEEE 802.1X, SSL, TLS, SSH, SFTP (SSH File Transfer Protocol), password login, HTTPS secure provisioning, IEEE 802.3at compliant. 10) Should comply to CE, UL, FCC, ROHS. (Additional BIS to be shared if applicable) 11) Should be Microsoft Teams certified Hardware
20X Zoom PTZ Camera with wall mount Bracket	Supply, Installation, Testing and commissioning of 20x Optical Zoom PTZ Camera. Should be able to output video resolution up to 1080p60. Should have below technical parameters. 1) Image Sensor: 1/2.8 Sony® CMOS Sensor 2) Shutter Speed: 1/50-1/10,000 sec 3) Focal Length: F=5.2-94 mm

	4) Minimum Illumination: 2 lux 5) Field of View: Horizontal: 56° 6) Pan/Tilt Angle: Pan: -130° — 130°, Tilt: -30° — 90°" Should support White Balance: Auto, Indoor, Manual and Exposure: Auto, Manual, Brightness Priority, Iris Priority. Should provide video outputs on USB, HDMI, 3G-SDI, NDI, ONVIF, RTSP, UVC. Should be controllable via RS-485 Should support control protocols PELCO-D, PELCO-P, VISCA/TCP, VISCA/UDP Should support image flip which allows for inverted mounting. Should support 256 configurable presets. Should have LED indication for active camera feed and privacy mode enabled. Should have button for hardware reset. Should be certified for Microsoft Teams and Zoom Rooms conferencing software Compliance: CE, FCC. (Additional BIS to be shared if applicable). Should be shipped along with Wall Mount Bracket (adjustable swivel head) from the same OEM.
20X Zoom AI Tracking Camera with mounting bracket	Supply, Installation, Testing and commissioning of visual AI based 20x Optical Zoom PTZ Camera. Should be able to perform smooth multiple/group presenter tracking using inbuilt dual camera design, wide-angle reference camera and main PTZ camera. Should be able to set/define dedicated presentation area, should have option to set/define blocking zones in presentation area for ignoring movable subjects (like cameras or displays) which can create false trigger. Should have feature to additional preset zone (like whiteboard area), while presenter tracking, when presenter enters this area, camera will send fixed shot without movement for proper capture of whiteboard Should be able to output video resolution up to 1080p60. Should have below technical parameters. 1) Image Sensor: 1/2.8 Sony® CMOS Sensor 2) Shutter Speed: 1/50-1/10,000 sec 3) Focal Length: F=5.2-94 mm 4) Minimum Illumination: 2 lux 5) Field of View (Reference & PTZ Camera): Horizontal: 104° & 56° 6) Pan/Tilt Angle: Pan: -130° — 130°, Tilt: -30° — 90°" Should support White Balance: Auto, Indoor, Manual and Exposure: Auto, Manual, Brightness Priority, Iris Priority. Should provide video outputs on USB, HDMI, NDI, 3G-SDI, ONVIF, RTSP, UVC. Should be controllable via RS-485 Should support control protocols PELCO-D, PELCO-P, VISCA/TCP, VISCA/UDP Should support 256 configurable presets. Should have LED indication for active camera feed and privacy mode enabled. Should have button for hardware reset. Should be certified for Microsoft Teams and Zoom Rooms conferencing software Compliance: CE, FCC. (Additional BIS to be shared if applicable). Should be mounted between 15-50 ft for presenter tracking Should be shipped along with ceiling mount bracket from the same OEM.
Wireless Presenter Device	1) SITC of 4K wireless presentation and wireless collaboration device. 2) User should be able to share content wirelessly using app, Google Chrome web browser, Miracast screen mirroring technology for latest Windows, Mac, Android, and iOS mobile devices. 3) User should be able to access the soundbars, cameras, or speakerphones on

	PC/Laptop conferencing application wireless, via wireless presenter App, Dongle/Adapter supplied, for bring your own meeting experience. 4) Should have option to upload minimum 5x image files, which can function as customizable welcome screen, when no content is being shared. 5) Should have I/O / RJ45 port for integration with room occupancy sensor to control room display based on room occupancy or vacancy. 6) Should have network security protocols Active Directory® service authentication, 802.1X network access control, TLS, SSH, AES content encryption and HTTPS. 7) Should be supplied with 1x USB dongle/Adapter using which user can share content via latest iOS, Android, Windows, Mac devices, without the need to download any app, no need to run any plugin or software. 8) Should have 1x HDMI Input, 1x HDMI Output, 1x stereo line-level audio output, 2x LAN port (to connect to Corporate, Guest network) and 2x USB port for peripherals connection. 9) Should have ethernet port with TCP/IP, UDP/IP, DHCP, SSL, SFTP (SSH File Transfer Protocol). 10) Should be able to control third party devices via 1x bi-directional RS-232, 1x IR, without the need to run control cable from any AV control system. 11) Should be able to create its own Wi-Fi network, for guest users, for content sharing. 12) Content Protection: HDCP 2.2 13) Compliance: UL, CE, FCC, RoHS/WEEE. (Additional BIS to be shared if applicable).
HDMI to USB Converter	Supply, Installation, Testing, and commissioning of HDMI to USB Converter. Should have one HDMI input, 1x analog audio input and one HDMI output with 1x parallel USB 3.0 output Resolution support: 4K Should have 1080p @ 60 fps uncompressed at USB for superior output Should have USB Video Class (UVC) and USB Audio Class (UAC) standards, to work with video capture or streaming software available in markets Content Protection: HDCP 2.2 Should be TAA compliant / IC3S (Indian Common Criteria Certification) compliant / Common Criteria Compliance: UL, CE, FCC, RoHS/WEEE. (Additional BIS to be shared if applicable). USB powered
DALI Interface	SITC of certified DALI protocol interface to integrate with AV control processor. Should have minimum one loop and able to control up to 64 DALI devices. Should support DT0, DT1, DT2, DT3, DT4, DT5, DT6, DT7, and DT8 (Tc)2 DALI type devices. Should have provision to connect with external contact closure, to set each channel output to its override defined level. Should be CE, FCC Class B, IC, WEEE compliant
Cable Manager	Supply, Installation, Testing, and commissioning of cable cubby box to install into a table or horizontal surface for cable management. Should have retractable lid/top flap which opens and hides within the enclosure so that connectivity inside the chassis is visible from all the side of cable cubby. And when the lid is closed, it should have small pass-through which allows cables to be fully extended outside when used. Should have easy access to all the cables and power port, and all these must be clearly visible and on surface level, not in hollow blackholes, so that users do not have to get up from the chairs to find connectivity.

	Should be supplied with 1x Three pin Universal Power, 2x USB Type Charging Should be supplied with minimum 5 passthrough holes for AV cables. Should be TAA compliant / IC3S (Indian Common Criteria Certification) compliant / Common Criteria Compliance: UL, CE, FCC, RoHS/WEEE. (Additional BIS to be shared if applicable). All the required accessories to be included with the package Additional hardware can be used to meet the requirement
Transmitter	Supply, Installation, Testing and commissioning of Transmitter for HDMI, RS-232, and IR Signal Extension over CAT Cable Should have one HDMI Input and one HDBT Lite/RJ45 output. Video Resolution: 4096x2160 @60 4:4:4, HDR10+, Dolby Vision video support. Audio Format: Dolby Digital®, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS®, DTS 96/24, DTS HD High Res, DTS HD Master Audio, LPCM up to 8 channels Should be able to transport 4096x2160 @60 4:4:4 resolution upto 130 ft (40 m) on HDBT Lite/RJ45 port Content Protection: HDCP 2.3 Should be TAA compliant / IC3S (Indian Common Criteria Certification) compliant / Common Criteria Should have bidirectional RS-232 1xIR input port and 1x IR output port for pass-through. Compliance: UL, CE, FCC, RoHS/WEEE. (Additional BIS to be shared if applicable).
Receiver	Supply, Installation, Testing and commissioning of Receiver for HDMI, RS-232, and IR Signal Extension over CAT Cable Should have one HDMI output and one HDBT Lite/RJ45 input. Video Resolution: 4096x2160 @60 4:4:4, HDR10+, Dolby Vision video support. Audio Format: Dolby Digital®, Dolby Digital Plus, Dolby True HD, Dolby Atmos, DTS®, DTS 96/24, DTS HD High Res, DTS HD Master Audio, LPCM up to 8 channels Should be able to transport 4096x2160 @60 4:4:4 resolution upto 130 ft (40 m) on HDBT Lite/RJ45 port Content Protection: HDCP 2.3 Should be TAA compliant / IC3S (Indian Common Criteria Certification) compliant / Common Criteria Should have bidirectional RS-232 1xIR input port and 1x IR output port port for pass-through. Compliance: UL, CE, FCC, RoHS/WEEE. (Additional BIS to be shared if applicable).
Amplifier	Supply, Installation, Testing and commissioning of Class D Amplifier. Should be able to output 4-channel (75W /channel) or 3-channel (75W-75W-150W) or 2-channel (150W/channel) or 1 channel up to 300 W Should be able to configure on Lo-Z, Hi-Z operation. Should have Frequency Response 20 Hz to 20 kHz ± 0.5 dB at 1 W. Should have S/N Ratio >103 dBA, 20 Hz to 20 kHz. Should have THD+N <0.1% at 1 kHz. Should have protection against overheating, excessive input, overloaded speaker lines. Should be Energy Star certified Should automatically go on standby when no signal is detected. Should have 1x control/connection port to enable/disable standby mode. Compliance: UL, CE, FCC, RoHS/WEEE. (Additional BIS to be shared if applicable).

Ceiling Speaker	Supply, Installation, Testing, and commissioning of 2-Way In-Ceiling Speaker. Should have Woofer - 6 inch, and Tweeter 0.79 inch. Should have Frequency Range: 65 Hz to 20 kHz (-10 dB) Should have Frequency Response: 95 Hz to 15 kHz (± 3 dB) Should support Transformer Taps 7.5W/15W/30W at 70V, 100V Should have Sensitivity: 91 dB @ 1W/1m Should have 50 Watts program power handling. Should have 110° conical coverage. Should be UL 94V-0 flame rated. Compliance: UL 1480, UL 2043, CE, FCC. (Additional BIS to be shared if applicable).
USB Switcher	Supply, installation, testing and commissioning of 2-input USB 3.2 Matrix Switcher which supports 10 Gbps USB 3.2 data. Should be able to route USB data from the six device USB ports to two host devices. Should be able to route USB based on Automatic connection, Front button on device and priority based. Configurable via Web browser and controllable via external control system. Should support security via 802.1x network access control, Active Directory® authentication, SSL, SSH to protect privacy and ensures compliance with organization's IT policies. Ports 2x USB-C 3.2 Gen 2 data connectors for host. Ports 2x USB-C 3.2 Gen 2 data connectors which provides up to 15 W of power over USB for devices. Ports 2x USB-A 3.2 data connectors which also provides up to 4.5 W of power over USB for devices. Ports 2x USB-A 2.0 connectors for keyboard and mouse and which also provides up to 2.5 W of power over USB. Should have 1x 1000 Base-T LAN port.
Camera Merger.	Supply, Installation, Testing, and commissioning of Multiwindow processor. Should have Input : 6x HDMI Input with parallel 6x USBC Input and 1x HDMI Multiview Output. Should be able to configure to view any of the 6 Input simultaneously all at once, one by one and defined preset layouts, on a single screen. Should be able to control via AV control system. Video Resolution: 4096x2160 @60 4:4:4, HDR10+, Dolby Vision video support. Audio Format: Dolby Digital®, Dolby Digital Plus, Dolby True HD, Dolby Atmos, DTS®, DTS 96/24, DTS HD High Res, DTS HD Master Audio, LPCM up to 8 channels Content Protection: HDCP 2.3, AES-128. Should have 7x Stereo line-level audio input / output (configured) Should have network security protocols Active Directory® service authentication, 802.1X network access control, TLS, SSH and HTTPS to ensure IT policies compliance. And need to be configured and shown during installation. Should be JITC/FIPS/NIAP certified. Should be TAA compliant / IC3S (Indian Common Criteria Certification) compliant / Common Criteria Should have ethernet port with TCP/IP, UDP/IP, DHCP, SSL, SFTP (SSH File Transfer Protocol). Compliance: UL, CE, FCC. (Additional BIS to be shared if applicable). Additional hardware can be used to meet the requirement
Partition Sensor	Supply, Installation, Testing and commissioning of partition sensor to be mounted on surface.

	Should be able to sense up to four feet of distance. Should be able to communicate with the AV control system. Should be CE, FCC compliant.
Wireless Touch Panel	Supply, Installation, Testing and commissioning of 10 inch. Wireless Touch Screen Contrast: 800:1 Resolution: 1920 x 1200 pixels Color Depth: 24 bit, 16.7M colors Brightness: 350 nits (cd/m²) Viewing Angle: Minimum $\pm 80^\circ$ horizontal, $\pm 80^\circ$ vertical Aspect Ratio: 16:10/16:9, Should have network security protocols Active Directory[®] service authentication, 802.1X network access control, TLS, SSH and HTTPS to ensure IT policies compliance. And need to be configured and shown during installation. Should have 64 and 128-bit WPA Enterprise, and WPA2 Enterprise security. Should have minimum 4 GB RAM and minimum 30 GB Storage memory Should be TAA compliant / IC3S (Indian Common Criteria Certification) compliant / Common Criteria Should have 50 ft / 15 m of coverage /range & Wi-Fi[®] 5 network support at 2.4 and 5 Ghz bands. Compliance: UL, CE, FCC, RoHS/WEEE. (Additional BIS to be shared if applicable). Control processor & Touch Control interface should be from same OEM, and must not require any internet connectivity for configuration, programming and running. Should have batter support up to nine hours of continuous operation Should be supplied with power supply from same OEM of touch panel and table top docking station
3 Feet HDMI Cable	SITC of gold-plated HDMI cable of minimum 3 Feet Should support 4096x2160p@60 Hz 4:4:4 video & 22 Gbps bandwidth. HDCP 2.3 compliant Should be CE, FCC compliant
6 Feet HDMI Cable	SITC of gold-plated HDMI cable of minimum 6 Feet Should support 4096x2160p@60 Hz 4:4:4 video & 22 Gbps bandwidth. HDCP 2.3 compliant Should be CE, FCC compliant.
Relay for projector lift control	Supply Installation Testing and commissioning of 8-Channel relay. Should support Maximum Per Channel 10A incandescent @ 120 to 240VAC, 5A fluorescent @ 120 to 240VAC, 0.5 HP @ 120 to 240VAC, 5A at 30VDC, 16A Resistive. Should support Module Total 80A incandescent @ 120 to 240VAC, 40A fluorescent @ 120 to 240VAC. Should have 8x Isolated Class 1 SPST relay switch circuits with 0A incandescent, 5A fluorescent, 16A resistive, 0.5 HP @ 240VAC (per channel) Rating. Should have 8x port isolated inputs (Rated 12-24VDC), for momentary pushbuttons, each input will cause the associated relay to toggle on/off. Should support standard DIN rail for installation, and have unique ID for each devices to be addressable and able to communicate with control system via RJ45/RS-495/similar communication. Should be CE, FCC Compliant. Should be from same OEM as Main control system.
Room Scheduler	Supply, Installation, Testing, and commissioning of 10 Inch Room scheduler. Should support direct integration with popular room booking software's like

	Microsoft Teams Rooms, Zoom Room, Microsoft Exchange Server and Office 365 software, Google Calendar and G Suite software, CollegeNET 25Live software, and Ad Astra software. Should be able to integrate with on-premise room scheduling software from same OEM. Should be supplied with light indicator and glass mounting accessories from same OEM. Contrast: 1000:1 Resolution: 1920 x 1200 pixels Color Depth: 24 bit, 16.7M colors Brightness: 400 nits (cd/m²) Viewing Angle: Minimum $\pm 80^\circ$ horizontal, $\pm 80^\circ$ vertical Aspect Ratio: 16:10/16:9, Should have network security protocols Active Directory® service authentication, 802.1X network access control, TLS, SSH and HTTPS to ensure IT policies compliance. And need to be configured and shown during installation. Should be TAA compliant / IC3S (Indian Common Criteria Certification) compliant / Common Criteria Should have ethernet port with TCP/IP, UDP/IP, DHCP, SSL, SFTP (SSH File Transfer Protocol), IPv4, IPv6. Should be able to communicate to customer network via physical LAN connection, Wi-Fi. Compliance: UL, CE, FCC, RoHS/WEEE. (Additional BIS to be shared if applicable). Should have option to integrate with occupancy sensor via relay/RJ 45 connection. Should have proximity sensor built-in for automatic screen wakeup when users approaches and screen brightness control.
Keypad with customize engraving	Supplying, installation, testing and commissioning of wired keypad. Should be single-gang. Should have five configurable button positions arranged in one column. Each position accommodates a single pushbutton or two buttons, as per to customer requirement. The unit should be addressable so that multiple units of same kind can be controlled via single communication port to the control system. Should be shipped with Custom backlit laser-etched engraving for all the buttons. Each button should be programmable for any system function. Should comply to UL, FCC, (Additional BIS to be shared if applicable).
USBC 6 Feet Cable	SITC of 6 feet USB-C Male to USB-C Male cable. Should support USB 3.2 Gen 1 (5 Gbps), DisplayPort™ Alt Mode, 60 W. Should support 4K60 video Should be CE/RoHS compliant
AV CAT Cable 1000 ft spool	SITC of 1000feet spool for CAT7 shielded twisted pair (S/FTP) cable for AV distribution. Should be able to transport 4K60 4:4:4 video signals at distances of 330 ft (100 m) Should meet industry standard of less than one pixel error per billion. Delay Skew: ≤ 25 ns / 95 m Conductors: 22 AWG solid bare copper, Insulation: Foam PE: Shield (per pair): AL foil Characteristic Impedance: 100 Ohms nominal Should be UL, IEC, certified

AV RJ45 Connector	SITC of connectors for CAT7 STP cable for AV distribution. Should be compatible with CAT7 cable Should have minimum 15 connectors in single box Should support Wiring Standards like T568A & T568B Should be UL, RoHS, IEC complaint
Crimping Tool for AV CAT cable and connector	SITC of Termination tool for the AV CAT7 AV connector. Should be supplied from same OEM as AV CAT cable and connector.
Occupancy Sensor	SITC of Ceiling-mounted occupancy sensor for integration with Room Scheduler for automatically spot ad-hoc room booking, and release the inactive Rooms. Should also be connected to AV Control system for automation. Ceiling-mounted occupancy sensor should support Passive infrared (PIR) motion detection & Ultrasonic for precise sensing. Sensor having Coverage Pattern of 360 degrees supporting 2,000 sq ft coverage area Should be able to power via PoE+ only for remote powering.

Details of Audio, Video / Conference system Services

S.No	S.No. as per Legend	Location	Sub-Location	Audio, Video / Conference system	Floor	Size (Mtr x Mtr)	Area (Sq. Mtr)
1	2	3	4	5	6	7	8
		SITE-A					
		Non Residential					
2	8	Admin cum Laboratories Buildings	Committee Room 1	✓	Ground Floor	16.23 x 7.00	113.61
			Committee Room 2	✓	Ground Floor	7.00 x 7.00	49.00
			Seminar Room	✓	First Floor	7.00 x 14.00	98.00
			Seminar Room	✓	Second Floor	7.00 x 14.00	98.00
			Seminar Room	✓	Third Floor	7.00 x 14.00	98.00
			Seminar Room	✓	Fourth Floor	7.00 x 14.00	98.00
			Seminar Room	✓	Fifth Floor	7.00 x 14.00	98.00
			Seminar Room	✓	Sixth Floor	7.00 x 14.00	98.00
4	19	Farmers Training Hostel	Audio Visual farmers & Scientist Interface facility	✓	Ground Floor	7.28 x 6.87	50.01
			Audio Visual farmers & Scientist Interface facility	✓	First Floor	7.28 x 6.87	50.01
							850.64
							851.00

C-14 STP (Sewerage Treatment Plant) & ETP (Effluent Treatment (Plant))

SEWAGE TREATMENT PLANT(STP)

SCOPE OF WORK

The scope of work includes the design, supply, installation, testing, and commissioning of a **minimum 100KLD Capacity Sewage Treatment Plant (STP) for all buildings in 33% development area of Site A** to assess the waste water generation and develop a comprehensive design for the STP system including process flow diagrams, treatment technologies, and equipment layouts and comply with local and national environmental regulations and submit the design documents for approval to engineer-in-charge after that supply, construction, fabrication, installation, testing, and commissioning of STP system, collection tanks, aeration systems, filters, pumps, blowers, disinfection units, sludge handling equipment, and chemical dosing pumps, sensors, flow meters, pH meters, turbidity meters, piping, insulation, and sealing to prevent leaks and cross-contamination, valves, tanks, electrical panels, earthing, grounding, and protection for all equipment, and Construct the necessary civil infrastructure, including tanks, foundations, platforms, and enclosures for housing the treatment units and all other necessary associated components to ensure a fully operational system that meets all relevant safety standards and regulations, CPCB norms etc., including all documentation, certifications. Provide a warranty for the installed STP System equipment's covering a period of 3(Three) years against any defects in materials or workmanship.

Design, Construction, Supply, Installation & Commissioning of 100 KLD **MBBR (Moving Bed Biofilm Reactor) technology** based STP for the building. The dimensions of STP shall be designed by the contractor. Minimum requirement of STP capacity is as follows:

Sr. No.	Location	Minimum Capacity of MBBR Plant
1	As per direction of Engineer-in Charge and aesthetics	100 KLD

NOTE:

- The above capacity of the system is indicative(minimum). Bidders are requested to evaluate the capacities of actual system considering the sewage requirements of the building. If the calculated capacity of STP is higher than the mentioned capacity in the above table, then the higher capacity, as evaluated by contractor, shall be installed and No additional capacity shall be paid. Bidders are requested to quote accordingly

- If the calculated capacity of STP is less than the minimum capacity mentioned in the above table, the contractor shall provide the STP as per the above table as per the direction of E-in-C. No extra cost for the same shall be paid. Bidders are requested to quote accordingly.

(i) Every E&M equipment like Raw Sewage pumps, Sludge Return / Re-lift pump, Sludge loading / Disposal pump, Internal sludge return pump, Filter Feed pumps, Dosing pumps, Sump Pumps, Treated Water Supply pumps, MBBR tank, Air blowers, filter press, water level indicators etc. shall have redundancy (1 working + 1 standby) to avoid single point failure.

(ii) The contractor shall obtain CFE (Consent for Establishment) and CFO (Consent for Operation) from the concerned local body (GPCB). Nothing extra shall be paid for this.

(iii) Any other items of work which have not been specifically mentioned in the specifications but are necessary for construction of the plant as per good engineering practice and safety norms and

operation and guaranteed performance of the entire plant shall be deemed to be included within the scope of work of these specifications and shall be provided by the contractor without any extra cost to the employer.

(iv) **Treated water pumping:** The treated water is required for purpose. The treated water shall be pumped from Treated water tank (TWT) to required locations as per direction of Engineer in charge as per requirements with bypass arrangement to municipal nalla in case of emergency. **Hence the required design of the pumps suitable for above mentioned purpose shall be provided by the contractor in 1 Working + 1 standby configuration.**

(v) Filter Feed Press is to be used instead of dry bed.

(vi) ACF (Activated Charcoal Filter) and DMF are to be used with backwash facility.

(vii) Ozonator, UV System, Sludge Handling Mechanism (centrifuge), Sludge Trolley, Bar Screen, Tube Settler Media etc. are also to be provided.

(viii) **All E&M Equipment, associated cabling, electrical panels, switchgears, provision for IBMS monitoring, sensors, level indicators, pressure gauges etc from raw sewage collection tank/ pumps to treated water tank/ pumps are in the scope of work.**

(ix) **All civil works from raw sewage collection tank to treated water tank shall be in the scope of work.**

(x) **SCHEDULE OF STP as follows:**

	Description	Requirement	Remark
	Scope and purpose for the proposed STP plant with details of sewerage to be treated including requisite incomer and outlet pipe connection.	Capacity: Not less than 100 KLD 1 incomer 1 outlet	
	Details of outlet generating STP for the purpose of calculation of capacity of STP	As per the intended building usage	
	Details of proposed technology if decided already.	MBBR	
	Requirement of standby of different equipment related to STP plant	Every E&M equipment like all pumps, blowers, filter press, water level indicators etc. shall have redundancy (1 working + 1 standby) to avoid single point failure.	The final decision shall be done by Engineer-in charge
	Details of raw sewage and details of required output parameters for treated raw sewage	Required as per detailed description below	
	Scope of firm for getting approval and NOC from local body / pollution control board as applicable	Required as per below details	

1.0 STP Requirements

1.1 The design should ensure treatment of total sewage as per the most stringent standards prescribed by GPCB (Gujarat State Pollution Control Board) & CPCB.

Inlet Parameters: Following inlet parameters are to be considered for design

BOD	300-350 mg / ltr
COD	400-450 mg / ltr
TSS	250-400 mg / ltr
pH	6.5-8.5
Oil & Grease	≤ 50-140 mg / ltr
Faecal Coliform (MPN/100ml)	10 ⁷ - 10 ⁸ MPN
Total kjeldani nitrogen	45 mg/ltr.

Treated Waste Water Quality: Treatment scheme shall be designed to achieve the following parameters fit for arboriculture / Flushing etc.

BOD	≤10 mg/ ltr.
COD	< 30 mg/ ltr.
TSS	< 10 mg/ ltr.
Ammoniacal Nitrogen	< 5 mg/ ltr.
Total Nitrogen	≤10 mg/ltr.
pH	6.5 - 7.5
Oil & Grease	< 10 mg/ ltr.
Faecal Coliform (MPN/100ml)	≤1000MPN (After disinfection)
Colour	< 5 Hazen
Odour	Unobjectionable

1.2 The equipment and civil structure shall be designed for completely automatic operation including monitoring of various parameters of the complete STP processes including the treated water quality.

1.3 The pump sets, pipelines and Panel i/c panel component shall have a minimum warranty of 1 years from the date of commissioning.

1.4 Air Blowers, Electrical Panels, Control panels shall be placed in enclosed room with proper ventilation and cooling.

2.0 Design Criteria

The design should ensure treatment of sewage as per the most stringent standards prescribed by GPCB (Gujarat State Pollution Control Board) & CPCB and below mentioned norms. Unit operation details for MBBR technology is as follows:

NOTE:

In case of any ambiguity the conditions and requirements as mandated by local body norms updated up to last date of submission of tender shall be binding to contractor and as per the decision of Engineer In Charge, BUT Treated water BOD shall be less than or equal to 10 mg per litre.

3.0 Defect Liability

3.1 The contractor shall ensure that the defects related to construction be attended within 10 working days from the date of intimation of such defects.

3.2 Failure to rectify defects within the time frame will lead to a permanent recovery of Rs 2500/- from the security deposits or running bill payments.

3.3 The operation and maintenance if any shall start after the successful completion free trial run of 6 months followed by completion of work.

EFFLUENT TREATMENT PLANT (ETP)

SCOPE OF WORK

The scope of work includes the design, supply, installation, testing, and commissioning of a **25 KLD Capacity Effluent Treatment Plant (ETP) for all buildings in 33% development area of Site A** to assess the wastewater generation and develop a comprehensive design for the ETP system including process flow diagrams, treatment technologies, and equipment layouts and comply with local and national environmental regulations and submit the design documents for approval to engineer-in-charge after that supply, construction, fabrication, installation, testing, and commissioning of ETP system, collection tanks, aeration systems, filters, pumps, blowers, disinfection units, sludge handling equipment, and chemical dosing pumps, sensors, flow meters, pH meters, turbidity meters, piping, insulation, and sealing to prevent leaks and cross-contamination, valves, tanks, electrical panels, earthing, grounding, and protection for all equipment, and Construct the necessary civil infrastructure, including tanks, foundations, platforms, and enclosures for housing the treatment units and all other necessary associated components to ensure a fully operational system that meets all relevant safety standards and regulations, CPCB norms etc., including all documentation, certifications. Provision for integration with building management systems. Provide a warranty for the installed ETP System equipment's covering a period of 1(One) year against any defects in materials or workmanship.

Design, Construction, Supply, Installation & Commissioning of **25 KLD** ETP for the building. The dimensions of ETP shall be designed by the contractor.

Minimum requirement of ETP capacity is as follows:

Sl. No.	Location	Minimum Capacity of Plant
1	As per direction of Engineer-in-Charge and aesthetics	25 KLD

NOTE:

- The effluent of laboratories, OTs, CSSD, TSSD and wash areas shall be considered in ETP design All Effluents shall finally be treated in this ETP. Contractor shall examine the type of effluents and decide the capacity, type and design of ETP best suited for such effluents.
- Contractor is requested to evaluate the capacities of actual system considering the EFFLUENT parameters for above stated.
- The above capacity of the system is indicative(minimum). Bidders are requested to evaluate the capacities of actual system considering the type and volume of effluent. If the calculated capacity of ETP is higher than the mentioned capacity in the above table, then the higher capacity, as evaluated by contractor, shall be installed and additional capacity shall be paid extra on pro-rata basis. Bidders are requested to quote accordingly.
- If the calculated capacity of ETP is less than the minimum capacity mentioned in the above table, the contractor shall provide the ETP as per the above table as per the direction of E-in-C. No extra cost for the same shall be paid. Bidders are requested to quote accordingly.
- The design of ETP shall ensure the odourless operation.

- All E&M Equipment, associated cabling, electrical panels, switchgears, IBMS monitoring, sensors, level indicators, pressure gauges etc from raw effluent collection tank / pumps to treated waste tank / pumps are in the scope of work.
- All civil works from raw effluent collection tank to treated waste tank shall be in the scope of work.
- The ETP shall be at negative pressure compared to its surrounding to prevent spread of contaminations.
- All Effluents piping from source to ETP shall be made up of acid-resistant materials like CPVC / SS / ABS / PVDF.

The contractor shall submit the preliminary scheme and design of all equipment and components of ETP to the Engineer in charge. After the acceptance of preliminary scheme, the contractor shall prepare the final scheme, detailed specifications, design calculations and detailed drawings for the E&M work. **These Design calculations shall be proof checked by Institute as per NIT and approval of Engineer-in-Charge. Nothing extra shall be paid for this.**

Every E&M equipment shall have redundancy (1 or 2 working + 1 standby) to avoid single point failure.

The contractor shall obtain CFE (Consent for Establishment) and CFO (Consent for Operation) from the concerned local body. Nothing extra shall be paid for this.

Any other items of work which have not been specifically mentioned in the specifications but are necessary for construction of the plant as per good engineering practice and safety norms and operation and guaranteed performance of the entire plant shall be deemed to be included within the scope of work of these specifications and shall be provided by the contractor without any extra cost to the employer.

ETP shall be of compact steel package type with raw effluent tank and treated tank to be of RCC of minimum M30 grade.

SCHEDULE OF ETP as follows:

Sl. No.	Description	Requirement	Remarks
1	Scope and purpose for the proposed ETP plant with details of Effluent to be treated including requisite incomer and outlet pipe connection.	Capacity: Not less than 25 KLD 1 incomer 1 outlet	
2	Details of outlet generating ETP for the purpose of calculation of capacity of ETP.	As per the intended building usage	
3	Details of proposed technology if decided already.	-	
4	Requirement of standby of different equipment related to ETP plant	Every E&M equipment shall have redundancy (1 or 2 working + 1 standby) to avoid single point failure.	
5	Details of raw Effluent and details of required output parameters for treated raw sewage	Required as per detailed description below	

6	Scope of firm for getting approval and NOC from local body / pollution control board as applicable	Required as per below details	

1.0 ETP Requirements and Design Criteria

1.1 The design should ensure standards prescribed by Local Statuary bodies / CPCB.

1.2 In ETP, Flocculator, Flash Mixer & Chemical dosing system shall be provided for preliminary treatment of Lab effluent. ETP shall comprise of bar screen chambers, flash mixer, level sensors, instruments, interconnecting piping etc.

1.3 PVC piping (10kg / sqcm) - For all submerged wastewater piping.

1.4 MS (C-Class) - For all exposed air piping and flexible stainless-steel pipe for submerged air piping.

1.5 GI (C class) for all other water piping

1.6 Accessories like valves, tube settler/lamella settler, media in tube settler, chlorine dosing, pressure gauges, instruments, level sensors, non-clogging mono-block pumps of suitable capacity & head, lime / alum / polyelectrolyte dosing system consisting of ABS dosing pump with suitable capacity HDPE tank including all piping from the dozer to the reaction tank etc. control panel, high speed Agitator of SS 304 and Flocculator complete with single phase motor for flash mixer, electrical wiring, panel, earthing etc. complete including all necessary safety requirements. One standby pump needs to be considered for each type.

1.7 All RCC / HDPE tanks shall be constructed as per requirements.

1.8 Desired Effluent Quality After Treatment:

Sl. No	Parameter	Unit	Treated water
1	pH	-	6.5 - 8.5
2	Suspended solids	Mg/l	< 100
3	BOD	Mg/l	< 150
4	COD	Mg/l	< 300
5	Oil & Grease	Mg/l	< 5

1.9 Sump Pumps to be provided for plant room drainage.

1.10 Tentative Equipment (Not Exhaustive):

Sl. No.	Pump		Pump Position	Application
1	Raw Pump	Sewage	Between Equalization Tank and Flash Mixture	To pump effluent water from Equalization Tank to Flash Mixture
2	Alkali Pumps	Dosing	To supply Alkali dosing mixture to Flash Mixture	For Alkali dosing treatment of Effluent Waste
3	Poly Pumps	Dosing	To supply Poly dosing mixture to Flash Mixture	For Poly dosing treatment of Effluent Waste
4	Lime Pumps	Dosing	To supply Lime dosing mixture to Flash Mixture	For Lime dosing treatment of Effluent Waste

5	Alum Pumps	Dosing	To supply Alum dosing mixture to Flash Mixture	For Alum dosing treatment of Effluent Waste
6	Sludge Pump	Transfer	Primary Settling Tank to ETP Sludge Holding Tank	To Pump out Filter Backwash Water
7	Transfer Pump	Between Filter Feed Tank and nearest Municipal drain	To convey water from Filter Feed Tank to nearest municipal drain point	
Sump Pumps to be provided for plant room drainage				

1.11 The equipment and civil structure shall be designed for completely automatic operation including online monitoring of various parameters of the complete ETP processes including the treated effluent.

1.12 The pump sets, pipelines and Panel i/c panel component shall have a minimum warranty of 1 years from the date of commissioning.

1.13 Treated effluent shall be handled and discharged as per local statutory bodies / CPCB.

C-15 Solar Photo Voltic Power Generation system

ROOF TOP SOLAR PV POWER SYSTEM

General Scope of work

The scope of work includes planning, designing & preparation of Drawings, obtaining approvals from the Department, supplying, assembling, installation, testing, commissioning and putting into operation and maintenance upto end of Defect liability period of **Photo Voltaic Systems on roof top for generation of 130 KWp or more**, consisting of PCU (power conditioning unit), including LOTO Meter Box (For Solar Generation Meter) required necessary Panel, cables, CPVC pipe/ms pipe, GI Wire, Copper Cable etc. as required to complete in all respect till the installation and activation of Net Metering to the Service provider. The area available at the terrace of **Admin cum Laboratories building** & feasible locations along boundary wall is to be utilized optimally for the provision of Solar panels.

Roof top solar power generation

The roof top solar plant generation units shall be installed by using supporting GI structure (mass of zinc coating shall be as per IS 4759:1996) having minimum head room clearance of 1.8 meter above the terrace level / ground level to have maximum installation. The GI supporting structure over the existing RCC Columns (8/10 inch, circular column) shall be designed to withstand a wind flow of 160 KMPH or more. The scope also includes getting approval from CEA/local electricity authority and release of bidirectional meter from the local electricity Distribution Company. If any item required to make the system functional, is not specifically mentioned in the scope of services, the same is deemed to be included within the scope of this tender and nothing extra shall be paid on this account.

The work shall be executed as per CPWD General Specifications for Electrical Works as amended up to date, relevant I.E. Rules, BIS/IEC, as per local electricity supplier and as per directions of Engineer-in-charge. These additional specifications/ conditions are to be read in conjunction with above and in case of variations; specifications given in the in the contract shall apply. However, nothing extra shall be paid on account of these additional specifications and conditions

Specific Scope of work:

Description	Capacity in KWp
Supply, Installation, Testing and Commissioning of on-grid Solar Photovoltaic Power Plant conforming to various applicable standards BIS, IEC, MNRE guidelines, the Central Electricity Authority Regulations and CPWD Specifications as amended up to date, consisting of Mono/Poly Crystalline silicon solar cells module, net metering facility, necessary control, protections, earthing, cabling, mounting structure, junction boxes, power conditioning units, Real time online web interfaced Data Monitoring System, Distribution panels, grid connecting arrangement, conduits, pipes, cable trays and other accessories etc. as required.	Minimum 130 KWp

- a) High Energy Efficiency Solar Photovoltaic Module of capacity 550 Wp or above, manufactured in India, conforming to IS 14286/IEC 61215, IS/IEC 61730-Part-1, IS/IEC 61730-Part-2. Solar Photovoltaic Module conversion efficiency shall not be less than 23% at STC with temperature coefficient of Pmax better than -0.30% per degree Celsius. PV modules used in solar power plants/ systems must be warranted for their output peak watt capacity, which should not be less than 90% at the end of 10 years and 80% at the end of 25 years. Solar Modules shall be designed to operate in relative humidity upto 100% with temperature between -10 Deg C and +85 Deg C. Further, each PV module used in any solar power project must have Radio frequency identification tag with information such as name of manufacturer, month and year of manufacturing, country of origin (separately for Solar cell and module), I-V curve, Unique Serial No and Model No of the module, Wattage, Im, Vm and FF, name of test lab issuing IEC certificate.
- b) Power Conditioning Unit (PCU) of 350-800 V DC Input voltage range and 415 V AC, three phase, 4 wire, 50Hz +/- 2.5 Hz, output voltage suitable to generate AC with a variation of 10% at nominal voltage. Power with efficiency not less than 97%, total harmonic distortion less than 3% and suitable for ambient temperature from 0 to 50 degree C, Minimum IP-65 for outdoor and Minimum IP 21 for indoor, Built-in meter and data logger, MPPT, switching devices IGBT/MOSFETs and controller Microprocessor /DSP. PCU/inverter shall be capable of complete automatic operation including wake-up, synchronization & shutdown. The PCU shall be able to withstand unbalanced load conforming to IEC standard with shutdown/standby mode. It must be provided with grid islanding along with manual disconnect pole isolation switch besides automatic disconnection. Minimum protections: Mains Under / Over Voltage, Over current, Over/Under grid frequency, Over temperature, Surge voltage induced at output due to external source, Shortcircuit, Lightning, Anti Islanding (for grid synch. Mode) and other protections as per applicable standards. LCD/LED display of minimum parameters: DC input voltage, DC current, AC Voltage and current (all 3 phases, in case of 3 phase), Instantaneous & cumulative AC output power, Daily DC energy produced and other parameters applicable standard. Communication interface RS 485 / RS 232.
- c) Module mounting structure: The roof top solar plant generation units shall be installed by using supporting Aluminium/Galvanized MS structure (mass of zinc coating shall be as per IS4759) having minimum head room clearance of 2.4 meter above the terrace level / ground level. The mounting structure would be designed to sustain wind load and seismic parameter of the site of installation. All the structure shall be design as per applicable BIS code and the material shall also confirm the applicable BIS Code. Structural material shall be corrosion resistant and electrolytically compatible with the materials used in the module frame, its fasteners, nuts and bolts. The suitable arrangements for maintenance and cleaning shall be provided.
- d) Real time online web interfaced Data Monitoring System

complete with accessories for various parameters such as Solar Irradiance, temperature, AC Output Voltage and current, Output Power, Power factor, DC Input Voltage and Current, Time Active, Time disabled, Time Idle, Power produced and other parameters as per standard practices.

e) Array junction box & Main junction box with IP 65 protection and termination arrangement for incoming and outgoing cable along with glands, lugs and other accessories etc. as required. Each junction box shall be made of GRP/FRP/Powder Coated Aluminum /cast aluminum alloy with full dust, water & vermin proof arrangement with High quality Suitable capacity Metal Oxide Varistors(MOVs) (semiconductor diode with resistant applied voltage)/ surge arrestors and suitable Reverse Blocking Diodes, isolation switches isolate the DC input to Inverter, copper bus bar etc.

f) Lightning ,surge voltage protection, earthing protection and grid islanding.

g) Cables: Connections & Interconnections by required size IR/UV protected XLPE insulated copper conductor 1.1 kV grade armored power and control cables(ISI Marked) along with supplying & fixing of necessary channel/conduit, GI cable trays , supports, lugs, thimble and other accessories etc. as required.

h) DC Distribution Board And AC Distribution Panel Board: IP65, free standing, metal clad, having copper bus bar, having required protection and control gears, connection interconnection, etc. as required.

1. AC collection Panel with metering to monitor generation at the terrace of each tower/block and AC cabling from Panel to receiving switch.
2. Required no. of Tap off boxes each with 4 pole 63 A MCCB for receiving solar power in bus Trunking or whatever required by supply company.
3. Measuring devices i/c net metering, indication devices, protection devices, switching devices, all necessary wiring, DC and AC cabling including feeding power to essential supply Bus Trunking by providing necessary tap off boxes
4. Mounting structure on terrace of the building, protection of system for external/ internal causes and from all kind of surges etc.
5. Earthing and Lightning protection of Solar system
6. Necessary Liasoning with Electric supply company for net meter arrangements.
7. Approval of scheme, drawings, layout before start of work from electrical supply company and engineer in charge.

Design basis for approval of roof top grid interactive solar photo voltaic plant by engineer in charge.

1. Arrangement of mounting structure and array of solar panel shall be submitted along with structural analysis and design (STAD) vetted by structural engineer .
2. The capacity of plant shall be derived as per available space on each terrace of the buildings.
3. The Invertors/PCU shall be installed preferably inside the building (staircase

mumty at top floor)

4. The ACDB panel shall be installed by creating enclosed covered space at terrace/top floor .

5. Array shall be designed considering the following:

- a. approximately 1 meter wide area from parapet shall be left around
- b. sufficient pathway shall be provided within array for the purpose of maintenance
- c. At least 1 water tap shall be provided near solar panel at terrace for cleaning of solar panel.
- d. shall have an optimum angle for mounting of solar PV modules to achieve near maximum all day power output,
- e. The drawings along with detailed design and equipment datasheet shall be submitted to engineer in charge for approval before starting the work. The work will be carried out as per designs approved by the Engineer-in-charge.
- f. The agency shall get designed suitable GRID at terrace, for wind speed of 180 Km/hour and provide the same. Such structure/grid shall be certified by structural consultant.

Guarantee Regarding Generated Output:

Agency shall give an undertaking that after the warrantee period of 5years,Generated output shall not deteriorate by more than 1 % per year during its additional useful life of 20 years.

Ambient Condition & Solar Isolation

Agency will seek from relevant database / source, all the data pertaining to the ambient conditions like temperature, humidity, wind load, rain, weather condition and historical solar radiation etc., pertaining to the site location and optimize the design accordingly. All design calculations and installation details shall be submitted to Engineer In Charge before starts of work.

Module mounting structure

- a. The array structure shall be made of hot dip galvanized MS angles of size not less than 50mm x 50mm x 6mm size. The minimum thickness of galvanized shall be at least 70 microns. All nuts & bolts shall be made of good quality steel.
- b. The work should be completed with supply, fitting fixing of clamps, saddles, nut & bolts etc. While quoting the rate, the bidder may mention the design & type of structure offered. All nuts & bolts shall be made of very good quality steel.
- c. The structure shall be designed to allow easy replacement of any module and shall be in line with site requirements.
- d. The structure shall be designed for simple mechanical and electrical

installation. It shall support SPV modules at a given orientation, absorb and transfer the mechanical loads to the ground properly. There shall be no requirement of welding or complex machinery at site.

e. The array structure shall be so designed that it will occupy minimum space without sacrificing the output from SPV panels & shall withstand heavy winds.

f. The supplier / manufacturer shall specify installation details of the PV modules and the support structures with appropriate diagrams and drawings.

Earthing and Protection

The array structure of the PV yard shall be grounded properly using adequate number of earthing kits. All metal casing / shielding of the plant shall be thoroughly grounded to ensure safety of the power plant. Earthing shall be in line with IE,IS,cpwd specifications. The earthing & grounding shall also meet the requirement of PV module/cell manufacturer

Cable and accessories

All the cables shall be supplied conforming to IS 694 & shall be of 650 V/ 1.1 kV grade as per requirement. The size of the cables between array interconnections, array to junction boxes, junction boxes to DCDB, DCDB to PCU etc. shall be so selected to keep the voltage drop and losses to the minimum. Type of DC cable shall be outdoor duty ,UV protected and suitable for application. The contractor is required to mention each size of cables used and should consider their resistance / impedance in the design optimization. Such calculation should be submitted. The contractor shall supply all installation accessories, which are required to install and successfully commission the power plant.

Solar Power Plant Data Monitoring System

a. Computer Aided Data Acquisition Unit shall have features for simultaneous monitoring and recording of various parameters of different sub-systems, power supply of the power plant at the AC side.

b. Computer Aided data Acquisition Unit shall be a separate & individual system comprising of different transducers to read the different variable parameters, Interfacing Hardware & Software, Industrial type PC, which will be robust & rugged suitable to operate in the Control Room Environment.

c. The PC shall of Industrial type, rugged & robust in nature of operate in an hostile environment. the PV have minimum intel Core 2 Duo processor having 2 x 150 GB HDD with 2 GB RAM. The PC shall also have minimum 25 inches Colour monitor, DVD Drive with writer, multimedia kit and UPS backup. The printer shall be of industrial type rugged & robust in nature. The printer shall be equipped for printing.

The data acquisition system shall perform but not limited to the following

operations and Measurement and continuous recording of

- a) Inverter Output.
- b) System Frequency.
- c) Energy Delivered to the GRID in KWH.
- d) Generated Output In KWH
- e. The data file should be MS excel compatible. All data shall be stored in a common work sheet chronologically. Representation of monitored data in graphics mode or in tabulation form. All instantaneous data can be shown in the Computer Screen.
- a) The Bill of Materials associated with the equipment must clearly indicate especially the details about the PC, Modems. Etc.
- b) Communication interface the entire system can be operated and monitored via several interfaces (RS232/RS485/ MPI/ Profibus/ Telephone modem/Ethernet) to have compatibility.

Space For Solar Array And Control Room

The agency shall give the details of array layout and control room layout to engineer in charge before execution for approval.

Type Tests

Type test reports of all major equipment's (Solar module, battery & PCU) shall be submitted to the department. The type test report shall be within 5 years from bid opening date, in absence of which fresh type test shall be done without any cost to department.

Installation And Commissioning

Detailed project execution program shall be submitted along with the offer to engineer in charge for its approval. The contractor will be responsible for arranging all tools & plants for installation and commissioning the complete system. The contractor will also submit the erection, testing & commissioning procedure for approval to the owner. These procedures will form an integral part of the acceptance report for successful erection and commissioning the system. These reports will be prepared and signed by the contractor's representative & the owner concerned with project.

Training & After Sales Service

Training and after sales service is an important component of supply. The terms and conditions for training and after sales supply and service are to be presented clearly in the proposal and the extent and duration of after sales support clearly defined.

An explanation of preventative maintenance schedule, plan of operation, scope and implementation of the after sales service is to be defined.

Documentation

Three sets of installation manual / user manual shall be supplied along with each power plant. The manual shall include complete system details such as array layout, schematic of the system, inverter details, working principle etc. Step by step maintenance and troubleshooting procedures shall be given in the manual. Contractor shall supply three sets of soft copies (in Pen Drive/ CD form) of all documents including drawings and user manual.

C-16 HI - WALL SPLIT SYSTEMS

It comprises of an indoor unit and an outdoor unit. The indoor unit may be mounted on wall or at ceiling. The outdoor unit consists of compressor, heat exchanger, fan and motor; installed in a separate independent cabinet. The indoor unit is an air handling system, designed primarily to provide conditioned air to an enclosed space, room or zone (conditioned space). It includes a prime source of refrigeration for cooling and dehumidification/heating and means for the circulation and filtering of air. The split AC shall be Five Star BEE rated and variable speed compressor.

APPLICATIONS:

(i) Almost Silent (Low dB level) operation of A.C is important, considering VIP rooms, conference rooms, etc. Various types of split air conditioners may be categorized based on type of compressor for outdoor unit and air-distribution for indoor unit, as below:

(a) Outdoor unit with variable speed compressor : It is also called an inverter AC or variable speed AC, which works on part load depending on the demand for the conditioned space. This uses a variable-

(b) Frequency drive to control the frequency and thereby the speed of the compressor motor.

(c) Free-blow indoor unit : It could be high wall mounted, ceiling suspended cassette (exposed type), or floor-mounted.

(d) Furred-in indoor unit (ceiling suspended) : It is mounted in the ceiling and provided with a duct collar and grille.

(e) Ducted indoor unit : It requires ducting for air distribution.

INSTALLATION

- (i) Wherever split A.C. are planned in the new buildings, necessary openings in wall may be provided by with use of 75 mm PVC pipe sleeves at suitable locations for taking refrigerant pipes and cable to outdoor unit, so as to avoid unnecessary cutting/ damage to walls at a later stage. The slope of sleeve of PVC pipe should be towards exterior to avoid seepage of water into the room. This opening should be sealed properly after installation to avoid entry of vermin and rain water.
- (ii) For condensate drain, 40 mm PVC/ HDPE pipe be also provided and taken to nearest drain or up to the stack for collection & disposal of condensate. The slope of such pipe also should be downwards. As far as possible, joints should be avoided in this pipe.
- (iii) The length of connecting refrigerant pipes between outdoor and indoor unit be kept to minimum feasible at site. However it should not exceed 9 m, as the efficiency of the unit gets severely affected on increase of distance. The refrigerant pipes should be taken along the walls/ columns etc. duly clamped to their surface by saddles. If walls etc. are not available, tray be used to support the refrigerant pipes. Where bending of refrigerant pipes is required, proper pipe bending tool should be used to avoid pinching of pipes.
- (iv) The refrigerant pipes should be properly insulated as per the recommendations of the manufacturer of split type AC units. The insulation over refrigerant pipes be examined once in a year and in case of any deficiency/ defect the same may be replaced.
- (v) Wall mounted unit and similar exposed indoor unit are provided with installation plate for ease in installation. Care shall be taken to ensure that enough clearance space is available below the ceiling in order to have free intake of return air.
- (vi) Outdoor unit is mounted on an epoxy-coated steel frame with rubber gourmet to minimise vibrations in an open area so that the fan of the air cooled condenser can discharge hot air to the atmosphere, without any obstruction. Care should be taken to ensure that free intake of air is also available to the outdoor air cooled condenser. Also

precaution should be taken that hot air from any one outdoor unit does not mix with the outdoor air intake of any other air cooled condenser.

- (vii) The location of the Outdoor unit shall be shown in the drawing and shall be ensured that the outdoor unit shall be easily approachable for maintenance activities.

Limitations :

Split air conditioner is generally not recommended for,

- (i) Where distance between indoor unit exceeds beyond the maximum of 30 m (or higher as per the recommendation of the manufacturer) from the outdoor unit for units up to 17500W (5 TR). The horizontal distance between the indoor unit and outdoor unit should not exceed 10 m for reciprocating compressor, nor for scroll compressor. The vertical distance between the indoor unit and the outdoor unit should not exceed 10 m for units with reciprocating compressor, and 25 m for unit with rotary/scroll compressor.
- (ii) Area requiring close control of both the indoor temperature and relative humidity.
- (iii) Sound recording rooms where criteria for acoustics are stringent.
- (iv) Special applications like sterile rooms for hospitals and clean room applications where
- (v) High filtration efficiency is desired.
- (vi) Large multi-storeyed buildings where multiplicity of compressors may entail
- (vii) Subsequent maintenance problems.

Guaranteed Technical Specification Required.

Description	Capacity
SPLIT SYSTEMS Supply , Installation, Testing and Commissioning of Air Cooled Hi Wall split type Air conditioners complete with Indoor unit(IDU), Out door unit (ODU), surface / concealed copper Refrigerant piping with insulation (closed cell elastomeric nitrile rubber tubular pipe section) upto 3 Mtr (IDU to ODU), copper power cable upto 3.5 Mtr (IDU to ODU) i/c drain pipe R-32/R-410/ R 407 Green Refrigerant, wireless Remote control, suitable for working between 180-260V with low & high voltage cutoff and 50 hz ,1 phase AC supply capable of performing cooling, dehumidification, air circulation of following capacity with Scroll / rotary compressor. The system shall be able to deliver 100% of the rated capacity upto 42 Degree Celsius. Min 5 year Original Equipment Manufacturer (OEM) warranty both compressor and Printed Circuit Board (PCB). Must comply : Electrical cable IS 694 or IS 9968 temperature sensing control IS /International Electro technical Commission (IEC) 60730, hermetic compressor IS 10617, heat exchanger IS 11329, capacitor IS 2993 and motor IS 12615. Complete as per CPWD specification and IS : 1391 Part II 2023. The system shall be able to operate up to 50 degree C (out door ambient temperature). Inverter Type - Cooling only 1.5 TR with 5 Star BEE Rating/2.0 TR with 5 Star BEE Rating - Minimum 40 Nos	1.5 / 2.0 TR
Stabilizer Supplying, installation, testing & commissioning of 5 KVA automatic voltage stabilizer BEE 5 star rating with all accessories complete etc as required.	5 KVA

C-17 RO water Plant

Reverse Osmosis (R.O) Plant

17.1 R.O. Plant for Drinking water

Minimum **2 Nos. 500LPH capacity, Reverse Osmosis Plant** shall be provided at terrace and interconnecting the supply lines and delivery lines. **(1 No. for Admin cum Laboratories Bldg & 1 No. for Farmers training Hostel)**

The R.O. plant shall comprise of R.O. High Pressure Feed Pumps (HPP), RO Raw Water Pumps (RWP) of Vertical multistage centrifugal type and suitable head to generate permeate flow as per requirements. The pump casing and impeller construction shall be of SS-316. The motor shall be TEFC with minimum IE-2 efficiency suitable for operation on supply of 415Volts, 3Phase, 50Hz .A.C. Supply. The pump shall be supplied complete with base channel, coupling foundation bolts, pressure gauge, valves at inlet and outlet of each pump. One standby pump needs to be considered for each type. Capacity of R.O Plants shall be selected based on the functional requirement (RO water demand) as stated above within minimum operating hours (preferably 8hrs./day).

It shall consist of Package type R.O. module capable of giving a net treated water output as per requirement, Special Anti-sealant dosing system consisting of suitable no. of Stainless-Steel tanks of capacity as per requirement with a positive displacement diaphragm dosing pump having variable flow rate, Micron cartridge filter (shall be made of FDA compliant high quality polypropylene or some other suitable material) suitable for a flow rate as per requirements.

CIP system (Cleaning in Place) consisting of SS tank with agitator complete with inlet/outlet, drain overflow etc. along with SS pump of capacity and cartridge filter of 10-micron, PH correction dosing system consisting of one SS tank with a positive displacement diaphragm dosing pump having variable flow rate. All the interconnecting pipelines shall be of SS316 with press fittings.

Tank shall be provided with water flow meter at inlet & outlet, inlet & outlet valves, overflow, drain connection. Centralized control panel made out of CRCA sheet min.2mmthick having main contactors for all pumps.

All control and power cabling shall be provided. Earth leads shall be connected to the structural earthing points available at the terrace .An emergency stop push button shall be provided in the panel.

17.2 Portable Water Coolers:

Minimum 9 Nos. Portable Water Coolers of following specifications shall be provided in the corridors, of buildings. (7 No. for Admin cum Laboratories Bldg & 2 No. for Farmers training Hostel)

Storage capacity	:80 Litres
Cooling capacity	:40 Litres/hour
MOC of outer panel	:SS /Precoated GI sheet
MOC of water tank	:Stainless Steel 304 grade
Drain Pan	:Stainless Steel 304grade
No. of Faucets	:Brass chrome plated 2Nos; 1No.for Cold water,1No. for Normal water
Compressor	:Hermitically sealed/Reciprocating
Refrigerant	:R134A
Thermal Insulation	:PUF
Temperature range	:10°C–25°C
Temperature Control	:Controlled through Thermostat.

C-18 Water supply System

The water supply to the ICAR -CIRC campus at Babugarh, Hapur (UP) (For Admin cum Laboratories Bldg, Farmers training Hostel & other buildings) shall be met from the local Municipality /Tube Wells/ Bore wells .

List of Codes and Manuals:

The following IF codes of practice and design manuals shall be referred:

- (a) CPWD specifications
- (b) National Building Code 2016.

Pumps for Water Supply & Borewell

A. Water Supply Pumps:

The scope of work includes the design, supply, installation, testing, and commissioning of water supply pump set system along with electrical panels for the all buildings and associated facilities and specialized areas such as the STP and other buildings for potable water, treated water, and rainwater reuse, providing efficient and reliable water supply across the campus as per NBC 2016 norms and building requirement. The design should consider varying water demand scenarios, including pressure maintenance systems, ensuring consistent water pressure across all facilities. Size and select pump sets based on hydraulic calculations, ensuring that each pump can meet the water demand for the respective facilities include redundancy and backup and submit the design documents for approval to engineer-in-charge after that install electrical panels, wiring, and control systems, including automatic pump starters, level sensors, and flow meters, piping networks, valves, pressure gauges, and fittings for each pump set. , including necessary civil works such as foundation and mounting for pump sets, earthing's. Ensure all installations comply with safety standards, working in coordination energy-efficient pump sets to minimize operational costs and environmental impact.

- a) Water supply pump sets shall be installed with following design guidelines:

Minimum 25% additional capacity pumps have to be installed for drinking water purpose. Theoretical calculation of pumps as well as specifications shall be got approved by Engineer-in-charge before execution.

02 working + 01 standby drinking water pumps shall be provided for each sump. All necessary NRVs, valves, pressure gauges, electrical panels for above drinking water system and borewell pumps to be provided.

B. Borewell Pump Sets:

The scope of work includes the design, supply, installation, testing, and commissioning of borewell submersible pump set in the existing Borewell at a depth as per yield report, suitable for operation on 415 volts Star- Delta starter, 3 phase AC supply, with a discharge of min 60 LPM, head including providing lowering of 50 mm dia. "B" class GI pipe & providing 3X6 sqmm copper submersible flat cable (double run), Timer based Pump control panel, borewell pump safety chain, bore well cap, header, for complete length of borewell, with heavy duty collar i/c connections, etc. complete as required. (Note: common electrical panel shall also be accepted as per the requirement for all the bore well pumps with all specifications as stated

above). The Cost inclusive of all cabling, panel, terminations etc required for completion of work and nothing extra shall be paid. Suitable number (as per Civil data obtained during boring) borewell pump sets will be provided to ensure a reliable water source for the both buildings. These pumps will be essential for maintaining an uninterrupted water supply during peak usage.

Pumps for borewell to be designed and installed based on data obtained from Civil wing based on water table level.

50% redundancy (or minimum 1 set of equal capacity) to be supplied and handed over for borewell pump.

- a) Dewatering pumps (2 nos.) inside Substation / STP if required
- b) Gardening pumps (3 nos.)(2 working + 1 No. Standby) .

C-19 Emergency light, Illuminated signages

EMERGENCY LIGHTING & SIGNAGES

Intelligent Emergency Lighting System Independent emergency lighting system shall be provided for each building. Scope: System shall consist of Addressable Panel with exit signage for all lift and staircase areas and Downlighter for the staircase and common corridors of Admin cum Laboratories Bldg & Farmers training Hostel, dinining area of each block.

1.1 General

The emergency lighting system will be a fully addressable, self-test system using self-contained or with central battery luminaires and comply with the requirements of BS5266 and all other related standards. All luminaires and exit signs shall incorporate an LED light source and Lithium Polymer battery technology to improve operational efficiency, reduce costs and protect the environment.

Luminaires incorporating fluorescent lamp technology, nickel cadmium or nickel metal hydride batteries will not be accepted. The emergency lighting control panel shall be capable of supporting up to minimum two circuits of emergency lighting luminaires. Each of these circuits shall be capable of supporting upto 95 devices. It shall be possible to connect upto 15 panels on to a single network. The user interface shall consist of a minimum 30-character LCD display. The Panel shall have central battery or UPS for powering all connected device of minimum 90 minutes for full load. The panel shall have display and programing keypad.

1.2 Luminaires and Signages

Each luminaire microprocessor controlled and allocated an individual address shall be self-contained or powered by main panel and consist of a single LED light source -with a specially designed lens to provide optimum light distribution, electronics and battery, all contained within a single plug-in housing. Each luminaire and signages shall be capable of a minimum of 2hrs. Continuous operation in an active mode. Each luminaire shall be fitted with a LED to indicate its status. Each luminaire shall be site programmable for operation in a maintained or non-maintained mode and shall provide a minimum of 2 hours continuous operation in the event of a mains power supply failure.

The stand by batteries incorporated in to each luminaire shall be rechargeable type.

LED Down-light with specially designed lens for corridor area applications. Both surface and semi-flush mounting models shall be available.

LED Down-light with specially designed lens for open area applications. Both surface and semi-flush mounting models shall be available.

LED recessed mounting single/double signages.

1.3 Emergency Lighting Control Panel (ELCP)

The ELCP shall consist of a sheet steel enclosure with a white powder coat finish and contain an internal termination board for all incoming and outgoing cables.

The panel shall be designed for surface mounting. All external cabling connections are via plug-in screw terminals. Terminals are of the rising-clamp style suitable for cables size up to 2.5mm². The ELCP shall have a transactions log of minimum 1000 events. Subsequent

events should overwrite the logon a FIFO principle. The data shall be held in non-volatile memory.

1.4 Network Communications Outputs

The ELCP shall be able to communicate to PC via Ethernet port for programming and logs. The ELCP shall include an RS485 port for communication with up-to eight combined keypad and display units. One serial port shall be dedicated for uploading and downloading the programmed data to and from a PC, or to provide data to a network interface module. The ELCP shall allow networking between multiple panels which will allow up-to 15 panels to be connected via an existing or dedicated TCPIP Ethernet network to a graphical interface.

1.5 User Interface

The user interface shall consist of a LCD display in a surface mounting enclosure. The LCD shall be menu driven and incorporate the following capabilities:

1.6 Service State

It shall be possible to set a line in to a "service state. In this state, the power will be removed from the line (to allow maintenance work on the line wiring to be carried out). When switched into this mode, the luminaires shall remain off so as to prevent discharge of the luminaire standby batteries.

1.7 Wiring

The cable that interconnects the luminaires, I/O units and the panel shall be a screened and twisted single pair 1.5mm² cable with a maximum length of up to 1000M.

1.8 Panel Programming Software

The Control Panel shall be fully site configurable and programmable using a PC-based programme and allow the data to be backed-up to a disc for archiving purposes. This programme shall also include the ability to produce reports of all the system programming in a printable format.

List of Preferred Make (Brands) of Materials

- 1) List of Preferred Make (Brands) of Materials is attached for usage in execution of work. However, approved equivalent material of any other specialized companies/firms may also be used, in case it is established that the Brands specified are not readily available in the market are in other unavoidable circumstances subject to approval of alternate Brand by the Engineer in Charge.
- 2) It must be ensured, in general, that all materials to be used in the works shall bear BIS Certification mark. In cases where for a particular material/product BIS Certification Mark is not available, then the material proposed to be procured can be used subject to the conditions that it should conform to CPWD Specifications and relevant BIS codes. In such cases written approval of the Engineer in Charge shall be obtained before use of such material in their works
- 3) The list given below does not absolve the Executing Agency from their quality and performance, the products shall be used. To achieve this, proper responsibility for using these products. It is only after, they have satisfied about check on the quality of the products, actually to be used, should be exercised.
- 4) 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 as per the contract with catalogues and proposed specifications (duly highlighting relevant matter). In case of specialized agencies, they will also submit full details of the works executed by the specialized agencies.
- 5) In case any make included in the preferred makes (brands) list is found to be below the standards of quality and specifications and/or is deficient in any other manner, that make shall be considered as deleted by the Engineer in charge from the list.
- 6) Public procurement (Preference to Make in India) Order (PPP-MIII)-2017 -Revision dated 29.05.2019 and DoT Public Procurement (Preference to Make in India) Order (PPP-MII Order) dated 29.08.2018 with upto date amendments /latest order till the last date of receipt of tender will prevail and shall be complied with.
- 7) The contractor will submit relevant documents to enable the Engineer in charge to verify that manufacturers have valid IS Certification as on date for materials, wherever applicable.
- 8) In case, make for any material to be used in work is not specified in the list, the Engineer in charge may approve the make.
- 9) The above make shall be used if not otherwise mentioned in the nomenclature of respective items.
- 10) Decision of Engineer in charge in case of any discrepancy shall be final and binding on all above points.

LIST OF PREFERRED MAKES FOR E&M

S.N o.	Details of material/equipment	Manufacturer's name/make
(A)	I.E.I., MCBDB & MCB, Cable & Wires	
1	MCB, Isolator, Industrial Plug Socket, RCCB, RCBO's (Only Premium series)	Schneider Electric / Legrand/ LK/ ABB/ Seimens /Havells/ C&S/HPL
2	MCB DB & Loose wire Box(Only Premium series)	Schneider Electric / Legrand/ LK/ ABB / Seimens/Havells/C&S/HPL
3	Change Over Switch(Only Premium series)	Schneider Electric /LK/ Havells/ HPL/ABB/ Seimens/C&S/HPL
4	Automatic Transfer switch (ATS) (Only Premium series)	Asco/ Russel/ Socomac/ ABB/ LK/Havells/HPL/ Seimens/ Schneider Electric
5	FRLS PVC ins. Copper cond. Single core cable for wiring (ISI marked)	Finolex/ RR Kabel/ KEI/ Havells/ Polycab/Grandlay/Batra Henlay/Rallison
6	Armoured/ Unarmoured telephone cable, coaxial cable	Delton/Finolex/ RR Kabel/ Havells/Bonton/AKG
7	MS Conduit (ISI marked) with heavy duty MS Conduit pipe accessories.	BEC/ NIC/ AKG
8	PVC Conduit (ISI marked) with heavy duty PVC Conduit pipe accessories.	AKG/ BEC/ Precision/Anchor / Polycab
9	Modular Switch, Socket/Telephone socket/ cable TV Socket/ Data outlet socket/ Fan Regulator/ G I Boxes Etc. (Wiring Accessories). (Only Premium series)	Legrand / Schneider Electric/ Wipro /MK Havells/Honeywell/
10	Selector Switch & Toggle switch	Sailzer(LK)/ Siemens/ABB
11	PVC Trunking	MK/Schneider Electric / Legrand.
12	GI pipe	Tata / Jindal (Hissar)/ SAIL
13	Paints	ICI/ Asian/Berger
14	Terminal Block & Connectors	Elmex/ Wago/ Hensel/ Connect well
15	phenolic laminated sheet/ Bakelite sheet	Hylem/ Formica (P-I grade)/ Mylam/ Greenlam.
16	Cat-6A cables, Wires & Fiber optic cable	Amp, Avaya/Beldon/Legrand/Molex/ Schneider/Bonton/Anchor/AKG
17	Street Light Pole	Havells/Bajaj/Wipro/Philips/ Crompton/Twinkle
(B)	Fan & Fittings	

1	Exhaust Fans/Fresh Air fan	Havells, Crompton, Almonard, Orient, Usha.
2	Ceiling Fans	Havells, Crompton, Orient, Usha.
3	LED fittings	Havells/ Phillips/ Lighting Technology/Wipro/Regent
(C) Sub -Station Equipment.		
1	LT panels, Meter Panel Boards, AMF Panels, Outdoor Feeder Pillars, APFC Panels, Bus ducts	Tricolite Electrical Industries/Control & Switchgears Pvt. Ltd./ Adlec Control System Pvt. Ltd. /Advance Panels & Switchgears Pvt. Ltd./Ambit switch gear /Precision System control/R.P. Controls/ Advance Power Control / Milestone/ HPL /NEPTUNE/ Pristine.
2	TTA Panels design verified (Main LT panels, capacitor panels	Siemens /Schneider /LK/Legrand/ABB/HPL /C&S/HPL (Only Premium series)
3	Air Insulated Rising Main	C&S/ LK/Schneider/Legrand/ Siemens
4	Sandwich type/Compact type Bus Trunking	C&S/ LK/Schneider/Legrand/ Siemens
5	Moulded Case Circuit Breaker (MCCB) Thermal release/ Microprocessor based (Ics=Icu=100%) (Only Premium series)	Schneider Electric / Legrand/ LK/ ABB/ Seimens/ C&S/HPL (Only Premium series)
6	Power/ Aux. contactor 3/4 pole	Schneider Electric / Legrand/ LK/ ABB/ Seimens/ C&S/BCH
7	Potential transformers, Current Transformers.	Automatic Electric/ Gilbert & Maxwell/ Matrix/ Precise/ LK/ Kappa
8	LED type indicating lamp/ Push Button	Schneider Electric / LK/ Seimens/ C&S/Vaishno
9	Over load Relays	Schneider Electric / LK/ Seimens/ C&S/ABB
10	Conventional/ Electronic Digital Meters (A/V/PF/Hz/KW/KWH)	Schneider Electric /Conzerv/ LK/ Secure/ AE/ C&S
11	Timer	Schneider Electric / Legrand/ LK/ ABB/ Seimens/ C&S
12	Fasteners, GI Clamps	Hilti/ Fisher/ Chilli/ GMGR
13	D.W. Corrugated HDPE pipe (ISI marked)	Rex/ Duraplast/ Triputi/ Duraline/ CPE
14	Transformers (Oil/Dry type)	Crompton/ ABB/ Schneider/ Voltamp/Power Star
15	HT panels / Ring Main unit	Crompton/ Seimens/ABB/ Schneider.
16	HT Cables (ISI marked)	Finolex/ RR Kabel/ KEI/ Havells/ Polycab/ /Grandlay
17	HT End Termination/ Cable jointing Kit	Reychem/Denson/ Cap Seal/Safekei/ 3M
18	ACBs with Display	Schneider Electric / Legrand / LK/ ABB / Siemens / C&S (Only Premium series)
19	Rubber Mat	Jyoti/ Deep Jyoti/ Premier (duly ISI marked)

20	Ammeter	Rishabh/ LK/ AE/ C&S
21	Voltmeter	Rishabh/ LK/ AE/ C&S
22	Fire Extinguishers (ISI marked)	Minimax/ Safex/ Lifeguard/ Kanex/ Omex/Ceasefire/ Andex
23	Capacitor & Reactors/ APFC Relay	Epcos/LK/ Ducati/ ABB/ Siemens/ Schneider/Havells
24	XPLE insulated PVC sheathed Alum. / Copper conductor Armored / Unarmored cable of 1.1 KV grade	Finolex/ RR Kabel/ KEI/ Havells/ Polycab/ /Grandlay/Rallison
25	Cable Glands double compression with Earthing links	Baliga lighting/ Comet/ Cosmos/ Dowells/ Gripwell
26	Bimetallic Cable Lugs	Comet/ Dowells (Biller India)/Hax Brass (Copper Alloy India) / Jainson/ Action.
27	MS / GI Cable tray and its supported accessories	Pilco/ Slotco/Pasco/ MEM/ BEC/Steelways/Legrand/Trueleader/LS Power control
28	Programmable logic controller (PLC)	Seimens/ Allen Bradley/ LK/ ABB
(D)	DG Sets.	
1	Diesel operated generating engine	Cummins India/ Caterpillar/ Volvo Penta/ Perkins/Kirloskar
2	Alternator	Stamford/ Lerroy Sommer/ Caterpillar/ Crompton/Jyoti/Kirloskar
3	DG set Canopy/ Enclosure & AMF panel	As per OEM/ OEA of respective DG set manufacturer
4	Alarm Annunciator	Advani Oralikon/ LK/ Minilec
(E)	Firefighting Equipment.	
1	M.S. Pipe	TATA, JINDAL HISAR, SAIL
2	G.I. Pipe	TATA, JINDAL HISAR, SAIL
3	Forged steel fittings/ Flanges	Johnson Industries/ VS Forge/ JK Forging/ Trueforge
4	Forged steel fittings & Flanges (For Welding joints)	VS Forge/ Rohini/ Kanwal Forge/johnson/ Trueforge
5	Pipe Hangers	Chilli/ Hilti/ GMGR
6	Gun Metal/ Brass valve (ISI marked)/ (Full way Globe valve/ Non return valve)	Sant /Leader/Advance/Zoloto/ Kirloskar
7	Butterfly/ Sluice valve (ISI marked).	Audco/Sant /Leader/Advance/Zoloto/ Kirloskar
8	Check valve (ISI marked).	Audco/Sant /Leader/Advance/Zoloto/ Kirloskar
9	Foot Valve (cast iron/ Gunmetal)	Audco/Sant /Leader/Advance/Zoloto/ Kirloskar

10	Y Type Strainer	Audco/Sant /Leader/Zoloto/ Kirloskar
11	Fire / Sprinkler pump / Terrace Fire pump	Kirloskar/ KSB/ Grundfos/Wilomather&platt
12	Electric Motor	ABB/ Siemens/ kirloskar/ Grundfos/ crompton/NGEF
13	Diesel Engine for Fire Pump	Cummins India/ Ashok Layland/ KOEL
14	Couplings (Type -Type)	Lovejoy/ Fenner/ Dunlop
15	Anti Vibration Mountings	Kanwal Industries Corporation/ Dunlop/ GERB/ Resistoflex
16	Pressure Switch (ISI marked)	SystemSensor/Infoss/Danfoss/Switzer/Honey well & Siemens
17	Pressure Gauge (ISI Marked)	H Guru/ Fiebig/dwyer
18	Double / Single Headed Landing Valve (ISI marked)	Minimax/New Age/ Safeguard/ Lifeguard/ Padmini/ Omex/Andex/Kalpex.
19	Male Female fire Hose Coupling (SS 304) (ISI marked)	Minimax/New Age/ Safeguard/ Lifeguard/ Padmini/ Omex/Andex/ Kalpex.
20	First Aid Hose Drum / Fire Hose Reels / Shut off Nozzle (Gunmetal / ABS) (ISI Marked)	Minimax/New Age/ Safeguard/ Lifeguard/ Padmini/Kalpex.
21	SS 304 / Gun metal Branch Pipe & Nozzle (ISI Make)	Minimax/New Age/ Safeguard/ Lifeguard/ Padmini/ Omex/Andex/ Kalpex.
22	Fireman Axe	Minimax/ New Age/ Safeguard/ Kalpex.
23	Water Flow Switch (FM/UL Listed)	System Sensor/Rapid Control/Potter/Switzer
24	Rust Preventive polymeric 4mm thick tape for pipes. (AW4) Wrapping (ISI Marked)	Pypcoat/ Marphalt/ Rustech/ Safex.
25	Level Controller & Indicator (water) (ISI Marked)	Auto pump/ Cirrus Engineering / Techtrol
26	Fire Brigade Inlet Connection (ISI Marked)	Minimax/New Age/ Safeguard/ Lifeguard/ Padmini/ Omex/Eversafe/ Kalpex.
27	Thermoplastic pipe for first Aid Hose Reel (ISI Marked)	New Age/ Safeguard/ Lifeguard/ Padmini/ Omex/Eversafe/ Kalpex.
28	Fire Sealant	Promat/ Birla 3 M/ Hilti
29	Over load Relays	Schneider Electric / LK/ Seimens/ C&S/ABB
30	power/ Aux. contactor 3/4 pole	Schneider Electric / Legrand/ Hager/ LK/ ABB/ Seimens/ C&S/BCH
31	LED type indicating lamp/ Push Button	Schneider Electric / LK/ Seimens/ C&S/ABB
32	LT jointing kit / Termination	Reychem/Denson/ Cap Seal/Safekei/ 3M
33	RRL Hose pipe (ISI Marked)	New Age/ Safeguard/ Lifeguard/ Padmini/ Kalpex
34	Dry Battery	Exide/ Amar Raja/ HBL/Amco

35	Battery Charger	Statcon/ Amar Raja/ CDC/ AE/ Expofyn/ thycon India
36	Epoxy Paint	ICI/ Asian/Berger/Nerolac
37	Air Release Valve	Rb/ Tbs/ Cimbrio/ Zoloto
38	Analogue/ Digital Measuring Instruments (Voltmeter/ Ammeter/ Energy meter/ KW/ PE/ Multi-Function meter)	AE/ Rishabh/ LK/ C&S/ Conzerve
39	Aluminium / Copper power cable / Control cable (Armoured / Unarmoured)	Finolex/ RR Kabel/ KEI/ Havells/ Polycab /AKG
40	Cable glands & Lugs	Comet/ Dowells/ Hax Brass (copper Alloy India)/ Jainson/ Action
41	Solenoid Valve / Spray Nozzle	Perker/ HD/ Tyco/ Emersion
42	Sprinkler	HD/ Tyco/Reliable/ Wormald/Viking
43	Sprinkler Heads/ Water Curtain Nozzle	Tyco/ Viking/ Omex/ Newage/ Lifeguard
44	Steel Flexible Extension	Omex/ Newage/ Tyco/ Lifeguard/ Kalpex.
45	Vibration Eliminator	Resistoflex/ D Waren /Kanwal
46	Welding Electrodes	Advani/ ESAB/ LK
47	Deluge Valve	Tyco/ Viking/ HD
48	Cast Iron Valve	Kirloskar/ Joloto/ Audco/ Advance
(F) Fire Alarm Systems.		
1	Addressable Manual call box	Notifier, Johnson control, Honeywell, Siemens, Bosch.
2	Addressable type fault isolator	Notifier, Johnson control, Honeywell, Siemens, Bosch.
3	Strobe lights cum hooter	Notifier, Johnson control, Honeywell, Siemens, Bosch.
4	Addressable control modules for hooter	Notifier, Johnson control, Honeywell, Siemens, Bosch.
5	Addressable monitor module for flow switch	Notifier, Johnson control, Honeywell, Siemens, Bosch.
6	Addressable type fire alarm control panel	Notifier, Johnson control, Honeywell, Siemens, Bosch.
7	Network repeater panel	Notifier, Johnson control, Honeywell, Siemens, Bosch.
8	Addressable multi sensing fire detector (Combination of optical type smoke detector and ROR type heat detector)	Notifier, Johnson control, Honeywell, Siemens, Bosch.
9	Response Indicator	Notifier, Johnson control, Honeywell, Siemens, Bosch.
(G) PA System		
1	PASystem	Tyco/Honeywell-Notifier/Edwards/Bosch/Johnson Control
2	JunctionBoxes	Customized

3	Speakers	Bosch/Bose/JBL/Honeywell /Audac/ Martin
4	Amplifier	Bosch/Bose/JBL/Honeywell/ Audac/ Lab Gruppen
5	Microphone	Bosch/JBL/Philips/Honeywell//Audac/ Martin/Bose
6	FireSurvivalCables/CircuitIntegrityCable	Havells/ Finolex/ KEI/RRKabel/Belden /Rallison/Batra Henly
7	MSConduits	BEC/AKG/NIC
(H)	UPSSystem	
1	UPS System (MinimumLevel-3 Inverter topology onlytobeused)	Schneider/VERTIV/Legrand(Numeric)/ABB/ Eaton/Mitsubishi
2	SealedMaintenanceFreeBatteries	Exide/Amaron/HBL/Rocket/Hitachi /Panasonic/Amco
(I)	VRV/ VRF BASED AIR CONDITIONING SYSTEM(Heating and Cooling)	
	VRV / VRF Outdoor / Indoor unit / Remote	DAIKIN / TOSHIBA / O GENERAL / MITSUBISHI ELECTRIC/Blue Star/Voltas
	4-way flow/1-way flow/ High wall Type VRV/VRF Cassette Type Indoor ceiling mounted unit	VRV/VRF Cassette Type Indoor ceiling mounted unit DAIKIN / TOSHIBA / O GENERAL / MITSUBISHI ELECTRIC
	Touch Type centralized controller	DAIKIN / TOSHIBA / O GENERAL / MITSUBISHI ELECTRIC
	Nitrile rubber insulation	Thermoflex/ A-Flex/ K-Flex/ Armaflex
	Inline Fans	KRUGER / COMEFRI / NICOTRA / HUMIDIN
	Duct Attenuators / Acoustic Louvers	CARYAIRE / AIRFLOW / TRISTAR / AIR MASTER/COSMOS/DYNACRAFT
	Flexible control cable and Wires	KEI/ Finolex/ Havells/ Polycab (Dully ISI Marked)
	Armoured/Unarmoured Power Cable	Finolex/ Polycab/ Havells/ KEI (Dully ISI Marked)
	Cable Tray	OBO/ INDIANA/ PILCO/ APEX/LEGRAND
	Copper Pipe	Max flow / Rajco / Mandev
	Y Joints	Toshiba/Daikin/Mitsubishi (ELECTRIC)/ O General
	GI Sheets	SAIL / TATA / JINDAL
	Extruded Aluminium Grilles / Diffuser	RUSKIN - TITUS / SYSTEMAIRE / AIR-MASTER/COSMOS/CARYAIRE/DYNACRAFT
	Combined fire/smoke Dampers	RUSKIN - TITUS / SYSTEMAIRE / AIR-MASTER/COSMOS/CARYAIRE/DYNACRAFT
	Ventilation / Exhaust Air Grilles	RUSKIN - TITUS / SYSTEMAIRE / AIR-

		MASTER/COSMOS/CARYAIRE/DYNAC RAFT
	Factory fabricated duct	TECHNOFAB / ROLASTAR / ZECO / ECODUCT / DUCTOFAB / WAVES/ NU AIR(NUTECH)
	Fire Sealant	HILTI / BIRLA -3M
	Fresh / Exhaust Air Louvers with Bird Screen	RUSKIN - TITUS / SYSTEMAIRE / AIR-MASTER/COSMOS/CARYAIRE/DYNAC RAFT
	Collar / Grill Damper (Aluminium)	RUSKIN - TITUS / SYSTEMAIRE / AIR-MASTER/COSMOS/CARYAIRE/DYNAC RAFT
	ELECTRICALS & ASSOCIATED WORKS	As per the make list of IEl work
	Any other item	To be approved by Engineer in Charge
	Air Curtain	Beacon/Thermodyne, EnvairElectro dyne
	Smoke sensor/COSensor	Honeywell / Danfoss / Johnson Control/Actis/System sensor/siemens/Kele
(J)	Solar Water Heater System	
1	Solar Hot Water System	Racold / V-Guard / TATA BP Solar /EmmveeSolar/Solahart/Venus/Honeywell/ EPLIndia/Suntech/RashmiIndustries/Kotak Urja/Photan/Greentek Northern
2	Insulation for Hot water pipes	Thermaflex/K-Flex/Armacell/Supreme/AKG
(K)	LAN System	
1	Wireless LAN Solution, Wireless controller, Web Security Solution, Web Application Firewall solution, Wireless LAN	Cisco / HP / Extreme / Arista/ R&M /Impulse / Ruckus / Juniper / Aruba /Panduit/Allied Telesis Cisco, Alcatel, Arista/ palo /alto/ Fortinet/ Sopos
2	Managed Network Switches, Core Switch, Distribution Switch, Access Switch, Fiber Module, Wireless Access Point	Fortinet/ Alcatel / HP / Extreme / Arista/ R&M /Impulse / Ruckus / Juniper / Cisco/ Aruba /Panduit/Nexus/Allied Telesis
3	End point security	Cisco/Aruba/SolarWinds/Everest/CATechnologiesSecure
4	Server/Networking Rack (wall mount/ floor mount)	Rittal Emersion /APW/Netrack/ WQ/Panduit/ Valrack/ Derwiser/ MTS
5	Cat-6A LAN Cable / OF C and accessories.	Panduit / Belden / Systemax /Commscope /Legrand/ R&M/Siemens/ Derwiser/Siemon
6	Patch panel / Patch Cord /Fiber patch cord / pigtails /Adapters/Connectors	Panduit / Belden / Systemax /Commscope/Legrand/R&M/Siemens/Derwiser/ Siemon
7	Network management system	Fortinet/Alcatel/ Cisco/Arista
8	Firewall/Router	Cisco/Fortinet/Sophos/Juniper/Arista/ Nokia

(L)	EPBAX System	
1	EPBAX IP based Server with Licenses / IP Phone/PC based Operator Console/IP Phone/Analog Phone	Alcatel-Lucent/Ericsson/Siemens/Avaya/Unify/NEC/Panasonic/Matrix/ Cisco/ Tadiran/ Arista/ Toshiba
2	Telephone Cable /TV Co-Axial Cable	Finolex/ Havells/RR Kabel/KEI/LK/ Polycab/Molex
3	MDF Box	ADC/GE/Malson/D-Link/ITL/Legrand/Krone
(M)	CCTV System	
1	IPCCTV Camera, NVR Management Software (UL Listed)(STQC certified)	Sony/Bosch//Tyco/Axis/Impulse/Avigilon/Matrix/ Lumens/Epson/ Digitek
2	FHD LED Display Monitor/Touchscreen panel	Samsung/Sony/Phillips/LG/Panasonic
3	Magnetic Contact	AssaAbloy/ SDCSecurity/ GE/Ebelco
4	Access Controller Reader & Software	Tyco/Axis/Lenel/RBH/Impulse/Bosch/Honeywell/HID
5	Line Interface Unit	Belden/CommScope/Tyco/Panduit/Molex/ Schneider/R&M/Legrand
6	Network Video recorder	Honeywell/Bosch/Pelco/Tyco/Axis/Impulse/Avigilon
7	Workstations, Server, Storage	HP/Dell/IBM/Lenovo
8	Hard Disk	WD/Seagate/Toshiba/HP
9	URack	Valrack/Rittal/Cisco/Wipro
(N)	Audio Video / Conference System	
1	Coloumn Speaker, Ceiling Speakers, Sub-Woofer, SPL Fill Loud Speaker, Floor monitor Speaker, Wall Speaker	Audac /Bose /Martin Audio /JBL/Electro Voice / Renkus Heinz/Kramer
2	Video and Tele Conference Solution	Avaya/Cisco/Lifesize/Polycom
3	4KVideoStreamer	QSC/Extron/Creston/AMX/Kramer
4	Audioconference system i/c chairman - unit & delegate units	Bose/JBL/EV/Renkus-Heinz STAPES, Bosch, Televic
5	Power Amplifier	Bose/LabGruppen/AshlyAudio/QSC / Crown / Dynacord / Yamaha/Kramer Audac
6	Recorder & Streaming System	Lumens/Mediasite/ Extron/Creston /Kramer/Wolfvision/Polycom
7	Digital Signal Processor	Bose/LabGruppen /Ashly Audio/QSC/ Crown/ Dynacord/Yamaha/ Kramer Xilica,, Biamp
8	Audio Mixer	Yamaha/Soundraft/ StudioMaster/QSC /Midas/Extron/DiGiCo
9	AV Over IP Encoder/Decoder	AMX/Extron/Creston/Kramer/QSC
10	Wireless Handheld Microphone, Wireless Lapel Microphone with Receiver, Gooseneck, Table Top, Microphone	Bose/AKG/Audio-Technica/ElectroVoice/Sennheiser/Shure/JBL
11	Digital Metallic Podium	EAPL/Liberty/Aagman Digital/ATDSC/

		LABWE/AHA
12	Wireless Presentation System	Crestron/Barco/Extron/Kramer/AMX
13	Microphone Cables, Speaker Cables	Beldon/Sommer/Klotz/Delton/QSC/Bose/Kramer/R&M
15	Control System, Streaming Transceiver, Streaming Trans receiver, wall plate, HDMI to USB Capture Card	Aurora/Crestron/Extron/Krammer
(O)	STP & ETP	
1	Air Blower	As per OEM recommended ION Exchange/ VENZA/ THERMAX/ Wipro Water Ltd./ Oxybee Solutions
2	Sludge transfer pump /Filter feed pump	
3	Screw Pump	
4	Filter Press	
5	MBBR Reactor	
6	MBBR Media	
7	HDPE/ PVC Tank	
8	CPVC/UPVC Pipes & Fittings	
9	Multigrade S and Filter, Activated Carbon Filter, Softeners	
10	Oil And Grease Skimmer	
11	Coarse/Fine Bubble Diffuser	
12	Tube Settler Media /Biopac Media	
13	Chemical Dosing Units	
14	UV System	
15	Ph Sensor/ Ph meter	
(P)	Solar Photo Voltic Power Generation system	
	PV Modules	EMMVEE/ Canadian Solar/ Trina Solar/ Renesola/ Waaree/ TATA/ Adani/ Havells
	PCU/Invertor	Delta/ Sungrow/ Fimer/ Fronius/ SMA/ Luminous
	String Monitoring Boxes	Hensel/ Spellsberg/ Eaton
	Control Relay	ABB/ Siemens/ Schneider
	Cables/ Wire	DC/AC Cable.. same as LT cables/Wires
	Plant Lightning Arrestor	Same as Lightning Protection System Make
	Material for Structure	TATA/Jindal/ SAIL
	Glass	Saint Gobin/ Borosil/ Thermosol/ Schott
(Q)	Split AC	
	1.5TR/2 TR Split AC	O-General/Diakin/Mitsubishi
	Voltage Stablizer	Bluebird/Voltas/Microtek/V-gurd
	Any other material	With prior approval of Engineer-in-charge
(R)	R.O water Plant	

	R.O Water Treatment plant	Kent/Aquaguard/ Ionexchange Water Tech/ 3DAqua/Raindrops/ Nefsol
	Watercooler	Voltas/Bluestar/Carrier/Usha/Hitachi
(S)	Pumps	
1	Drinking water pump sets	Kirloskar/Mather & Platt/ KSB/ Wilo/ Texmo
	Starters (DOL/Star Delta/Soft)	LK/Siemens/ABB/Legrand
(T)	Emergency light, Illuminated signages	
	Illuminated Sign Board, Exit Signages /LED EXIT Emergency Lighting	PROLITE / BAJAJ / CROMPTON / PHILIPS / LEGRAND/ MK/System Tek/ Hochiki/Cooper/Tecknoware /ASM/TM
(U)	LIFT	
	LIFT	OEM as per eligibility criteria (approved by engineer-in -charge

Note: The firm has to ensure that equipment manufacturer comes under definition of local manufacturers as per Govt. of India, Policy of Public Procurement (Preference to make in India) order,2017(PPM-MII order 2017) issued by Department of Industrial Policy and Promotion. Only products conforming to above policy shall be allowed to be used in the work.

**Assistant Engineer(E),
MESD, CPWD, Meerut**

**Executive Engineer(E),
GED, CPWD, Ghaziabad,**

Electrical & Mechanical Works:-

C-1	Internal & External Electrical Installations i/c Lightning conductor, Street light.	Scope of this sub head covers Admin cum Laboratories Building & Farmers Training Hostel and other Buildings like Substation ,STP,ETP etc, i/c planning, designing, supply, installation, testing and commissioning of complete Internal and External Electrical Works which includes all copper wiring in MS conduit, LED energy efficient luminaries , fans, modular switches, sockets, DBs, MCBs, MCCBs , RCCBs, Sandwich Rising Mains, end feed units , tap off boxes, distribution of normal, UPS Power, AHUs low side power, Power supply to smoke extraction fans etc, cable trays raceways, lighting control, day light(photo) and, earthing, lightening arrestor (all of the above) as per NBC-2016 amended upto date, networking wiring (CAT 6A) in MS conduit, wiring for voice communication system, call bell system, street light, compound light and landscape lights, contour & fascia light, Geysers, Electrical signages (including photo luminescent), Street light LED lighting and display systems. etc. as required, cabling & associated misc. works. If any item required to make the building / scheme habitable and functional, is not specifically mentioned in the scope of services, the same is deemed to be included within the scope of this tender and nothing extra shall be paid on this account.
C-2	Fire fighting System	Design, Supply, Installation, testing & commissioning of fire fighting system shall be as per provision of NBC-2016 amended upto date and clearance issued by Local fire Service and will consist of Wet Risers, Internal & External Hydrants, sprinkler in the entire building, compartmentation of basements with water curtains , UG & OH Tanks , Pumps i.e main Fire Pumps (2 Nos) Diesel Pump as standby (1 No), Jockey Pumps (2 Nos) and water curtain pump (1 No) . Gas suppression system shall be provided in server room and in sub-station panels. If any item required to make the building / scheme habitable and functional, is not specifically mentioned in the scope of services, the same is deemed to be included within the scope of this tender and nothing extra shall be paid on this account. (Admin cum Laboratories Building & Farmers Training Hostel and other Buildings like Substation ,STP, ETP etc).
C-3	Fire alarm system & PA System	The work shall consist of planning, designing, supplying, installation, testing & commissioning of Automatic Intelligent Addressable Fire alarm system and Public Address System. The system shall be as per CPWD specifications, NBC 2016 and Local

		bylaws and as per clearance issued by U.P. Fire Service. Scope of work also includes integration of Fire alarm system with Smoke Extraction System, Fire Fighting System, AHUs, Ventilation system etc, as per NBC 2016 amended upto date, requirements of the main control room, etc. If any item required to make the building / scheme habitable and functional, is not specifically mentioned in the scope of services, the same is deemed to be included within the scope of this tender and nothing extra shall be paid on this account. (Admin cum Laboratories Building & Farmers Training Hostel and other Buildings like Substation, STP, ETP etc).
C-4	Lifts	Providing, Installation, Testing and Commissioning & putting into operation of Total 5 Nos. Lifts. In Admin cum Laboratories Building (2 Nos. 13 Passenger Lift and 1 Nos. 13 Passenger Fire Lift) and in Farmers Training Hostel (2 Nos. 13 passenger lift), Machine Room lifts serving as per Annexure - I in Sub Head C-4 with all control equipment's & accessories for the required nos. of landings/openings and capacity as per architectural plans and speed of lifts in accordance with NBC 2016 as amended up to the date. All electrical works including interconnections from MCCB (including SITC of MCCB) and loop earthing from the earth bar provided in the machine room. (i) Provision of adequate lighting in the lift shafts and all landings. Provision of hoisting beam or hook above the lift well and trap door. Architrave work at lift entrance. (ii) Temporary barricades with caution boards at each landing to prevent accident during execution of work. (iii) Electric supply to individual lift shall be given from the dedicated lift panel. If any item required to make the building / scheme habitable and functional, is not specifically mentioned in the scope of services, the same is deemed to be included within the scope of this tender and nothing extra shall be paid on this account.
C-5	Sub-station Equipment	Design, Supply, installation, testing and commissioning of power supply to the building which includes Cast Resin Dry type transformer (2 x 1250KVA minimum) , HT Panels (Six panels Minimum), LT Panels, sandwich bus trunking , HT cables, power distribution throughout the building with Copper / aluminium conductor XLPE insulated, FRLS PVC inner and outer sheathed armoured UG Cable, Fire Survival Cables as per provisions of NBC-2016 amended upto date , sub-panels, as per SLD, Feeder Pillars etc. as per specifications given. The

		work includes supplying and laying of two number HT Cable from meter board of supply company to the HT Panels inside the building. The work also includes earthing and safety equipment as per specifications. The sub-station will be installed in separate building as CPWD Specifications. Gas suppression system shall be provided in panels as per NBC -2016 guidelines. If any item required to make the building / scheme habitable and functional, is not specifically mentioned in the scope of services, the same is deemed to be included within the scope of this tender and nothing extra shall be paid on this account. Note:- The minimum capacity as mentioned is indicative, the agency is to calculate the capacity of the capital equipment of afresh and same will be got approved from the engineer-in-charge. Increase in capacity up to 5%,nothing extra will be paid. However any increase beyond 5% the difference shall be paid as extra item. (Design for Admin cum Laboratories Building & Farmers Training Hostel and other Buildings like Substation ,STP,ETP etc. and Future plans of Buildings Electrical load in 33% of development area of Site-A in ICAR-CIRC Campus).
C-6	D.G. set	The work shall cover complete design, supply, transportation, foundation, installation, testing and commissioning of DG Sets (2 x 500 KVA minimum) capacity for Admin cum Laboratories Building & Farmers Training Hostel .All minor civil works including Foundation, electrical work including DG Synchronizing panel and other works such as cooling of DG Sets with water circulation pumps, pipe line cooling tower , ventilation and acoustic treatment of DG Sets room, extending exhaust pipe of suitable dia duly insulated and cladded with Aluminium sheet up to above the building as per latest CPCB norms, testing, installation and commissioning of the sets shall be carried out by the tenderer as per specification. The tender should quote for complete job to be executed under the works contract. If any item required to make the building / scheme habitable and functional, is not specifically mentioned in the scope of services, the same is deemed to be included within the scope of this tender and nothing extra shall be paid on this account. Note: The minimum capacity as mentioned is indicative, the agency is to calculate the capacity of the capital equipment of afresh and same will be got approved from the engineer-in-charge. Increase in capacity up to 5%, nothing extra will be paid. However any increase beyond 5% the difference shall be paid as extra item.

C-7	UPS	Design, Supply, Installation, testing & commissioning of 1 No. x 100 KVA (minimum for lighting and data networking) in parallel redundant mode with 30 min. battery backup with individual UPS. The complete system with all switches, cabling, safety devices, batteries, earthing including the UPS system of capacity so calculated shall be in the scope of work. If any item required to make the building / scheme habitable and functional, is not specifically mentioned in the scope of services, the same is deemed to be included within the scope of this tender and nothing extra shall be paid on this account. Note: The minimum capacity as mentioned is indicative, the agency is to calculate the capacity of the capital equipment afresh and same will be got approved from the engineer-in-charge. Increase in capacity up to 5%, nothing extra will be paid. However any increase beyond 5% the difference shall be paid as extra item. (In Admin cum Laboratories Building only).
C-8	VRV/ VRF BASED AIR CONDITIONING SYSTEM (Heating and Cooling)	The scope of work under this sub-head will consists of Design, Supply, Installation, testing & commissioning of VRV/ VRF BASED AIR CONDITIONING SYSTEM (Heating and Cooling) for Admin cum Laboratories Building at ICAR-CIRC, Babugarh, Hapur (UP) as per design calculation & as per guidelines issued by ASHRAE, ISHRAE, BIS, CPWD Specifications, NBC 2016, and the requirement of ICAR-CIRC and additional specifications. Area to be Air conditioned: - 1) All the rooms and Laboratories in Admin cum Laboratories Bldg except corridor, toilets, lift lobby, Reception, Waiting area, Store rooms. 2) Canteen/Dining areas of block. The work will 1000 HP minimum capacity VRV/ VRF BASED AIR CONDITIONING SYSTEM (Heating and Cooling) , Outdoor Units, Indoor Units, copper piping , pipe Insulation , plumbing, ducting, electrical work, etc. complete in all respect as per specifications. The work shall also include planning, designing, preparing drawings and getting the drawings approved from the Engineer-in-Charge and its subsequent execution. If any item required to make the system functional, is not specifically mentioned in the scope of services, the same is deemed to be included within the scope of this tender and nothing extra shall be paid on this account. Note: Any variation beyond 5% of the prepared (in the tender documents) capacity of capital equipment shall be paid on pro-rate basis by reducing the rate of 1000HP. VRF to per HP rate. However the proposed capacity of capital

		equipment is the minimum capacity to be provided in the structures. (In Admin cum Laboratories Building only).
C-9	Solar Water Heating system	Planning, Designing, Supply, Installation, Testing and commissioning of Solar Water Heating system of Total capacity minimum 4000 LPD (heat exchanger type) with recirculation pumps, solar collector panels, support structures, mixing tanks, absorbers, electrical control panels, backup heaters, make up water tank, interconnecting pipes with insulation, valves, pressure gauges, thermometers, cabling etc complete. The work shall be executed as per detailed technical specifications mentioned in NIT and as per directions of Engineer-in-Charge. If any item required to make the building / scheme habitable and functional, is not specifically mentioned in the scope of services, the same is deemed to be included within the scope of this tender and nothing extra shall be paid on this account. Note: The minimum capacity as mentioned is indicative, the agency is to calculate the capacity of the capital equipment of afresh and same will be got approved from the engineer-in-charge. Increase in capacity up to 5%, nothing extra will be paid. However any increase beyond 5% the difference shall be paid as extra item. (In Admin cum Laboratories Building & Farmers Training Hostel only).
C-10	LAN System	The wiring shall be in the scope of the work of the firm and shall be IP based LAN networking, as described in the Internal EI subhead. LAN networking shall be covered in the LAN subhead. The complete system has to be supplied, installed, tested and commissioned in complete manner to have a fully functional system, as required. Planning, designing, supplying, installation, testing & commissioning of LAN networking for as per client requirement suitable nodes with 10G backbone with Wi-Fi modem on all floors covering complete floor area. The system shall have redundancy at the level of core switch as well for the backbone. If any item required to make the building / scheme habitable and functional, is not specifically mentioned in the scope of services, the same is deemed to be included within the scope of this tender and nothing extra shall be paid on this account. Note: The capacity requirement to be provided as per the design and functional requirement of client, the agency is to calculate the capacity of the capital equipment of afresh and same will be got approved from the engineer-in-charge. Nothing extra will be paid. (In In Admin cum Laboratories Building &

		Farmers Training Hostel only).
C-11	EPBAX System	Planning, designing, supply, installation, testing and commissioning of complete of IP Based EPBX of initial capacity of 1000 Telephones & expandable up to 2000 telephones shall be located at server room. All the Telephones in the Complex will be IP Based and will use the existing LAN Network for the communication within the complex (inside buildings & in between buildings) as well as for outside the complex. All Rack Panels of Individual buildings shall be connected to Central PABX (private automatic branch exchange) system through Optical Fiber Cable IPbased voice communication system with PRI (Primary Rate Interface) Trunklines (30channels) with clip facility for minimum 500 IPusers license for 5 Years.. The system shall have redundancy at the level of core switch as well for the backbone. If any item required to make the building / scheme habitable and functional, is not specifically mentioned in the scope of services, the same is deemed to be included within the scope of this tender and nothing extra shall be paid on this account. Note: The minimum capacity as mentioned is indicative, the agency is to calculate the capacity of the capital equipment afresh and same will be got approved from the engineer-in-charge. Increase in capacity up to 5%, nothing extra will be paid. However any increase beyond 5% the difference shall be paid as extra item. (In Admin cum Laboratories Building & Farmers Training Hostel only).
C-12	CCTV System	Design, Supply, Installation, testing & commissioning of CCTV system to monitor & supervise the entire area (internal and external) for security purpose, as well as record and inform officials on unwanted, untoward incidents. It is also essential to have recorded images to be stored at least for min 30 days of all critical areas to facilitate investigations of a reported incident. The cameras will cover entire boundary and external areas. The system will be designed to cover the entire building keeping in view the security requirement of ICAR-CIRC Building. The hardware required for the system including Servers VMS & Recording, Workstations, Monitors, CAT-6A Patch Cable to connect the camera to nearest POE enabled LAN point, Cables, connectors, conduits, power supplies etc. is in the scope of work. The complete LAN networking, for the CCTV should be separate and exclusive for CCTV system only. If any item required to make the building / scheme habitable and functional, is not specifically mentioned in the scope of services, the same is deemed to be included within the scope of this tender and nothing extra shall

		be paid on this account. (In Admin cum Laboratories Building & Farmers Training Hostel only).
C-13	Audio Visual/ Conference system	The scope of work in designing planning supplying installation testing & commissioning of Audio-Visual System including Video Conference System in complete manner to have a fully functional system, as required in the conference and seminar rooms If any item required to make the building / scheme habitable and functional, is not specifically mentioned in the scope of services, the same is deemed to be included within the scope of this tender and nothing extra shall be paid on this account. (In Admin cum Laboratories Building & Farmers Training Hostel only).
C-14	STP (Sewerage Treatment Plant) & ETP (Effluent Treatment Plant)	The Scope of work includes designing, Planning, supplying, Installation, testing & commissioning of the STP and ETP plant for the building and complex based on the norms of the local body, State Pollution control board, NBC- 2016 amended upto date . The STP plant has to be installed based on the same but with minimum capacity 100 KLD and ETP plant with minimum capacity 25 KLD. All pumps shall be in 1W+1S combination. Treated effluent shall meet all standards prescribed by State pollution control Board. Treated effluent will be recycled for purposes and recycle/distribution scheme including pumping will be part of STP and nothing extra will be paid on account of this. The capacity will be worked out as per NBC 2016 amended upto date to meet the requirement of waste generated in the building. If any item required to make the building / scheme habitable and functional, is not specifically mentioned in the scope of services, the same is deemed to be included within the scope of this tender and nothing extra shall be paid on this account. Note: The minimum capacity as mentioned is indicative, the agency is to calculate the capacity of the capital equipment of afresh and same will be got approved from the engineer-in-charge. Increase in capacity up to 5%, nothing extra will be paid. However any increase beyond 5% the difference shall be paid as extra item. (Design for Admin cum Laboratories Building & Farmers Training Hostel and Future plans of Buildings in 33% of development area of Site-A in ICAR-CIRC Campus).

C-15	Solar Photo Voltic Power Generation system	The scope of work in designing planning supplying installation testing & commissioning and putting into operation and maintenance upto end of Defect liability period of Photo Voltaic Systems on roof top for generation of 130 KWp or more, consisting of PCU (power conditioning unit), including LOTO Meter Box (For Solar Generation Meter) required necessary Panel, cables, CPVC pipe/ms pipe, GI Wire, Copper Cable etc. as required to complete in all respect till the installation and activation of Net Metering to the Service provider. The area available at the terrace of Admin cum Laboratories building. If any item required to make the building / scheme habitable and functional, is not specifically mentioned in the scope of services, the same is deemed to be included within the scope of this tender and nothing extra shall be paid on this account. Note: The minimum capacity as mentioned is indicative, the agency is to calculate the capacity of the capital equipment afresh and same will be got approved from the engineer-in-charge. Increase in capacity up to 5%, nothing extra will be paid. However any increase beyond 5% the difference shall be paid as extra item. (In Admin cum Laboratories Building only).
C-16	Split AC	The scope of work in designing planning supplying installation testing & commissioning of Air Cooled Hi Wall split type Air conditioners complete with Indoor unit(IDU), Out door unit (ODU), surface / concealed copper Refrigerant piping with insulation (closed cell elastomeric nitrile rubber tubular pipe section) upto 3 Mtr (IDU to ODU), copper power cable upto 3.5 Mtr (IDU to ODU) i/c drain pipe R-32/R-410/ R 407 Green Refrigerant, wireless Remote control, suitable for working between 180-260V with low & high voltage cutoff and 50 hz ,1 phase AC supply capable of performing cooling, dehumidification, air circulation of following capacity with Scroll / rotary compressor. The system shall be able to deliver 100% of the rated capacity upto 42 Degree Celsius.Min 5 year Original Equipment Manufacturer (OEM) warranty both compressor and Printed Circuit Board (PCB). Must comply : Electrical cable IS 694 or IS 9968 temperature sensing control IS /International Electro technical Commission (IEC) 60730, hermetic compressor IS 10617, heat exchanger IS 11329, capacitor IS 2993 and motor IS 12615. Complete as per CPWD specification and IS : 1391 Part II 2023. The system shall be able to operate up to 50 degree C (out door ambient temperature). Inverter Type - Cooling only 1.5 TR with 5 Star BEE Rating/2.0 TR with 5 Star BEE Rating- Minimum 40 Nos.

		If any item required to make the building / scheme habitable and functional, is not specifically mentioned in the scope of services, the same is deemed to be included within the scope of this tender and nothing extra shall be paid on this account. Note: The minimum capacity as mentioned is indicative, the agency is to calculate the capacity of the capital equipment afresh and same will be got approved from the engineer-in-charge. Increase in capacity up to 5%, nothing extra will be paid. However any increase beyond 5% the difference shall be paid as extra item. (In Farmers Training Hostel only). Stabilizer SITC of 40 Nos, 5 KVA automatic voltage stabilizer with all accessories complete etc as required.
C-17	R.O water Plant	Planning, designing, Supply, Installation, Testing and commissioning of 2 Nos R.O Plant having each capacity 500 LPH for drinking water, fully automatic type , including providing control panel, laying necessary cables; laying of water lines to each water cooler i/c storage type water cooler of capacity of 80 litre. with complete stainless-steel body with inbuilt stabilizer are to be provided for drinking water – 1 Nos. at each floor. (Minimum 9 nos. to be provided at various locations). The work shall be executed as per detailed technical specifications mentioned in NIT and as per directions of Engineer-in-Charge. If any item required to make the building / scheme habitable and functional, is not specifically mentioned in the scope of services, the same is deemed to be included within the scope of this tender and nothing extra shall be paid on this account. (In Admin cum Laboratories Building & Farmers Training Hostel only).
C-18	Water supply System	Planning, designing, Supply, Installation, Testing and commissioning of water supply pump set system along with electrical panels for the all buildings and associated facilities and specialized areas such as the STP and other buildings for potable water, treated water, and rainwater reuse, providing efficient and reliable water supply across the campus as per NBC 2016 norms and building requirement. The design should consider varying water demand scenarios, including pressure maintenance systems, ensuring consistent water pressure across all facilities. Size and select pump sets based on hydraulic calculations, ensuring that each pump can meet the water demand for the respective facilities include redundancy and backup and submit the design documents for approval to engineer-in-charge after that install electrical panels, wiring, and control systems, including automatic pump starters, level sensors, and flow meters, piping networks,

		valves, pressure gauges, and fittings for each pump set. , including necessary civil works such as foundation and mounting for pump sets, earthing's. Ensure all installations comply with safety standards, working in coordination energy-efficient pump sets to minimize operational costs and environmental impact. Water supply pump sets shall be installed with following design guidelines: (a) Minimum 25% additional capacity pumps have to be installed for drinking water purpose. Theoretical calculation of pumps as well as specifications shall be got approved by Engineer-in-charge before execution. (b) 02 working + 01 standby drinking water pumps shall be provided for each sump. All necessary NRVs, valves, pressure gauges, electrical panels for above drinking water system and borewell pumps to be provided. Pumps for borewell to be designed and installed based on data obtained from Civil wing based on water table level. (a) 50% redundancy (or minimum 1 set of equal capacity) to be supplied and handed over for borewell pump. (i) Dewatering pumps (2 nos.) inside Substation / STP if required (ii) Gardening pumps (3 nos.) (2 working + 1 No. Standby) The work shall be executed as per detailed technical specifications mentioned in NIT and as per directions of Engineer-in-Charge. If any item required to make the building / scheme habitable and functional, is not specifically mentioned in the scope of services, the same is deemed to be included within the scope of this tender and nothing extra shall be paid on this account. (In Admin cum Laboratories Building, Farmers Training Hostel and 33% Site-A development area of campus).
C-19	Emergency light, Illuminated signages	Planning, designing, Supply, Installation, Testing and commissioning Emergency lighting and signages for corridor areas, lift lobby, entry/ exit, staircase and other areas required as per NBC 2016 for Admin cum Laboratories Bldg & Farmers training Hostel and utility building, pump house, STP, ETP, Substation etc. The design shall be as per NBC 2016 and fire by laws of Uttar Pradesh Govt. The purpose is to use the internally illuminated emergency exit light with directional pictogram to enable safe evacuation & to avoid panic & stampede. It shall also include LED indication for monitoring the status of exit lights. The system shall be state of the art, capable to provide fault indication in emergency exit lighting, fast acting, approved & reliable electrically operated System. Wiring / cabling for Emergency lighting and signages as per NBC 2016 shall be in the scope of work. If any item required to make the building / scheme habitable and functional, is not specifically mentioned in the scope of services, the same

		is deemed to be included within the scope of this tender and nothing extra shall be paid on this account.

Note:

1. **The capacity of Capital Equipment has been worked out for the guidance of the bidders for quoted their rates. However the successful bidder will calculate the capacity of capital equipment based on final approved drawing for the client/department.**
2. **The minimum capacity as mentioned is indicative, the agency is to calculate the capacity of the capital equipment afresh and same will be got approved from the engineer-in-charge with prior consent of CE, Ghaziabad. Increase in capacity up to 5%, nothing extra will be paid. However any increase beyond 5% the difference shall be paid as extra item. (In Admin cum Laboratories Building & Farmers Training Hostel only).**

PART-D

CHAPTER-D

Architectural Controlling Norms, Schedule of Finishes & Specifications

Introduction

1. Plinth Area

Indicative Plinth areas of various blocks to be constructed have been indicated in 'Brief of Work and conceptual Architectural Drawings are attached in the bid document.

2. Where Local bye-laws so require, additional area for fire escape staircase and its access will be provided independent of the areas indicated in this document.

3. General Design Guidelines

- a) The clear heights of the floors have been indicated in attached Architectural drawings – 3.9m Admin cum laboratory building and for training hostel 3.00mtr
- b) Dual piping system & use of water from STP for flushing.
- c) External finishes shall be used as per the approved Architectural drawing/design.
- d) Vehicular free pedestrian movement & Landscape design element such as raised lawns shall be provided.
- e) Provision for barrier free access as per the building byelaws, PWD Act 2016 (with latest amendments) & CPWD specifications/guidelines shall be provided.
- f) Products made from recycled material shall be used for non-structural work such as Kerb stones, walkways, open parking, drain/manhole covers Sub base of roads etc. with the prior approval of Engineer-in-charge.
- g) SMC panel water tanks of approved various sizes will be installed at terraces overhead tank 20,000ltr. (for admin block) & 10000 ltr (for farmer training hostel)
- h) Building shall be designed keeping in view the Thermal Transmission Coefficient's' values as specified in the HVAC sub head of Part-C of this NIT and to comply with the UPECBC Code 2017 amended up to date.
- i) Work will be executed for all heights; no extra amount will be entertained for extra height.

4. Details of features and facilities to be provided in the proposed Buildings

S.No.	Floor	Area	Floor Wise Space Distribution of Plinth area (tentative/ Indicative)
Admin building			
1.	Ground Floor	2184.10 sqm	Main entrance, Entrance lobby, Reception cum waiting area, 1 No. Library, In charge Library Office, Canteen, 2 Nos. Store room, Central store, Fire lift, 2 Nos Passenger lift, 3 Nos Staircase, Electrical/Fire/Low Current shaft, Male Toilet, Female toilet, handicapped toilet, Janitor room,

			CIF, 2 nos. CIF LABS, 2 nos. Parking.
2	First Floor	2184.10 sqm	Director room, PS room, Rest room (with toilet) , Utility room, Committee room 2 Nos, Record room, Hindi cell, IJSC room, Women cell, ARIS cell cum computer centre, Server room, ARIS, Estate office, Estate, 3 Nos staircase, DDO, Dispatch bill & cash office, Purchase office, I/C purchase, 2 Nos Passenger lift, Fire lift, Electrical shaft, Male Toilet, Female toilet, handicapped toilet, Janitor room, UPS & housekeeping, Visitor room, Common utility, AO room, AAO room, Admin office, Male Toilet, Female toilet, PME office, I/C PME, I/C ITMU FAO Room, AFAO Room.
3	Second Floor (CPR Division)	2184.10 sqm	Core laboratory 4 nos., HOD room(incl. Toilet), office of HOD, Seminar room, Classroom, Staff room, Utility room, Stair case 3 nos., 4 nos. Sample preparation, Store 2 Nos., Digestion room, Scientist room 10 nos., 2 nos. Male Toilet, 2 nos. Female toilet, Divisional library, Visitor room, Fire lift, 2 Nos Passenger lift, Electrical shaft, handicapped toilet, Janitor room, UPS & housekeeping, Sterilization room, Cold room.
4	Third floor (CBG division)	2184.10 sqm	Core laboratory 4 nos., HOD room(incl. Toilet), office of HOD, Seminar room, Classroom , Staff room, Utility room, Stair case 3 nos., 4 nos. Sample preparation, Store 2 Nos., Digestion room, Scientist room 10 nos., 2 nos. Male Toilet, 2 nos. Female toilet, Divisional library, Visitor room, Fire lift, 2 Nos Passenger lift, Electrical shaft, handicapped toilet, Janitor room, UPS & housekeeping, Sterilization room, Cold room.
5	Fourth floor (CNM division)	2184.10 sqm	Core laboratory 4 nos., HOD room (incl. Toilet), office of HOD, Seminar room, Classroom, Staff room, Utility room, Stair case 3 nos., 4 nos. Sample preparation, Store 2 Nos., Digestion room, Scientist room 10 nos., 2 nos. Male Toilet, 2 nos. Female toilet, Divisional library, Visitor room, Fire lift, 2 Nos Passenger lift, Electrical shaft, handicapped toilet, Janitor room, UPS & housekeeping, Sterilization room, Cold room.

6	Fifth floor (LPM & cattle utility section)	2184.10 sqm	Core laboratory 4 nos., I/C LPM, Common room, Seminar room, Classroom, Staff room, Utility room, Stair case 3 nos., Sample preparation 3 nos., Store 2 Nos., Digestion room, Scientist room 10 nos., 2 nos. Male Toilet, 2 nos. Female toilet, Divisional library, Visitor room, Fire lift, 2 Nos Passenger lift, Electrical shaft, handicapped toilet, Janitor room, UPS & housekeeping, Sterilization room, Cold room, Media lab, I/C CUS
7	Sixth floor (Animal Biotechnolo gy section and animal health section)	2184.10 sqm	Core laboratory 4 nos., I/C Office incl. toilet, Common room, Seminar room, Classroom , Utility room, Stair case 3 nos., Sample preparation 2 nos., Store 2 Nos., Digestonative Lab, Bio lab, Scientist room 10 nos., 2 nos. Male Toilet, 2 nos. Female toilet, Visitor room , Fire lift, 2 Nos Passenger lift, Electrical shaft, handicapped toilet, Janitor room, UPS & housekeeping, Sterilization room, 2 Nos Cold room, Media lab, I/C AHS, Cell culture lab, Fermentation Lab
8	Terrace Floor plan	132.96 sqm	3 Nos mumty & Machine room
	Total area	15421.66 sqm	
Farmer training hostel			
1	Ground floor	1545.10 sqm	Living room 3 nos., Bed room 3 nos., Hostel room 3 nos., Care taker room, Care taker DRG room, Dining hall, Kitchen, Wash area, Gents dormitory, Dormitory, Driver Dormitory, Ladies dormitory, Common Hall, Open court 4 nos., Audio visual farmers & Scientist interface facility, Visitors room, Office, Reception, Stair case 2 nos., 2 nos. Passengers lift, Toilet & bath 22 nos.
2	First Floor	1649.80 sqm	Double bed room with toilet 6 nos., Hostel room 13 nos. with toilet, Common Hall & reading room, Shuttle court 2 nos., Store 3 nos., Audio visual farmers & Scientist interface facility, Office with toilet 2 nos., Stair case 2 nos., 2 nos. Passengers lift, Passage
3	Terrace	67.50 sqm	Mumty 2 nos., Machine room 2 nos.
	Total	3262.40 sqm	

Furniture works			
1.	GF		CIF LAB-2
	Second Floor	1 Each	Sample Preparation Sterilization Room Cell Culture Core Laboratory
	Fifth Floor	1 Each	Media Lab
	Sixth Floor	1Each	Fermentation Lab Bio Lab Designative Lab
Development			
1.	(Site A)	1,05,200 sqm (approx.)	Area in between Road No. 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 25, 27 and 26. As per attached drawing.

Note:

1. The floor plans / enclosed conceptual drawings are for initial assessment and quoting for tender by the agency. However, the agency is to prepare a fresh general arrangement drawings for approval of engineer-in-charge. This general arrangement drawing to be purposed by agency may have some re-arrangement of various office accommodations utility and toilets of different floors without increasing the purposed area of construction Minimum Acceptable Specifications.
2. Developments works are indicated and in case of discrepancy in are a statement as mentioned above and measured area/mentioned area in drawing, the numerical details given above will prevail for the purpose of calculation of payment vis a vis quoted rates
3. Submission of measurements, in case of EPC contracts, is only for record purpose. Payment of bills of the contractor is made on basis of stage-wise completion of work as per terms of the Contract.

5. Development Works (including survey, investigation, design and construction)**5.1 Roads:**

Approach and peripheral roads & pathways as per NBC 2025 and functional requirements, to the building for Construction-As per site requirements

5.2 Storm water drains, sewer lines, Rain water harvesting & STP/ETP (Civil Works):

Survey, investigation, design & construction of storm water drains, sewer line, rainwater harvesting in the plot area around the building. i/c connection to the trunk sewer line. The construction of STP/ETP (civil works) is also included in the scope of work in addition to these works. Planning, designing and execution of the roof top rainwater harvesting system for recharging the sub-soil water including laying of pipelines and construction of substructure / superstructures.

5.3 Internal water supply:

- (a) Planning, designing and execution of the internal water supply system in all building components.
- (b) Providing and laying of internal water supply grid with external water supply grid network in the all-building components.

5.4 External water supply: -

- (a) Survey, investigation, design and execution of water supply system of the whole campus.
- (b) Providing and laying water supply lines around the buildings and connection to local body like Nagar Palika/ HAPUR PILAKHUWA DEVELOPMENT AUTHORITY main water line which is to be connected to underground water tank.

5.5 Procurement and installation of all external signage.

All the signage along the pathways, road ways, Parking spaces, gates, entrance to the main building, nomenclature of the building, identification signage for different structures, services etc. shall be provided. Besides above, the road cautionary, informative and regulatory signage shall also be provided.

6. Accessible India Measures (Universal Accessibility):

The agency shall conceptualize the building considering the built environment accessibility and its simple mentation in the building. All measures shall be taken to omit obstacles and barriers indoors and outdoors in work places. An accessible building is where persons with disabilities have no barrier in entering it and using all the facilities therein. This covers the built environment—services, steps and ramps, corridors, entry gates, emergency exits, lifts, parking—as well as in door and outdoor facilities including lighting, signage's, alarm systems and public toilets.

The CPWD publication of “Hand book on Barrier free and accessibility”. And MOUD guidelines published in 2016 “Harmonized Guide lines and Space Standards on Barrier Free Built Environment for persons with Disability and Elderly Persons” and requirements as per International Standard/ ISO21542–2011 could be referred to for compliance.

The agency shall also be responsible for getting the accessibility audit (Post Audit) done to confirm whether the building meets the standards.

7. Health & Safety Manual provisions

The EPC Contractor will comply of the provisions contained safety, Health and Environment health book 2019 available on CPWD website www.cpwd.gov.in, failing which he/they will be liable for the penalties on each violation subject to compounding of the same to maximum of such default as mentioned in the various unsafe act/unsafe conditions in this manual. This apart from the other fines/ levies /penalties mentioned the documents elsewhere. It is incumbent upon the EPC contractor to ensure in undertaking all

health and safety compliance for safety of all concerned to generate safety conscious and safety regulatory as is primary statutory duties or responsibilities in the contract.

8. Local Body Approval:

The main Architectural consultant to be engaged by EPC contractor has to finalize the Architectural plans and has to apply online for obtaining the approvals from Local Body, Airport authority. The other approvals are also required from Environmental clearance, HAPUR PILAKHUWA DEVELOPMENT AUTHORITY and NOC/ Tree Cutting Permissions from UP Forest Department etc. are also to be obtained by the EPC Contractor.

The successful bidders will obtain the all approvals speedily by utilizing his owner sources at his own cost to ensure commencement of the works within the stipulated four-month period in the tender documents for planning and designing. The delay, if any, on account of force majeure conditions will be considered by Engineer-in-charge for time over run especially in commencement activities of the project. No other time over run will be entertained whatsoever. The EPC Contractor shall obtain approvals relating to building structural design & drawings and facilitate proof checking from any IIT in parallel to obtaining of above stated approvals to avoid any time overrun in commencement and execution of the works. **Payment for proof checking from any IIT will be made by department.**

Any other approval besides above, if required, shall also be in the scope of EPC contractor.

9. Execution of work

- (a) The contractor should visit and examine the site of work and satisfy himself as to the nature of the existing roads and other means of communication and other details pertaining to the work and local conditions and facilities for obtaining his own information on all matters affecting the execution of work. No extra charge made in consequence of any misunderstanding, incorrect information on any of these points or on ground of insufficient description will be allowed.
- (b) The work shall be carried out in conformity with the Plumbing drawings and within the requirements of architectural, HVAC, electrical, structural and other specialised services drawings which will be generated for execution after finalising BIM Model.
- (c) The Contractor shall cooperate with all trades and agencies working on the site. He shall make provision for hangers, sleeves, structural openings and other requirements well in advance to prevent hold up of progress of the construction schedule. All supports to the civil structure shall be provided with dash fasteners.
- (d) On award of the work, Contractor shall submit a schedule of construction as per clause -5 of the agreement for approval of the Engineer in charge. All dates and time schedule

agreed upon shall be strictly adhered to within the stipulated time of completion/ commissioning along with the specified phasing, if any.

10. Completion drawings

On completion of work, Contractor shall submit one complete set of original tracings and two prints of "as built" drawings to the Engineer-in-charge. These drawings shall have the following information.

- (a) Location of all mechanical equipment with layout and piping connections and mechanical equipment.
- (b) All shop drawings shall be up dated from time to time for the purpose of making completion drawings.
- (c) Drawings of all services like water supply line, sewer line, drainage, Underground tank, alignment route of external electrical services like street lighting and feeder pillars and all internal civil and electrical services like Lifts, sub-station, DG set, Water supply pumps, Wet riser, Automatic Fire Alarm system, UPS, HVAC plant, CCTV, EPBAX system, Audio visual system.
- (d) No completion certificate shall be issued unless the above drawings are submitted. Piping and drainage works shall be tested as specified under the relevant clauses of CPWD specifications.

Contractor or his associate agency engaged to do this work must hold a valid plumbing or any other as required license by them municipal authority or other competent authority under whose jurisdiction the work falls.

Which are not mentioned above but are essential considering functional & statutory requirements of the building.

- 11. All works has to be executed as per specifications provided in the bid document, CPWD Specifications-2019 (updated) Vol-I & Vol-II and National Building Codes 2025, relevant BIS Code (in case of difference if any, stringent/higher specification of the two shall be followed). In absence of CPWD Specification, IS Codes, MORTH Specifications, National Building Code 2025, Specifications, or sound engineering practices shall be adopted as per order of precedence defined in the contract.**

(i) Specifications in brief to be followed for execution of work	Civil work: CPWD Specifications 2019 Volume-I & II with correction slips up to the last date of submission of bid and CPWD Specification.

(ii) List of Specialized Works (Civil)

The following work are the specialized works for which contractor has to associate specialized agencies to execute the work based on eligibility:

1. Waterproofing.
2. Structural Glazing/Façade Works.
3. Aluminium work
4. Fire Check Doors
5. Expansion Joint
6. UPVC Windows/ Aluminium Window

Other services as per CPWD Works Manual 2024 declared specialized and added in specialized items list till last date of submission of bid including extensions, if any.

The EPC Contractor shall engage specialized agencies or experienced firm to satisfy eligibility criteria of having successfully completed works during last seven year ending last date of the month previous to the one in which tenders are invited. Three similar works each of value not less than 40% of the estimated cost of respective specialized work worked out by the Engineer-In-Charge or Two similar works each of value not less than 60% of the estimated cost of respective specialized work worked out by the Engineer-In-Charge or One similar works each of value not less than 80% of the estimated cost of respective specialized work worked out by the Engineer-In-Charge. Estimated cost of specialized work shall be approved of by Engineer-in-Charge concerned.

Similar works in case of specialized work mean work involving in specialized work stated above in residential or non- residential buildings.

The EPC Contractor has to submit Guarantee bond for every work after completion of specialized work. For Waterproofing & Facade work 10-year guarantee bond will be submitted and for all remaining specialized works 5 years guarantee bond will be submitted. 10% Security deposit in addition to 2.5% security deducted for completed work, of the respective specialized work based on the estimated cost worked out by consultant and approved of by Engineer-in-Charge concerned and will be kept for 10 years in case of water proofing work and 5 years in all remaining specialized work and same will be released after ten or five years as applicable. Agency can also submit the Bank Guarantee against Security Deposited.

12. Brief Description of activities: -

12.1 Planning:

1. Survey, soil investigation (including soil investigation) and other related works & services. 3D & 4D Building Information Modelling (BIM) of the building as per TOR mentioned in this documents & services shall be in the scope of work of the firm.

2. Architectural detailing of building & services and obtaining modification / revision/ all statutory/local body approvals to start construction work as given above. This also includes Environmental Impact Assessment & clearance and compliance, Traffic Impact assessment and design of merging/demerging of traffic etc.
3. The project is to be executed as a RCC structure. The structural design of earth quake resistant RCC framed structure buildings and Design of beams and slabs & design of services i/c proof checking from any IIT and getting approval from CPWD after vetting of drawings by approved institute.
4. Design and construction of building, services, fittings etc.as per Minimum GRIHA 5-STAR rating/Equivalent CPWD GHAR Green rating and conforming to UP ECBC CODE 2017 amended up to date including dual plumbing system, rain water harvesting/recharging system, Onsite STP/ETP installation, energy saving LED lights, passive building system, thermal insulation, etc.
5. All building shall be designed for differently abled persons as per the latest norms of Central Govt.

12.2 Execution of Work:

1. After getting approval from local bodies including necessary modifications as per requirements of execution of works and approval from CPWD, as per the scope of buildings & services defined in the contract document, CPWD Specifications, NBC-2025 amended up to date, BIS Codes, relevant BIS codes for entire works, MORTH Specifications and Sound Engineering Practices and handing over the assets after making them habitable in all respects.
2. Submission of completion plan of the building & services including getting approval/clearance from local bodies and UP Fire Service etc. Submission of building & services plan & drawing and other related documents both in hard copy and the soft copy (in Auto CAD and other software used for the purpose) after completion (i.e. 'as-built').
3. Clearance of site before "Handing over" of these facilities after fulfilling all the obligations under the contract.

12.3 Defects Liability prior for Three years after completion of work and fit for occupation:

Construction of Babugarh campus of ICAR-CIRC at Babugarh Hapur, UP. (SH:C/o Administration cum Laboratory building and Farmers Training Hostel i/c Land development at Site A, in EPC Mode -I)

PART-E

CHAPTER-F

AREA STATEMENT &

PROJECT MANAGEMENT

AREA STATEMENT:

The various component of the building covered in the scope s above work is as given below: -

Description		Approximate Built-up Area (to be constructed as per details given in this Tender document)
1.	Admin cum laboratory building(G+6)	15421.66 sqm
2.	Farmer training hostel (G+1)	3262.40 sqm
	Total	18684.06 sqm
3.	Development (Site A)	1,05,200sqm (approximate). Area in between Road No. 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 25, 27 and 26. As per attached drawing.

Note: -

1. In case of discrepancy in area statement as mentioned above and measured area/mentioned area in drawing, the numerical details given above will prevail for the purpose of calculation of payment vis a vis quoted rates.

Project Monitoring

1 Time Schedule & Review

- 1.1 The Agency shall prepare the phase wise (monthly) resource chart (materials, manpower and machinery) based on the project execution schedule as per clause 5.1 of GCC.
- 1.2 The Agency shall submit the photographs & videos of progress of work on fortnightly basis to make it possible to create a short film of the entire execution of the work to be kept in archive.
- 1.3 Agency shall submit a detailed Fortnightly progress & program report to the Engineer-in-charge by 5th of every month. The format of monthly progress & program report shall be as approved by Engineer-in-Charge.
- 1.4 The Agency will make it possible to be represented by a senior level executive who have sufficient financial powers to take decisions required for completing the project in time.
- 1.5 The agency shall stick to the construction schedule, if there is any hindrance or delay due to any reason the same shall be mitigated through engaging extra man power, material and machinery.
- 1.6 The Agency shall submit every month the details of “Funds-Requirements” for the next six months.
- 1.7 Coordination meeting with the architect and various consultants shall be called fortnightly for better coordination at site.
- 1.8 Monitoring by higher authority shall have been done through CCTV for which necessary infrastructure like IP enabled cameras, cabling and internet facility of appropriate speed so that physical progress of the project can be seen from different CPWD offices.

PART-F

CHAPTER-F

SCHEDULE OF STAGE PAYMENTS

Time schedule for completion of project

S. No.	Activities	Execution schedule (From the date of Commencement) (cumulative)
A	Preliminary stage	
	Preparation of General Arrangement Drawings, Architectural Drawings, master plan and getting approval it from client.	01 month
B	Approval stage	
B.1	Preparation and submission of all necessary drawings, reports & documents of complete project for approval from local bodies and statutory bodies.	01 months
B.2	Approval from local bodies and statutory bodies of proposed master plan / layout plans / sewage treatment plant, water softening / purifying plant / solid waste treatment/ roads and path/ parking area, electrical systems including all statutory clearances. Vetting of Structural drawings from any I.I.T.	02 months
C	Detailed architectural Design & Drawing and Estimate stage	
C.1	Preparation and issue of final “good for construction” working drawings for constructions purpose. (Architectural, Interior, structural, services, structural glazing, interior, E&M services i/c HVAC & etc. and Preparation, proof check of structural drawing from any IITs and approval from CPWD	04 Months
E	Construction and completion of project	18 Months
F	NOC/completion certificate/occupancy certificate from local bodies	20 Months

PAYMENT – SCHEDULE FOR EPC WORK				
FOR PART ‘A’ OF FINANCIAL SCHEDULE				
All running / intermediate & final payments shall be made to the agency in accordance with the following schedule:				
S. no.		ACTIVITY	Percentage of Total Quoted Amount of construction (for civil work)	
			Civil work in % age	
1		Planning, Designing and obtaining approvals from local bodies	3.0	
	a	Soil Investigation		0.10
	b	Approval of Architectural Drawings (GAD) from end user (client)		0.50
	c	Approval from following local bodies		
	i	Fire Safety Department		0.40
	ii	HPDA		0.40
	d	Approval of Structural Drawings		0.40
	e	Approval of all Civil Services Drawings		0.40
	f	Approval of all E & M Services Drawings		0.40
	g	Approval of landscaped drawings		0.40
2		Foundation work of Admin cum laboratory building up to plinth level	4.0	
	a	Earth work in excavation in required size and depths for Isolated or combined footings as per drawing		0.80
	b	PCC below Footings		0.70
	c	RCC work complete for Footings, pedestals, column, etc.		1.00
	d	RCC works for Plinth beams		0.80
	e	Back filling up to required level		0.70
3		Level G (Ground Floor of Admin cum laboratory building)	8.0	
	a	RCC work complete for Column, beam, slab		3.00
	b	Brick work/AAC work		1.00
	c	Water supply work		0.20
	d	Aluminium and Steel work including doors and windows complete		1.00
	e	Plastering, painting, flooring, cladding, internal finishing work		1.40
	f	False ceiling and Wall paneling work		1.00
	g	Sanitary fittings complete		0.20
	h	Courtyard, stilt parking, stairs, ramp etc. Complete		0.20
4		Ground Floor of Farmer training hostel i/c foundation	1.0	
	a	RCC work complete for Column, beam, slab		0.50
	b	Brick work/AAC work		0.10
	c	Water supply work		0.05
	d	Wood and Steel work complete		0.10

	e	Plastering, painting, flooring, cladding, internal finishing work		0.10
	f	Metal False ceiling in Toilets		0.05
	g	Sanitary fittings complete		0.10
5		(Level G+1 for Admin cum laboratory building)	8.0	
	a	RCC work complete for Column, beam, slab		3.00
	b	Brick work/AAC work		1.00
	c	Water supply work		0.20
	d	Aluminium and Steel work including doors and windows complete		1.00
	e	Plastering, painting, flooring, cladding, internal finishing work		1.40
	f	False ceiling and Wall paneling work		1.00
	g	Sanitary fittings complete		0.20
	h	Courtyard, stairs, ramp etc. Complete		0.20
6		Level G+1 for Farmer training hostel	3.0	
	a	RCC work complete for Column, beam, slab		1.50
	b	Brick work/AAC work		0.30
	c	Water supply work		0.15
	d	Wood and Steel work complete		0.25
	e	Plastering, painting, flooring, cladding, internal finishing work		0.50
	f	Metal False ceiling in Toilets		0.15
	g	Sanitary fittings complete		0.15
7		Level G+2 for Admin cum laboratory building	8.0	
	a	RCC work complete for Column, beam, slab		3.00
	b	Brick work/AAC work		1.00
	c	Water supply work		0.20
	d	Aluminium and Steel work including doors and windows complete		1.00
	e	Plastering, painting, flooring, cladding, internal finishing work		1.40
	f	False ceiling and Wall paneling work		1.00
	g	Sanitary fittings complete		0.20
	h	Courtyard, stairs, ramp etc. Complete		0.20
8		Level G+3 for Admin cum laboratory building	8.0	
	a	RCC work complete for Column, beam, slab		3.00
	b	Brick work/AAC work		1.00
	c	Water supply work		0.20
	d	Aluminium and Steel work including doors and windows complete		1.00
	e	Plastering, painting, flooring, cladding, internal finishing work		1.40
	f	False ceiling and Wall paneling work		1.00
	g	Sanitary fittings complete		0.20
	h	Courtyard, stairs, ramp etc. Complete		0.20
9		Level G+4 for Admin cum laboratory building	8.0	
	a	RCC work complete for Column, beam, slab		3.00
	b	Brick work/AAC work		1.00
	c	Water supply work		0.20

	d	Aluminium and Steel work including doors and windows complete		1.00
	e	Plastering, painting, flooring, cladding, internal finishing work		1.40
	f	False ceiling and Wall paneling work		1.00
	g	Sanitary fittings complete		0.20
	h	Courtyard, stairs, ramp etc. Complete		0.20
10		Level G+5 for Admin cum laboratory building	8.0	
	a	RCC work complete for Column, beam, slab		3.00
	b	Brick work/AAC work		1.00
	c	Water supply work		0.20
	d	Aluminium and Steel work including doors and windows complete		1.00
	e	Plastering, painting, flooring, cladding, internal finishing work		1.40
	f	False ceiling and Wall paneling work		1.00
	g	Sanitary fittings complete		0.20
	h	Courtyard, stairs, ramp etc. Complete		0.20
11		Level G+6 for Admin cum laboratory building	8.0	
	a	RCC work complete for Column, beam, slab		3.00
	b	Brick work/AAC work		1.00
	c	Water supply work		0.20
	d	Aluminium and Steel work including doors and windows complete		1.00
	e	Plastering, painting, flooring, cladding, internal finishing work		1.40
	f	False ceiling and Wall paneling work		1.00
	g	Sanitary fittings complete		0.20
	h	Courtyard, stairs, ramp etc. Complete		0.20
12		Terrace Level – Admin cum laboratory building	2.0	
	a	RCC complete Column, beam, slab		0.80
	b	Brick work/AAC work in Mumty, Parapet wall, Lift well etc.		0.40
	c	Water supply work complete		0.30
	d	Water Proofing and levelling complete		0.30
	E	Steel work for SMC Tank fittings with support structure		0.20
13		External structural Glazing, Texture Paint etc.	5.0	
	a	Structural Glazing		2.50
	b	Texture Paint		2.50
14		Terrace Level – Farmer training hostel	3.0	
	a	RCC complete Column, beam, slab		1.00
	b	Brick work/AAC work in Mumty, Parapet wall, Lift well etc.		0.70
	c	Water supply work complete		0.50
	d	Water Proofing and levelling complete		0.40
	E	Steel work for SMC Tank fittings with support structure		0.40
15		Other Works	16.0	
	a	Signages, blinds		1.00
	b	Rainwater drainage from roof and ground and Rainwater harvesting structure.		4.00
	c	Road work including drain, kerbstone, brick work, grass paver block/ paver block, M.S Grill all complete from entrance to peripheral road including approach up to basement & Roads around the building & Boundary wall		4.00

	d	Covered pathways and Entrance i/c ramps etc.		2.00
	e	External Water supply line & Sewer line up to STP		2.00
	f	Shed and pump house complete		1.50
	g.	ESS complete		1.50
16		Lab furniture	3.0	3.00
17		Handing over of the building/premises after completion of entire work with the satisfaction of client department/ Engineer-in-charge.	4.0	
	a	Obtaining approval of completion certificate/ occupancy certificate from local bodies.		2.00
	b	Commissioning of buildings including all civil work services		2.00
		Total	100	100
	Note: Payment of any part work of the above components may be made on Pro-rata basis for the work done.			

STAGES OF PAYMENT FOR ELECTRICAL & MECHANICAL COMPONENT

S. No.		Description of work component	Percentage of Total Quoted Amount of construction (for electrical work)	
			E&M % age	
			Total	Breakup
		E&M Services		
C-1		Internal & External Electrical Installations i/c Lightning conductor, Street light	33.39	
	1	Supplying & laying of conduits and boxes of all floors		2.00
	2	Supplying & laying of wires for all floors		2.00
	3	Supply of DBs, MCCBs, MCBs, Rising Mains along with accessories		4.80
	4	Supply of Electrical indoor Lightning fittings, Fans, Ex / Fresh air fans, Ventilating fans, Sensors, Lightning conductor, Raceways etc.		7.36
	5	Supply street light poles, landscape lighting, lightning conductor, cabling, panels etc.		3.61
	6	Complete Installation		8.00
	7	Testing & Commissioning of All Installations		5.00
	8	Consultancy charges including providing all MEP drawing & Model as per agreement condition.		
		(a) Admin cum Laboratories building		0.41
		(b) Farmer Training Hostel		0.21
C-2		Firefighting System	6.65	
	1	Supplying & Laying of Pipe fittings Valves, Hydrants, Sprinklers & Accessories		2.44
	2	Supply of Fire pumps, Engine, Panels, cables etc.		2.30
	3	Laying of pipes with Accessories		0.30
	4	Installation of Equipment		0.80
	5	Testing & Commissioning of all Installations		0.81
C-3		Fire Alarm System & PA System	3.38	
	1	Supply of Main FA Panels, repeater panels, detectors, PA system, Speakers, cables and accessories		2.31
	2	Complete Installation		0.66
	3	Testing & Commissioning of All Installations		0.41
C-4		Lifts	3.56	
	1	Supply of Lift equipment		2.00
	2	Complete Installation		0.66

	3	Testing & Commissioning of All Installations		0.89
C-5		Substation	6.74	
	1	Supply of Substation equipment i/c transformer, HT panel etc.		2.00
	2	Supply of LT Panels, and sub-LT panels, APFC Panels		1.20
	3	Supply other related works like HT & LT cabling, bus duct etc.		0.97
	4	Installation of above equipment		0.57
	5	Testing & Commissioning of All Installations		2.00
C-6		DG sets	3.85	
	1	Supply of DG sets, Synch Panel, Bus Trunking, UG Diesel tank, Exhaust Piping		2.50
	2	Supply of other Misc. items and complete Installation		0.50
	3	Testing & Commissioning of All Installations		0.85
C-7		UPS System	0.71	
	1	Supply of UPS Unit, Batteries and stand		0.40
	2	Supply of other Misc. and complete Installation		0.17
	3	Testing & Commissioning of All Installations		0.14
C-8		VRV/ VRF BASED AIR CONDITIONING SYSTEM (Heating and Cooling)	19.45	
	1	Supplying of materials like Indoor, outdoor units		6.00
	2	Fabrication and installation of Ducts & Supply of copper Pipe, insulation etc..		3.03
	7	Installation of above equipment		6.42
	8	Testing and commissioning of all equipment		4.00
C-9		Solar water Heating System	0.31	
	1	Supply of Solar panels, Storage Tanks, Re-circulating pumps		0.16
	2	Supply of other Misc. items and complete Installation		0.10
	3	Testing & Commissioning of All Installations		0.05
C-10		LAN System	2.43	
	1	Supply of LAN equipment		1.40
	2	Supply of other Misc. items and complete Installation		0.72
	3	Testing & Commissioning of All Installations		0.32
C-11		EPBAX System	2.53	
	1	Supply of EPBAX equipment		1.73
	2	Supply of other Misc. items and complete Installation		0.40

	3	Testing & Commissioning of All Installations		0.40
C-12		CCTV System	1.30	
	1	Supply of CCTV equipment		0.70
	2	Supply of other Misc. items and complete Installation		0.24
	3	Testing & Commissioning of All Installations		0.36
C-13		Audio Visual/ Conference system	3.36	
	1	Supply of Equipment		2.00
	2	Supply of other Misc. items and complete Installation		0.73
	3	Testing & Commissioning of All Installations		0.63
C-14		STP (Sewerage Treatment Plant) & ETP (Effluent Treatment Plant)	2.87	
	1	Supply of Equipment		1.75
	2	Supply of other Misc. items and complete Installation		0.82
	3	Testing & Commissioning of All Installations		0.30
C-15		Solar Photo Voltic Power Generation system	2.53	
	1	Supply of Equipment		1.60
	2	Supply of other Misc. items and complete Installation		0.40
	3	Testing & Commissioning of All Installations		0.53
C-16		Split AC	0.77	
	1	Supply of Equipment		0.40
	2	Supply of other Misc. items and complete Installation		0.20
	3	Testing & Commissioning of All Installations		0.17
C-17		R.O. Water Plant	0.52	
	1	Supply of Equipment		0.32
	2	Supply of other Misc. items and complete Installation		0.10
	3	Testing & Commissioning of All Installations		0.10
C-18		Water Supply System	0.50	
	1	Supply of Equipment		0.28
	2	Supply of other Misc. items and complete Installation		0.11
	3	Testing & Commissioning of All Installations		0.11
C-19		Emergency light, Illuminated signages	0.14	
	1	Supply of Equipment		0.07
	2	Supply of other Misc. items and complete Installation		0.03

	3	Testing & Commissioning of All Installations		0.04
C-20		Commissioning of Building including all E&M Services and getting required clearances/ approval/ NOC	5.00	
	1	Commissioning of building including all E&M Services and getting required clearances /approval /NOC		5.00
		Total		100.00
		(NOTE: For above all E&M services pro-rata payment will be made supply/execution in parts	100.00	100.00

CHAPTER-F-1

SCHEDULE OF QUANTITIES

Financial Quote

ABSTRACT

Name of Work: Construction of Babugarh campus of ICAR-CIRC at Babugarh Hapur, UP. (SH:C/o Administration cum Laboratory building and Farmers Training Hostel i/c Land development at Site A, in EPC Mode -I).

Item no	Description of item	Qty	Rate		Unit	Amount (Rs.)
	Civil Works		In Figures	In Words		
1	Engineering, Procurement and Construction of Administration cum Laboratory building G+6 storeyed building, Farmers Training Hostel (G+1) storeyed building RCC framed structure and Land development at Site A on EPC basis (SH: Civil works including Internal Water supply, Sanitary Installations, Drainage, Development works like Terrace water Tanks, ,Rain water harvesting system, Internal Roads, Pathways, Water Supply Lines, Storm Water Drains, External Sewer age System, Service Trenches, bio medical waste, DG set/panel room, utility room, canteen and cafe, guard room, overhead tanks, underground sump well, Development of Site, and Electrical works i/c Internal & External Electrical Installations, Lightning conductor, Lift, Fire Alarm System, Firefighting system, Sub-Station, DG sets, UPS, VRV/VRF Air Conditioning System , Solar water heating system, solar photo voltaic power generation system , CCTV system,					

	LAN system, IP based EPBAX system, Audio, Video/ Conference system, Street lightening with LED, Water supply pumps, STP plant, Emergency light and illuminated signages, RO water plant, Split AC & other Misc. works.)					
	(a) Detailed planning and preparation of detailed Structural & Services drawings of all components of various buildings using Proposed Structural System technology including civil and E&M works. (b) Construction & Commissioning of Building(s) using proposed structural system technology as per relevant provisions of latest BIS codes / NBC or any other international code with all components of building such as foundation, flooring, roof, walls, finishes, E&M works, internal roads with footpath, external sewerage, water supply, storm water drain, rain water harvesting and bulk services for civil and electrical, etc. as per enclosed concept drawings, scope of work, specifications and other provisions as detailed in the tender documents complete up to the entire satisfaction of the Engineer-in-Charge.					

1.1	All Civil Works work (as described anywhere else in NIT)	1 job	Rs.72,53,72,624/-	Seventy Two Crore Fifty Three Lac Seventy Two Thousand Six Hundred Twenty four Only	Per job	Rs 73,56,78,489/-
1.2	All E&M Works (as described anywhere else in NIT)	1 Job	Rs.28,62,26,164/-	Twenty Eight Crore Sixty Two Lac Twenty Six Thousand One Hundred Sixty Four Only	Per job	Rs. 28,56,51,664/-
	Total Cost					Rs. 102,13,30,153/-

I/we quote my / our rate for the above work as under:

Notes: -

1. The rates quoted are inclusive all external development works for Civil and E&M components including external service connections.
2. The rates quoted is inclusive of all applicable taxes and duties.
3. **Broad scope of works and plinth area details are as per this NIT document.**

PART-G

VOLUME-II

SOIL INVESTIGATION REPORT

(This Report is Interim & Indicative only.)

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BRIEFDESCRIPTION

CLIENT	EE MEERUT INCOME TAX OFFICE CAMPUS BHAINALI GROUNDMEERUT
NAME OF WORK	Enabling Estimate for 70 Acre land and 80 Acre Land of ICAR-CIRC Babugarh, Hapur UP. (SH. Determination of SBC,)
LOCATION	Babugarh, Hapur UP
TESTING AGENCY	GEO GLOBE CONSULTANTS (ISHPO : 9001-2015) PlotNo.777, JLPL Industrial Area, Sector 82, Mohali, Punjab-160062. Contact: 9888608424 Gmail: ggconsultants2010@gmail.com Website: www.geoglobeconsultant.com
TESTING	GEO-TECHNICAL INVESTIGATION

SOIL INVESTIGATION



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SR. NO.	DESCRIPTION
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1 INTRODUCTION

- 1.01 The report presented herein deals with result of field and laboratory investigation carried out to assess the nature of sub-soil strata at 70 Acre land and 80 Acre Land of ICAR-CIRC Babugarh, Hapur UP.
- 1.02 The work of soil investigations was assigned to M/s Geo Globe Consultants, Mohali. (Pb)

SCOPE OF WORK

The soil investigation covers the following: -

- 2.01 Conducting Standard Penetration Test (SPT) in 10 Nos. bore hole up to a depth of, 15 m or refusal.
- 2.02 Collecting soil samples at various depths as per requirement of the Client from the bore holes as feasible, for laboratory tests.
- 2.03 Analyzing the field and laboratory observations.
- 2.04 Submitting four copies of the soil investigations report and recommending safe Bearing capacity of soil.

3 SITE

- 3.01 The Site of Investigation is at ICAR-CIRC Babugarh, Hapur UP. There is no special features which affected the explorations.
- 3.02 The location of bore holes was given by the client's representative who was with the investigating team till the investigations were over.

4GROUND WATER TABLE

Sr.No.	B.H Location	Water Table Depth From NGL (m)
1	80 Acre Land BH 1	Nil
2	80 Acre Land BH 2	Nil
3	80 Acre Land BH 3	Nil
4	80 Acre Land BH 4	Nil
5	80 Acre Land BH 5	Nil
6	70 Acre land BH 6	Nil
7	70 Acre land BH 7	Nil
8	70 Acre land BH 8	Nil
9	70 Acre land BH 9	Nil
10	70 Acre land BH 10	Nil

RECOMMENDATIONS

- ❖ On the basis of field & laboratory investigation & Analysis in the following pages for bearing capacity values following reference have been drawn.
- ❖ The value of allowable B.C to be adopted for design consideration at different depths are as follows
- ❖ This is the general recommendation. The designer may change the recommendation & he may decide the depth of the foundation & type of foundation as per the structural details of structure.

	Location	size of fdn (B) m	Depth from NGL m	Type of Foundation	(qa)Net t/m ²
1	BH -1-5 (80 ACRE)	2 x 2 Square	1.5	Isolated Footing	13.43
2	BH -1-4 (80 ACRE)	2 x 2 Square	2.5	Isolated Footing	20.64
3	BH (6-10)(70 ACRE)	2 x 2 Square	1.5	Isolated Footing	11.6
4	BH(6-10) (70 ACRE)	2 x 2 Square	2.5	Isolated Footing	17.88

5 FIELD INVESTIGATIONS

The field investigations were conducted to cover the entire scope of the job.

BORING – OPERATIONS (IS 1892-1979)

The exploratory bore holes were made by rotary rig percussion boring method by pushing the casing pipe and removing material within the casing. To avoid excessive disturbance to the in-situ deposits, the casing was not driven but was rotated frequently with slow motion. The samples were taken from below the bottom of the casing after completely cleaning the bore holes of any loose material at all depths wherever the samples had to be taken. The undisturbed soil samples were taken by pushing thin walled tubes into the bore holes. Immediately after taking these, they were logged, labeled, sealed in polythene bag and sent to the laboratory for testing.

5.02 STANDARD PENETRATION TEST (SPT) IS: 2131)

The Standard Penetration Tests were conducted at various depths in the bore holes. These tests were conducted by driving into the soil a standard split spoon sampler. This sampler

was driven with the help of a hammer weighing 63.5 kg. Which was vertically guided to fall through a free height of 75cm on the driving

6. LABORATORY INVESTIGATIONS

The laboratory tests were conducted on selected soil samples recovered from the test bore holes. The results obtained have been given in the various tables at the end of the report.

6.01: GRAIN SIZE ANALYSIS: (IS 2720 PART 4)

Grain Size analysis was carried out on Disturbed and undisturbed Samples obtained during boring operation. Percentage of sand and combined Silt and Clay were determined from this analysis. The test was carried out as per IS: 2720 (Part IV)

6.02: LIQUID LIMITS AND PLASTIC LIMITS(IS 2720 PART 5)

To obtain an idea about the consistency characteristics of materials met with at various elevations, the liquid limits and plastic limits of fine fractions were evaluated as per procedure laid down in IS : 2720 (Part-V). These values have been recorded only in the case of plastic samples (cohesive soils), on the bore hole data.

To obtain an idea about the consistency characteristics of materials met with at various elevations, the liquid limits and plastic limits of fine fractions were evaluated as per procedure laid down in IS : 2720 (Part-V). These values have been recorded only in the case of plastic samples (cohesive soils), on the bore hole data.

6.03 SPECIFIC GRAVITY (IS – 2720: PART 3)

Specific gravity of soil was determined as follow. $G =$

$$G = \frac{m_4 - m_1}{(m_3 - m_2) \times G_l}$$

$$m_4 - m_1 - (m_3 - m_2)$$

Where,

G_l = Specific gravity of the liquid Used at the constant temperature.

m_1 = Mass of 50 ml capacity density bottle in g.

m_2 = Mass of bottle and dry soil sample passed through 2 mm IS sieve.

m_3 = mass of bottle + soil and air-freed distilled water in g.

m_4 = mass of bottle when full of distilled water only in g.

6.04 THE BULK DENSITY IS : 2720 (PART IV)

The bulk density and grain size analysis was done for the samples taken as per IS : 2720 (Part IV)

6.05 DIRECT SHEAR TEST (IS 2720 PART 13):1986

Remolded Specimens

To prepare specimen soil was tamped in the shear box itself with the base plate and grid plate or porous stone as required in place at the bottom of the box.

The cut specimen was weighed and trimmings obtained during cutting was used to obtain the moisture content. Using this information, the bulk dry density of the specimen was determined

This test was performed in a shear-box apparatus. The apparatus consisted of two-piece shear box of square cross-section. The lower half of the box was rigidly held in position in a container which rested over rollers and which was pushed forward at a constant rate by a geared jack, driven by an electric motor. The upper half of the box butted against a proving ring. The soil sample was compacted in the shear box and was held between metal grids and porous stones. Normal load was applied on the pressure pad. The shearing strain was made to increase at constant rate. The shear force at failure corresponding to the applied normal load was measured with the help of the proving ring. A number of identical specimens were tested under increasing normal loads and the required maximum shear force was recorded and a graph was plotted between shear force as the ordinate and normal load as the abscissa to get the failure envelope and the value of C & ϕ .

6.06 TRIAXIAL COMPRESSION TEST (IS 2720 PART 11)

Preparation of Test Undisturbed Specimens The object of the specimen preparation is to produce cylindrical specimens of height twice the specimen diameter with plane ends normal to the axis and with the minimum change of the soil structure and moisture content. The method of preparation was taken on as per clause 4.2(c) IS 2720 P-11.

Wax used was removed and the cutting edge end of the sample smoothed so that it is approximately normal to the axis of the tube. Precautions were taken to prevent adhesion between the soil and the extruder, by interposing oiled paper discs or lightly oiling the face of the extruder

TESTING:

The specimen prepared as described above was placed centrally on the pedestal of the triaxle cell. The cell was assembled with the loading ram initially clear of the top cap of the specimen and the cell containing the specimen placed in the loading machine. The operating fluid was admitted to the cell and the pressure raised to the desired value.

The loading machine was adjusted to bring the loading ram a short distance away from the seat on the top cap of the specimen and the initial reading of the load measuring gauge was recorded. The loading machine shall be further adjusted to bring the loading ram just in contact with the seat on the top cap of the specimen and the initial reading of the gauge measuring the axial compression of the specimen shall be recorded. A rate of axial compression was selected such that failure was produced within a period of approximately 5 to 15 minutes. The test was commenced, a sufficient number of simultaneous readings of the load and compression measuring gauges being taken to define the stress strain curve. The test was continued until the maximum value of the stress has been passed or until an axial strain of 20 percent has been reached. The specimen was then unloaded and the final reading of the load measuring gauge was recorded as a check on the initial reading.

The cell was drained of fluid and dismantled, and the specimen taken out. The rubber membrane was removed from the specimen and the mode of failure was be noted .

6.07CONSOLIDATION TESTS (IS 2720 PART 15)

The consolidation tests were carried out on undisturbed soil specimen in order to determine the settlement characteristics of soil at different depths. The tests is conducted in accordance to IS: 2720 (Pt-XV).

An undisturbed soil specimen was extruded to the consolidation ring of 60mm dia. The edge was trimmed carefully such that the sample was flushed with the top andbottom edges of the ring. The thickness of the specimen was measured and theweight was recorded. The bottom porous stone was then centered on the base of the consolidation cell. The specimen was then placed centrally between the bottom porous stone and the upper porous stone. A filter paper was provided in between specimen and

porous stones. Then the loading cap was placed on the top. The consolidometer was placed in position in the loading device and suitably adjusted. The dial gauge is then clamped into position for recording the relative movement between the base of the cell and the loading cap. A seating pressure of 0.05 kg/cm^2 was applied to the specimen. The cell was kept filled with water. After 24 hr. the test was continued further using a loading sequence on the soil specimen of 0.25, 0.5, 1.0, 2.0, 4.0, & 8.0 kg/cm^2 . For each loading increment after application of load, readings of the dial gauge was taken using time sequence 0, 0.25, 1, 2.25, 2, 6.25, 9, 16, 25, 36, 49 ... up to 24 hrs. From the observations of all incremental pressures, void ratio versus log (pressure) curve was obtained. The slope of the straight line portion was designated as compression index c_c .

6.08 CONSOLIDATION TESTS (IS 2720 PART 15)

The consolidation tests were carried out on undisturbed soil specimen in order to determine the settlement characteristics of soil at different depths. The tests is conducted in accordance to IS: 2720 (Pt-XV).

An undisturbed soil specimen was extruded to the consolidation ring of 60mm dia. The edge was trimmed carefully such that the sample was flushed with the top and bottom edges of the ring. The thickness of the specimen was measured and the weight was recorded. The bottom porous stone was then centered on the base of the consolidation cell. The specimen was then placed centrally between the bottom porous stone and the upper porous stone. A filter paper was provided in between specimen and porous stones. Then the loading cap was placed on the top. The consolidometer was placed in position in the loading device and suitably adjusted. The dial gauge is then clamped into position for recording the relative movement between the base of the cell and the loading cap. A seating pressure of 0.05 kg/cm^2 was applied to the specimen. The cell was kept filled with water. After 24 hr. the test was continued further using a loading sequence on the soil specimen of 0.25, 0.5, 1.0, 2.0, 4.0, & 8.0 kg/cm^2 . For each loading increment after application of load, readings of the dial gauge was taken using time sequence 0, 0.25, 1, 2.25, 2, 6.25, 9, 16, 25, 36, 49 ... up to 24 hrs. From the observations of all incremental pressures, void ratio versus log (pressure) curve was obtained. The slope of the straight line portion was designated as compression index c_c .

7.0 INTERPRETATION OF SOIL STRATA

- i) On perusal of the strata chart (Table-1) indicates the sub-soil strata at the site is heterogeneous in nature
- ii) In Bore hole location No 1 to 10 nos the majority of soil strata from NGL to 4.5 m silty sand was encountered beyond up to 15 m poorly graded sand was encountered.

BORE HOLE -1

Depth m	Observed N-value (N)	Corrected N-value (Nc)	Overburden pressure t/m ²	Correction Factor
1.5	9	13	2.41	1.48
3.0	12	15	4.54	1.27
4.5	17	19	7.05	1.12
6.0	20	20	9.35	1.02
7.5	22	20	12.92	0.92
9.0	26	22	15.51	0.86
10.5	19	16	16.23	0.84
12.0	45	35	20.16	0.77
13.5	37	27	22.80	0.73
15.0	45	31	25.21	0.69

BORE HOLE -2

Depth m	Observed N-value (N)	Corrected N-value (Nc)	Overburden pressure t/m ²	Correction Factor
1.5	8	12	2.45	1.47
3.0	8	10	5.08	1.23
4.5	11	12	7.55	1.10
6.0	12	12	10.27	0.99
7.5	15	14	12.38	0.93
9.0	14	12	14.69	0.87
10.5	19	15	17.56	0.81
12.0	24	18	20.36	0.76
13.5	28	20	23.02	0.72
15.0	24	16	25.86	0.68

BORE HOLE -3

Depth m	Observed N-value (N)	Corrected N-value (Nc)	Overburden pressure t/m²	Correction Factor
1.5	11	16	2.50	1.47
3.0	12	15	5.04	1.23
4.5	14	15	7.49	1.10
6.0	17	17	10.04	1.00
7.5	20	18	12.67	0.92
9.0	17	15	15.22	0.86
10.5	23	19	17.68	0.81
12.0	23	18	20.34	0.76
13.5	26	19	23.00	0.72
15.0	30	21	25.75	0.69

BORE HOLE -4

Depth m	Observed N-value (N)	Corrected N-value (Nc)	Overburden pressure t/m²	Correction Factor
1.5	22	32	2.65	1.45
3.0	18	22	5.24	1.22
4.5	14	15	7.69	1.09
6.0	13	13	10.17	1.00
7.5	14	13	12.54	0.93
9.0	22	19	14.70	0.87
10.5	27	22	17.76	0.81
12.0	38	28	21.93	0.74
13.5	51	36	24.91	0.70
15.0	58	38	27.86	0.66

BORE HOLE -5

Depth m	Observed N-value (N)	Corrected N-value (Nc)	Overburden pressure t/m ²	Correction Factor
1.5	11	16	2.50	1.47
3.0	12	15	5.04	1.23
4.5	14	15	7.49	1.10
6.0	17	17	10.04	1.00
7.5	20	18	12.67	0.92
9.0	17	15	15.22	0.86
10.5	23	19	17.68	0.81
12.0	23	18	20.34	0.76
13.5	26	19	23.00	0.72
15.0	30	21	25.75	0.69

BORE HOLE -6

Depth m	Observed N-value (N)	Corrected N-value (Nc)	Overburden pressure t/m ²	Correction Factor
1.5	6	9	1.80	1.45
3.0	10	12	1.85	1.22
4.5	12	13	1.85	1.09
6.0	16	16	1.88	1.00
7.5	11	10	1.89	0.93
9.0	16	14	1.90	0.87
10.5	20	16	1.90	0.81
12.0	22	17	1.92	0.74
13.5	26	19	1.96	0.70
15.0	30	21	1.98	0.66

BORE HOLE -7

Depth m	Observed N-value (N)	Corrected N-value (Nc)	Overburden pressure t/m ²	Correction Factor
1.5	5	7	2.50	1.47
3.0	9	11	5.00	1.23
4.5	12	13	7.52	1.10
6.0	16	16	10.09	1.00
7.5	15	14	12.81	0.92
9.0	20	17	15.14	0.86
10.5	22	18	17.74	0.81
12.0	26	20	20.17	0.76
13.5	32	23	23.16	0.72
15.0	30	21	25.75	0.69

BORE HOLE -8

Depth m	Observed N-value (N)	Corrected N-value (Nc)	Overburden pressure t/m²	Correction Factor
1.5	7	10	2.48	1.47
3.0	11	14	4.94	1.24
4.5	13	14	7.45	1.10
6.0	14	14	10.17	1.00
7.5	17	16	12.69	0.92
9.0	16	14	15.08	0.86
10.5	19	16	16.87	0.83
12.0	24	19	18.81	0.79
13.5	36	27	21.60	0.74
15.0	44	30	26.29	0.68

BORE HOLE -9

Depth m	Observed N-value (N)	Corrected N-value (Nc)	Overburden pressure t/m ²	Correction Factor
1.5	7	10	2.42	1.48
3.0	10	12	4.98	1.23
4.5	13	14	7.39	1.10
6.0	15	15	10.09	1.00
7.5	16	15	12.55	0.93
9.0	19	16	15.14	0.86
10.5	23	19	17.66	0.81
12.0	27	21	20.39	0.76
13.5	39	28	23.42	0.72
15.0	56	38	26.37	0.68

BORE HOLE -10

Depth m	Observed N-value (N)	Corrected N-value (Nc)	Overburden pressure t/m²	Correction Factor
1.5	7	10	2.50	1.47
3.0	11	14	5.04	1.23
4.5	14	15	7.49	1.10
6.0	19	19	10.04	1.00
7.5	21	19	12.67	0.92
9.0	23	20	15.22	0.86
10.5	25	20	17.68	0.81
12.0	29	22	20.34	0.76
13.5	37	27	23.00	0.72
15.0	44	30	25.75	0.69

FOUNDATION ANALYSIS

Bearing capacity has been evaluated keeping in view of the foundation will be safe against local or general shear failure.

:-Shear Failure Analysis:-BH 1 to 5 (Plot No. 1) (80 acres)

The shear value determined in the laboratory with the help of Shear Test on the collected samples from the location the actual lowest shear value determined in the laboratory worked out to C-value 0 Kg/cm² and ϕ value as between 31°-33°. Using these values the net bearing capacity is calculated from the following formula as per IS 6403-1981 for local shear failure.

Determination of Bearing Capacity size 2 x 2 m Isolated Foundation depth 2 m

Bearing Capacity from General shear criterion:

Type of Foundation : Isolated Footing

C = 0.0, kg/cm² $\Phi = 31^\circ$, $\Phi' = 22^\circ$ (Effective angle of shearing resistance)

(A) Shear failure Considerations:

Relevant B.C factors					
N_c	16.88	S_c	1.3	d_c	1.22
N_q	7.82	S_q	1.2	d_q	1.11
N_γ	7.13	S_γ	0.8	d_γ	1.11

Inclination factors are taken as Unity

$\gamma_b = 1.79$, $\gamma_d = 1.63$

B = 2 m,

d = 1.5 m

w' = 1 (Water factor)

TABLE 2 SHAPE FACTORS

Sl. No.	SHAPE OF BASE	SHAPE FACTOR		
		i_c	s_q	s_γ
i)	Continuous strip	1.00	1.00	1.00
ii)	Rectangle	$1 + 0.2 B/L$	$1 + 0.2 B/L$	$1 - 0.4 B/L$
iii)	Square	1.3	1.2	0.8
iv)	Circle	1.3	1.2	0.6

Use B as the diameter in the bearing capacity formula.

IS 6403 : 1981

5.1.2.2 The depth factors shall be as under:

$$d_c = 1 + 0.2 D_f/B \sqrt{N\phi}$$

$$d_q = d_\gamma = 1 \text{ for } \phi < 10^\circ$$

$$d_q = d_\gamma = 1 + 0.1 D_f/B \sqrt{N\phi} \text{ for } \phi > 10^\circ$$

NOTE — The correction is to be applied only when back filling is done with proper compaction.

Net Ultimate b.c

$$\begin{aligned} q_{nf} &= \frac{2}{3} N_c S_c d_c + q (N_q - 1) S_q d_q + 0.5 B \gamma N_\gamma S_\gamma d_\gamma W' \\ &= 33.57 \text{ t/m}^2 \end{aligned}$$

Net Safe b.c

$$'q_{ns}' = 13.43 \text{ t/m}^2 (\text{f.o.s} = 2.5)$$

SETTLEMENT CONSIDERATION

(IS: 8009 (PART-I)-1976,
REAFFIRMED 1998)

$$N_{av} = 18$$

$$\text{Corresponding settlement} = 18 \text{ mm}$$

$$\text{Permissible settlement} = 50 \text{ mm}$$

$$B_c \text{ works out to be} = 27.77$$

$$\text{However lowest amongst two shall be recommended} = 13.43 \text{ t/m}^2$$

BH 6 to 10 (Plot No. 2) (70 acres)**:-Shear Failure Analysis:- BH 6 to 10 (Plot No. 2) (70 acres)**

The shear value determined in the laboratory with the help of Shear Test on the collected samples from the location the actual lowest shear value determined in the laboratory worked out to C-value 0 Kg/cm² and ϕ value as between 30°-33°. Using these values the net bearing capacity is calculated from the following formula as per IS 6403-1981 for local shear failure.

Determination of Bearing Capacity size 2 x2 m Isolated Foundation depth 2 m

Bearing Capacity from General shear criterion:

Type of Foundation : Isolated Footing

C =0.0, kg/cm² $\Phi =30^0$, $\Phi^* =21^0$ (Effective angle of shearing resistance)

(A) Shear failure Considerations:

Relevant B.C factors					
N_c	15.81	S_c	1.3	d_c	1.22
N_q	7.07	S_q	1.2	d_q	1.11
N_γ	6.20	S_γ	0.8	d_γ	1.11

Inclination factors are taken as Unity

$\gamma_b = 1.75$, $\gamma_d = 1.60$

B =2 m,

d= 1.5 m

$w' = 1$ (Water factor)

TABLE 2 SHAPE FACTORS

SL No.	SHAPE OF BASE	SHAPE FACTOR		
		s_c	s_q	s_γ
i)	Continuous strip	1.00	1.00	1.00
ii)	Rectangle	$1 + 0.2 B/L$	$1 + 0.2 B/L$	$1 - 0.4 B/L$
iii)	Square	1.3	1.2	0.8
iv)	Circle	1.3	1.2	0.6

Use B as the diameter in the bearing capacity formula.

IS 6403 : 1981

5.1.2.2 The depth factors shall be as under:

$$d_c = 1 + 0.2 D_f/B \sqrt{N\phi}$$

$$d_q = d_\gamma = 1 \text{ for } \phi < 10^\circ$$

$$d_q = d_\gamma = 1 + 0.1 D_f/B \sqrt{N\phi} \text{ for } \phi > 10^\circ$$

NOTE — The correction is to be applied only when back filling is done with proper compaction.

Net Ultimate b.c

$$\begin{aligned} q_{nf} &= \frac{2}{3} N_c s_c d_c + q (N_q - 1) s_q d_q + 0.5 B \gamma N_\gamma s_\gamma d_\gamma W' \\ &= 29.60 \text{ t/m}^2 \end{aligned}$$

Net Safe b.c

$$q_{ns} = 11.60 \text{ t/m}^2 (\text{f.o.s} = 2.5)$$

SETTLEMENT CONSIDERATION

(IS: 8009 (PART-I)-1976,
REAFFIRMED 1998)

$$N_{av} = 13$$

$$\text{Corresponding settlement} = 23 \text{ mm}$$

$$\text{Permissible settlement} = 50 \text{ mm}$$

$$B_c \text{ works out to be} = 21.73$$

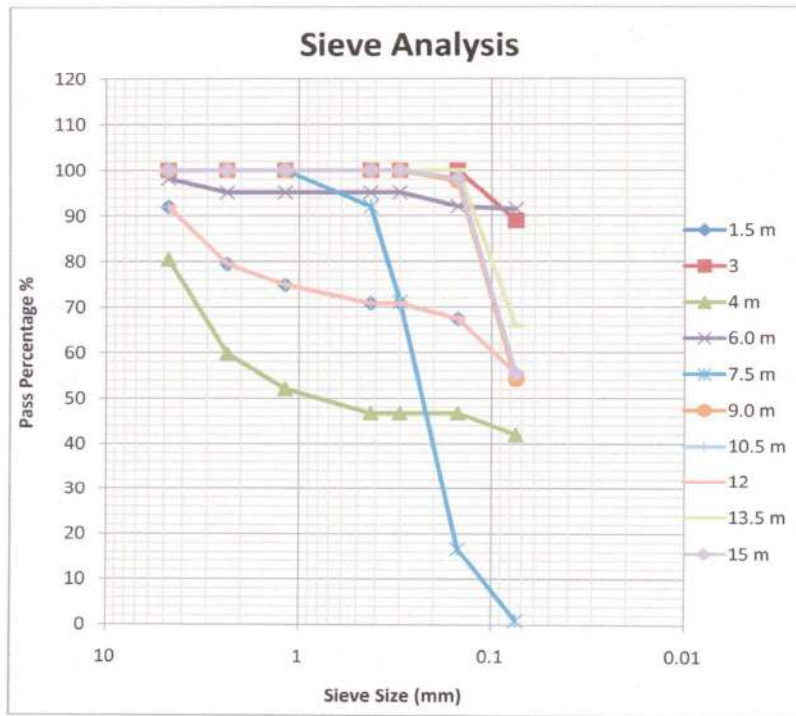
$$\text{However lowest amongst two shall be recommended} = 11.6 \text{ t/m}^2$$



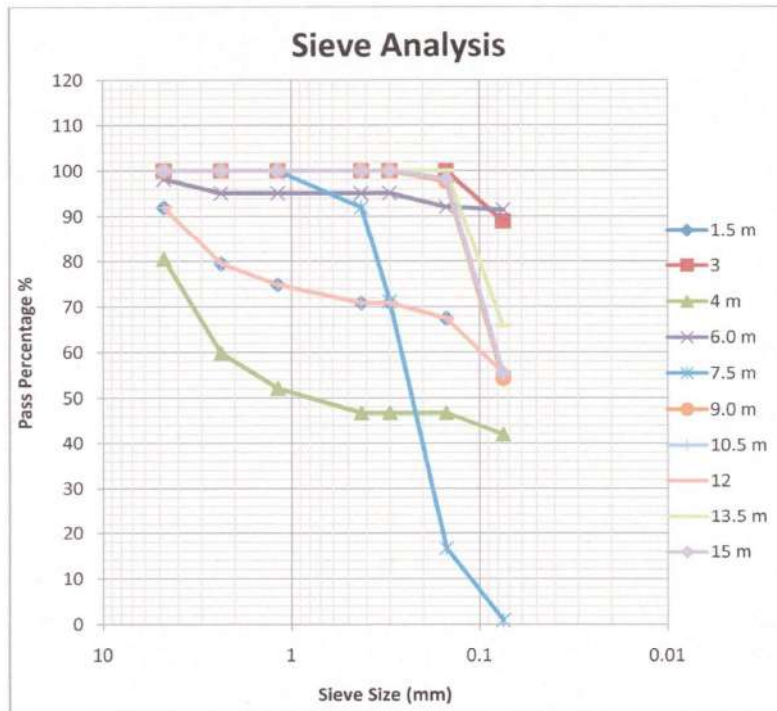
25 | Page

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Plot No. 777, Sector 82, JLPL, S.A.S. Nagar, Mohali

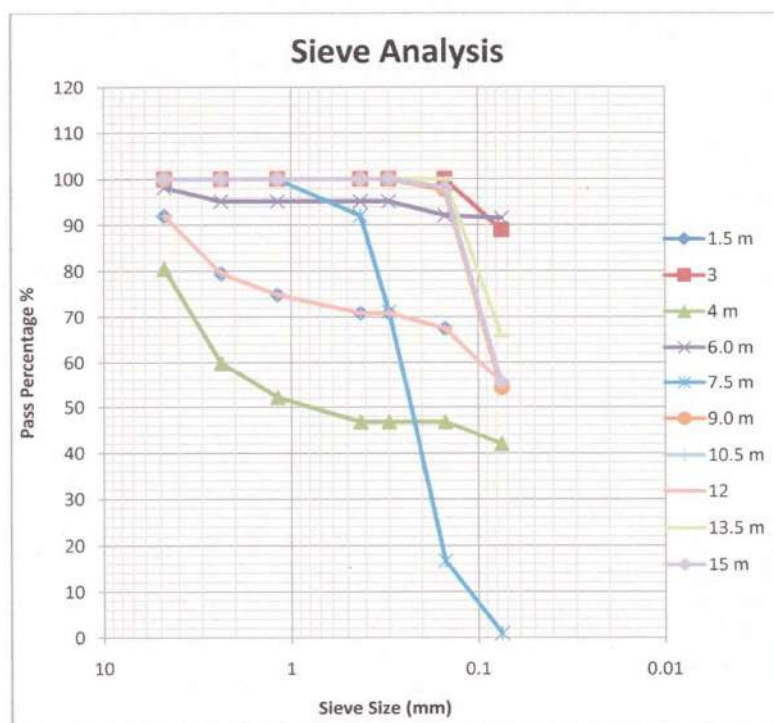
SEIVE ANALYSIS FOR BH-1 for Different Depths



SEIVE ANALYSIS FOR BH-3 for Different Depths



SEIVE ANALYSIS FOR BH-5 for Different Depths

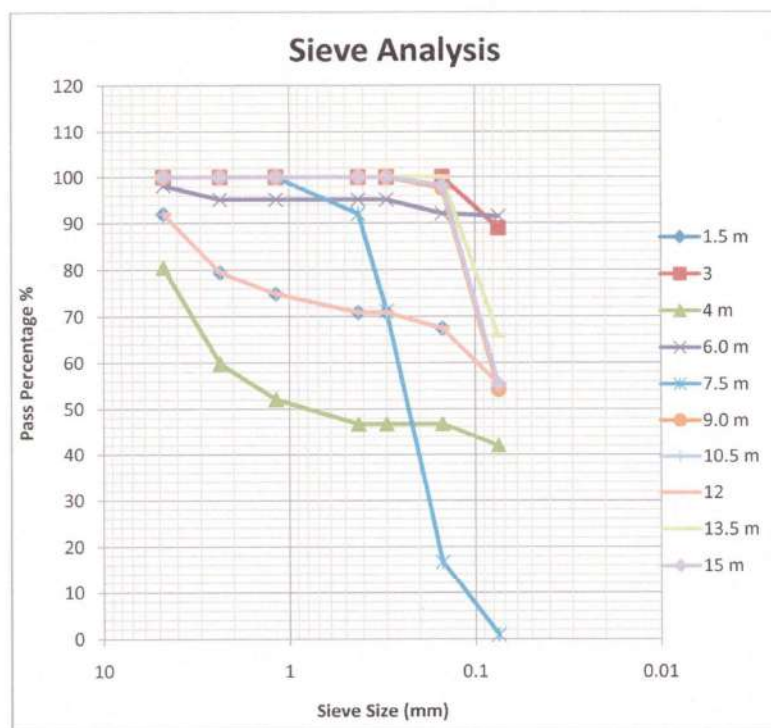




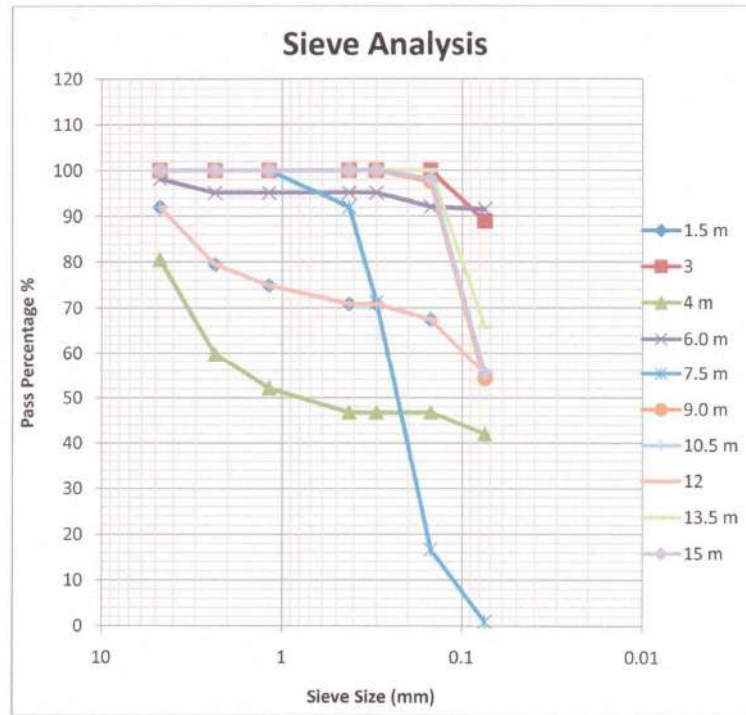
Addition: NIL Correction: NIL
Overwriting: NIL Deletion: NIL

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SEIVE ANALYSIS FOR BH-7 for Different Depths



SEIVE ANALYSIS FOR BH-10 for Different Depths



BORE LOG CHART

BH-1(PLOT 80 ACRE)

Geo Globe Consultants

PROJECT: Soil Investigation for Construction of proposed structure.

LOCATION: 80 Acre Land of ICAR-CRC Babugarh,

BH NO.: 1

REFERENCE POINT (RL) : NGL

DATE OF BORING :

DIA OF CASING=150 mm

LABORATORY TEST RESULTS

DEPTH FROM NGL (m)	SPT (N) BLOWS 30cm		STANDARD PENETRATION RESISTANCE CURVE	SYMBOLIC REPRESENTATION	I.S.C. GROUP	Level Of Water Table	% MOISTURE	% GRAVEL MODULES (-80 MM FRACTION)	% SAND	% SILT + CLAY (-75 MICRON)	LL	PI	DENSITY (gm/cc)		SP. GRAVITY	VOID RATIO	UNCONFINED COMP. STRN Kg/Cm ² (C _u)	B _u Kg/C ²	Φ° DIRECT SHEAR TRIAXIAL COMPRESSION TEST	COMPRESSION INDEX	C _c = 0.30 (e _{sp} = 0.27)	REMARKS
	OBSERVED SPT	CORRECTED											FIELD Density gm/cc	DRY Density gm/cc								
1.5	9	13		ML		13.0	0.00	12.4	87.6	N	P	1.83	1.61	2.63	0.64	-	-	31	-	-	-	SILT
3.0	12	15		ML		21.8	0.00	40.8	59.2	N	P	1.86	1.51	2.64	0.74	-	-	31	-	-	-	SILT
4.5	17	19		SM		17.6	0.00	91.2	8.8	N	P	1.86	1.57	2.66	0.70	-	-	32	-	-	-	SILTY SAND
6.0	20	20		SM		19.0	0.00	88.1	11.9	N	P	1.87	1.56	2.64	0.69	-	-	32	-	-	-	SILTY SAND
7.5	22	20		SM		8.7	0.00	87.5	12.5	N	P	1.89	1.72	2.62	0.52	-	-	33	-	-	-	SILTY SAND
9.0	26	22		SM		8.7	0.00	87.5	12.5	N	P	1.89	1.72	2.64	0.53	-	-	33	-	-	-	SILTY SAND
10.5	19	16		SM		22.0	0.00	85.4	14.6	N	P	1.90	1.55	2.85	0.71	-	-	33	-	-	-	SILTY SAND
12.0	45	35		SM		12.1	0.00	93.0	7.0	N	P	1.90	1.68	2.66	0.58	-	-	32	-	-	-	SILTY SAND
13.5	37	27		SM		12.1	0.00	93.0	7.0	N	P	1.91	1.69	2.64	0.56	-	-	33	-	-	-	SILTY SAND
15.0	45	31		SM		13.3	0.00	91.2	8.8	N	P	1.92	1.68	2.62	0.56	-	-	32	-	-	-	SILTY SAND

BORE LOG CHART

BH-2(PLOT 80 ACRE)

Geo Globe Consultants

PROJECT: Soil Investigation for Construction of proposed structure.
 LOCATION: 80 Acre Land of KAR-CHIC Babughah, Hapur
 BH NO.: 2

REFERENCE POINT (RL) > NGL
 DATE OF BORING >
 DIA OF CASING-150 mm

LABORATORY TEST RESULTS

DEPTH FROM NGL (m)	SPT (N) BLOWS 30cm		STANDARD PENETRATION RESISTANCE CURVE	SYMBOLIC REPRESENTATION	I.S.C. GROUP	Level of Water Table	LABORATORY TEST RESULTS				DENSITY (gm/cc)		SP. GRAVITY	VOID RATIO	UNCONFINED COMP. STREN Kg/Cm ² (C _u)	C _u Kg/C	φ ² DIRECT SHEAR TRIAXIAL COMPRESSION TEST COMPRESSION INDEX Cc = 0.30 (40 - 0.27)	REMARKS	TYPE OF SAMPLE DS OR UDS
	OBSERVED SPT	CORRECTED					% MOISTURE	% GRAVEL MODULES (-80 MM FRACTION)	% SAND	% SILT + CLAY (-75 MICRON)	LL	PI							
1.5	8	12	0.0 10.0 20.0 N VALUES 0 DEPTH IN M —●— OBSERVED N —■— CORRECTED N	SM	8.7	0.00	43.5	56.5	N	P	1.79	1.83	2.66	0.63	-	-	30	SILTY SAND	DS
3.0	8	10		SM	5.3	0.00	74.7	25.3	N	P	1.80	1.69	2.64	0.56	-	-	30	SILTY SAND	UDS
4.5	11	12		SM	7.0	0.00	72.7	27.3	N	P	1.81	1.68	2.66	0.59	-	-	31	SILTY SAND	DS
6.0	12	12		SM	4.7	0.00	93.2	6.8	N	P	1.81	1.71	2.66	0.55	-	-	31	SAND	DS
7.5	15	14		SM	11.1	0.00	80.6	19.4	N	P	1.85	1.85	2.66	0.61	-	-	32	SAND	DS
9.0	14	12		SM	12.4	0.00	84.3	15.7	N	P	1.85	1.63	2.65	0.62	-	-	32	SAND	DS
10.5	19	15		SM	12.0	0.00	80.6	19.4	N	P	1.89	1.67	2.65	0.58	-	-	33	SAND	DS
12.0	24	18		SM	11.0	0.00	82.1	17.9	N	P	1.90	1.70	2.66	0.57	-	-	32	SAND	DS
13.5	28	20		SM	11.0	0.00	82.1	17.9	N	P	1.91	1.71	2.64	0.55	-	-	33	SAND	DS
15.0	24	16		SM	10.4	0.00	84.4	15.6	N	P	1.92	1.72	2.62	0.52	-	-	32	SAND	DS

BORE LOG CHART

BH-3(PLOT 80 ACRE)

Geo Globe Consultants

PROJECT:- Soil Investigation for Construction of proposed structure.

LOCATION:- 80 Acre Land of ICAR-CIRC Babugarh, Hapur

BH NO:- 3

REFERENCE POINT (RL) :- NGL

DATE OF BORING :-

DIA OF CASING:- 150 mm

LABORATORY TEST RESULTS

DEPTH FROM NGL (m)	SPT (N) BLOWS 30cm		STANDARD PENETRATION RESISTANCE CURVE	SYMBOLIC REPRESENTATION	I.S.C. GROUP	Level Of Water Table	% MOISTURE	% GRAVEL MODULES (-80 MM FRACTION)	% SAND	% SILT + CLAY (-75 MICRON)	LL	PI	DENSITY (gm/cc)		SP. GRAVITY	VOID RATIO	UNCONFINED COMP. STRN Kg/Cm ² (C _u)	C _u Kg/C ²	φ° DIRECT SHEAR TRIAXIAL COMPRESSION TEST	COMPRESSION INDEX Cc = 0.30 (e ₀ = 0.37)	REMARKS	TYPE OF SAMPLE DS OR UDS
	OBSERVED SPT	CORRECTED											FIELD Density gm/cc	DRY Density gm/cc								
1.5	11	16		SM			9.5	0.00	58.1	41.9	45	15.0	1.84	1.66	2.64	0.59	-	-	32	-	SILTY SAND	DS
3.0	12	15		SM			8.5	0.00	86.8	13.2	46	14.0	1.84	1.68	2.63	0.56	-	-	32	-	SILTY SAND	DS
4.5	14	15		SM			9.5	0.00	69.9	30.1	30.6	7.6	1.84	1.66	2.64	0.59	-	-	32	-	SILTY SAND	DS
6.0	17	17		SM			10.7	0.00	99.1	0.9	30.5	6.8	1.87	1.67	2.65	0.58	-	-	32	-	SILTY SAND	DS
7.5	20	18		SM			10.9	0.00	75.4	24.6	N	P	1.89	1.69	2.66	0.57	-	-	32	-	SILTY SAND	DS
9.0	17	15		SM			10.7	0.00	88.6	11.4	N	P	1.89	1.69	2.66	0.57	-	-	32	-	SILTY SAND	DS
10.5	23	19		SM			11.2	0.00	82.1	17.9	N	P	1.89	1.68	2.65	0.57	-	-	33	-	SILTY SAND	DS
12.0	23	18		SM			11.1	0.00	84.8	15.2	N	P	1.90	1.68	2.66	0.57	-	-	32	-	SILTY SAND	DS
13.5	26	19		SM			11.1	0.00	84.8	15.2	N	P	1.91	1.70	2.64	0.55	-	-	33	-	SILTY SAND	DS
15.0	30	21		SM			10.9	0.00	90.4	9.6	N	P	1.92	1.72	2.62	0.53	-	-	32	-	SILTY SAND	DS

BORE LOG CHART

BH-4, PLOT NO. 1 (PLOT 80 ACRE)

Geo Globe Consultants

PROJECT: Soil Investigation for Construction of proposed structure.

LOCATION: 80 Acre Land of ICAR CRC Babugarh, Hapur

BH NO:- 4

REFERENCE POINT (RL) :- NGL

DATE OF BORING :- 22.2.2024

DIA OF CASING:-150 mm

LABORATORY TEST RESULTS

DEPTH FROM NGL (m)	SPT (N) BLOWS 30cm		STANDARD PENETRATION RESISTANCE CURVE	SYMBOLIC REPRESENTATION I.S.C. GROUP	Level Of Water Table	% MOISTURE	% GRAVEL MODULES (-80 MM FRACTION)	% SAND	% SILT + CLAY (-75 MICRON)	LL	PI	DENSITY (gm/cc)		SP. GRAVITY	VOID RATIO	UNCONFINED COMP. STRN Kg/Cm ² (C _u)	C _c Kg/C	4 th DIRECT SHEAR TRIAXIAL COMPRESSION TEST COMPRESSION INDEX C _c = 0.30 (e _o = 0.27)	REMARKS	TYPE OF SAMPLE DS OR UDS
	OBSERVED SPT	CORRECTED										FIELD Density gm/cc	DRY Density gm/cc							
1.5	22	32		SM		9.9	0.00	57.1	42.9	45	15.0	1.96	1.77	2.85	0.50	-	-	33	SILTY SAND	DS
3.0	18	22		SM		10.7	0.00	82.3	17.7	46	14.0	1.95	1.75	2.85	0.52	-	-	32	SILTY SAND	DS
4.5	14	15		SM		9.6	0.00	71.4	28.6	30.5	7.5	1.89	1.71	2.65	0.55	-	-	31	SILTY SAND	DS
6.0	13	13		SM		11.1	0.00	96.9	3.1	30.5	6.8	1.90	1.69	2.64	0.56	-	-	32	SAND	DS
7.5	14	13		SM		9.6	0.00	76.0	24.0	N	P	1.85	1.67	2.62	0.57	-	-	32	SAND	DS
9.0	22	19		SM		12.3	0.00	90.4	9.6	N	P	1.85	1.63	2.64	0.62	-	-	32	SAND	DS
10.5	27	22		SM		10.7	0.00	83.6	16.4	N	P	1.89	1.69	2.65	0.57	-	-	33	SAND	DS
12.0	38	28		SM		11.7	0.00	81.7	18.3	N	P	2.06	1.83	2.66	0.46	-	-	32	SAND	DS
13.5	51	36		SM		11.7	0.00	81.7	18.3	N	P	2.08	1.85	2.64	0.43	-	-	33	SAND	DS
15.0	58	38		SM		11.8	0.00	91.6	8.4	N	P	2.08	1.86	2.62	0.41	-	-	32	SAND	DS

BORE LOG CHART

BH-5, PLOT NO. (PLOT 80 ACRE)

Geo Globe Consultants

PROJECT: Soil Investigation for Construction of proposed structure.
LOCATION: 80 Acre Land of ICAR-CIRC Babugarh, Hapur
BH NO.: 5

REFERENCE POINT (RL) : NGL
DATE OF BORING : 23.2.2024
DIA OF CASING: 150 mm

LABORATORY TEST RESULTS																						
DEPTH FROM NGL (m)	SPT (N) BLOWS 30cm		STANDARD PENETRATION RESISTANCE CURVE	SYMBOLIC REPRESENTATION	I.S.C. GROUP	Level Of Water Table	% MOISTURE	% GRAVEL MODULES (>80 MM FRACTION)	% SAND	% SILT + CLAY (<75 MICRON)	LL	PI	DENSITY (gm/cc)		SP. GRAVITY	VOID RATIO	UNCONSOLIDATED COMP. STRN Kg/Cm ² (C _u)	C _u B _u /C	φ° DIRECT SHEAR TRIAXIAL COMPRESSION TEST	COMPRESSION INDEX C _c = 0.30 (w _p = 0.27)	REMARKS	TYPE OF SAMPLE DS OR UDS
	OBSERVED SPT	CORRECTED											FIELD Density gm/cc	DRY Density gm/cc								
1.5	13	19		SM			10.7	0.00	56.5	43.5	45	15.0	1.88	1.68	2.65	0.58	-	-	32	-	SILTY SAND	DS
3.0	15	18		SM			11.1	0.00	83.7	16.3	46	14.0	1.88	1.68	2.65	0.58	-	-	32	-	SILTY SAND	DS
4.5	23	25		SM			10.9	0.00	74.4	25.6	30.6	7.6	1.89	1.60	2.65	0.57	-	-	32	-	SILTY SAND	DS
6.0	28	28		SM			10.4	0.00	98.5	1.5	30.5	6.8	1.91	1.71	2.64	0.54	-	-	32	-	SAND	DS
7.5	25	23		SM			10.1	0.00	74.9	25.1	N	P	1.96	1.76	2.62	0.49	-	-	32	-	SAND	DS
9.0	22	19		SM			10.3	0.00	89.9	10.1	N	P	1.93	1.73	2.64	0.52	-	-	32	-	SAND	DS
10.5	28	22		SM			9.6	0.00	82.2	17.8	N	P	1.95	1.76	2.65	0.50	-	-	33	-	SAND	DS
12.0	29	22		SM			10.9	0.00	79.7	20.3	N	P	1.93	1.73	2.66	0.54	-	-	32	-	SAND	DS
13.5	32	23		SM			10.9	0.00	79.7	20.3	N	P	1.98	1.77	2.64	0.49	-	-	33	-	SAND	DS
15.0	36	24		SM			12.1	0.00	94.2	5.8	N	P	1.98	1.75	2.62	0.50	-	-	32	-	SAND	DS

BORE LOG CHART

BH-6, PLOT (70 ACRE)

Geo Globe Consultants

PROJECT: Soil Investigation for Construction of proposed structure.

LOCATION: HARUR

BH NO.: 6

REFERENCE POINT (RL) : NGL

DATE OF BORING : 23.2.2024

DIA OF CASING-150 mm

LABORATORY TEST RESULTS

DEPTH FROM NGL (m)	SPT (N) BLOWS 30cm		STANDARD PENETRATION RESISTANCE CURVE	SYMBOLIC REPRESENTATION I.S.C. GROUP	Level Of Water Table	% MOISTURE	% GRAVEL MODULES (-80 NMM FRACTION)	% SAND	% SILT + CLAY (-75 MICRON)	LL	PI	DENSITY (gm/cc)		SP. GRAVITY	VOID RATIO	UNCONFINED COMP. STRENGTH Kg/Cm ² (C _u)	C _u Kg/C	4 th DIRECT SHEAR TRIAXIAL COMPRESSION TEST COMPRESSION INDEX C _c = 0.30 (eo = 0.27)	REMARKS	TYPE OF SAMPLE DS OR UDS
	OBSERVED SPT	CORRECTED										FIELD Density gm/cc	DRY Density gm/cc							
1.5	6	9		SM	8.7	0.00	52.2	47.8	N	P	1.75	1.60	2.65	0.66	-	-	30	-	SILTY SAND	DS
3.0	10	12		SM	7.3	0.00	81.8	18.2	N	P	1.85	1.71	2.65	0.55	-	-	30	-	SILTY SAND	DS
4.5	12	13		SM	9.6	0.00	72.3	27.7	N	P	1.85	1.67	2.65	0.58	-	-	31	-	SILTY SAND	DS
6.0	16	16		SM	9.6	0.00	100.0	0.0	N	P	1.88	1.70	2.64	0.55	-	-	32	-	SAND	DS
7.5	11	10		SM	11.0	0.00	73.3	26.7	N	P	1.89	1.69	2.62	0.55	-	-	32	-	SAND	DS
9.0	16	14		SM	11.1	0.00	88.1	11.9	N	P	1.90	1.69	2.64	0.56	-	-	32	-	SAND	DS
10.5	20	16		SM	10.9	0.00	89.8	10.2	N	P	1.90	1.70	2.65	0.56	-	-	33	-	SAND	DS
12.0	22	17		SM	11.6	0.00	78.8	21.2	N	P	1.92	1.71	2.66	0.56	-	-	32	-	SAND	DS
13.5	24	17		SM	11.6	0.00	78.8	21.2	N	P	1.96	1.74	2.64	0.52	-	-	33	-	SAND	DS
15.0	28	19		SM	12.1	0.00	89.0	11.0	N	P	1.98	1.75	2.62	0.50	-	-	32	-	SAND	DS

BORE LOG CHART

BH-7, PLOT (70 ACRE)

Geo Globe Consultants

PROJECT: Soil Investigation for Construction of proposed structure.

LOCATION: HAPURI

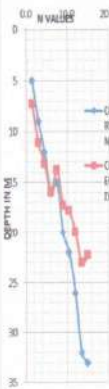
BH NO.: 7

REFERENCE POINT (RL) = NGL

DATE OF BORING : 25.2.2024

DIA OF CASING=150 mm

LABORATORY TEST RESULTS

DEPTH FROM NGL (m)	SPT (N) BLOWS 30cm		STANDARD PENETRATION RESISTANCE CURVE	SYMBOLIC REPRESENTATION	I.S.C. GROUP	Level Of Water Table	LABORATORY TEST RESULTS				DENSITY (gm/cc)		SP. GRAVITY	VOID RATIO	UNCONFINED COMP. STREN kN/cm ² (C _u)	C _c kN/cm ²	4 th DIRECT SHEAR TRIAXIAL COMPRESSION TEST COMPRESSION INDEX Cc = 0.30 (eo = 0.27)	REMARKS	TYPE OF SAMPLE DS OR UDS
	OBSERVED SPT	CORRECTED					% MOISTURE	% GRAVEL MODULES (-40 MM FRACTION)	% SAND	% SILT + CLAY (-75 MICRON)	LL	PI							
1.5	5	7		SM		6.8	0.00	57.7	42.3	N	P	1.80	1.67	2.65	0.59	-	30	SILTY SAND	DS
3.0	9	11		SM		8.1	0.00	84.5	15.5	N	P	1.82	1.67	2.65	0.59	-	30	SILTY SAND	DS
4.5	12	15		SM		9.6	0.00	88.4	11.6	N	P	1.85	1.67	2.65	0.58	-	31	SILTY SAND	DS
6.0	16	18		SM		10.7	0.00	91.4	8.6	N	P	1.88	1.68	2.64	0.57	-	32	SAND	DS
7.5	15	14		SM		9.6	0.00	85.9	14.1	N	P	1.89	1.71	2.62	0.53	-	32	SAND	DS
9.0	20	17		SM		12.0	0.00	98.5	1.5	N	P	1.90	1.68	2.64	0.57	-	32	SAND	DS
10.5	22	18		SM		11.5	0.00	99.2	0.8	N	P	1.90	1.69	2.65	0.57	-	33	SAND	DS
12.0	26	20		SM		13.3	0.00	88.1	11.9	N	P	1.92	1.68	2.66	0.58	-	32	SAND	DS
13.5	32	23		SM		13.3	0.00	88.1	11.9	N	P	1.96	1.72	2.64	0.54	-	33	SAND	DS
15.0	33	22		SM		10.9	0.00	97.7	2.3	N	P	1.98	1.77	2.62	0.48	-	32	SAND	DS

BORE LOG , BH 8, PLOT (70 ACRE)

Geo Globe Consultants

PROJECT: Soil Investigation for Construction of proposed structure.

LOCATION: HAPUR

BH NO.: 8

REFERENCE POINT (RL) : NGL

DATE OF BORING : 25.2.2024

DIA OF CASING: 150 mm

LABORATORY TEST RESULTS

DEPTH FROM NGL (m)	SPT (N) BLOWS 30cm		STANDARD PENETRATION RESISTANCE CURVE	SYMBOLIC REPRESENTATION I.S.C. GROUP	Level Of Water Table	% MOISTURE	% GRAVEL MODULES (> 80 MM FRACTION)	% SAND	% SILT + CLAY (< 75 MICRON)	LL	PI	DENSITY (gm/cc)		SP. GRAVITY	VOID RATIO	UNCONFINED COMP. STRN K _u /Cm ² (C _u)	B _u Kg/C ²	φ° DIRECT SHEAR TRIAXIAL COMPRESSION TEST	COMPRESSION INDEX	Cc = 0.98 (e _o - 0.27)	REMARKS	TYPE OF SAMPLE DS OR UDS
	OBSERVED SPT	CORRECTED										FIELD Density gm/cc	DRY Density gm/cc									
1.5	7	10		SM		8.3	0.00	62.8	37.2	N	P	1.81	1.56	2.65	0.60	-	-	30	-	-	SILTY SAND	DS
3.0	11	14		SM		9.5	0.00	64.1	35.9	N	P	1.82	1.65	2.65	0.61	-	-	31	-	-	SILTY SAND	DS
4.5	13	14		SM		10.7	0.00	88.2	11.8	N	P	1.85	1.66	2.65	0.60	-	-	31	-	-	SILTY SAND	DS
6.0	14	14		SM		9.9	0.00	86.3	13.7	N	P	1.88	1.70	2.64	0.56	-	-	32	-	-	SAND	DS
7.5	17	16		SM		10.7	0.00	97.5	2.5	N	P	1.89	1.69	2.62	0.55	-	-	32	-	-	SAND	DS
9.0	16	14		SM		12.4	0.00	104.5	-4.5	N	P	1.90	1.68	2.64	0.58	-	-	32	-	-	SAND	DS
10.5	19	16		SM		17.2	0.00	106.7	-6.7	N	P	1.90	1.61	2.65	0.65	-	-	33	-	-	SAND	DS
12.0	24	19		SM		21.5	0.00	100.6	-0.6	N	P	1.92	1.57	2.66	0.70	-	-	32	-	-	SAND	DS
13.5	36	27		SM		21.5	0.00	100.6	-0.6	N	P	1.96	1.60	2.64	0.65	-	-	33	-	-	SAND	DS
15.0	44	30		SM		22.0	0.00	101.7	-1.7	N	P	1.98	1.75	2.62	0.50	-	-	32	-	-	SAND	DS

BORE LOG , BH9 , PLOT NO. 2 (70 ACRE)

Geo Globe Consultants

PROJECT: Soil Investigation for Construction of proposed structure.

LOCATION: HAPUR

BH NO.- 9

REFERENCE POINT (RL) : NGL

DATE OF BORING : 25.2.2024

DIA OF CASING-150 mm

LABORATORY TEST RESULTS

DEPTH FROM NGL (m)	SPT (N) BLOWS 30cm		STANDARD PENETRATION RESISTANCE CURVE	SYMBOLIC REPRESENTATION I.S.C. - GROUP	Level Of Water Table	% MOISTURE	% GRAVEL MODULES (<80 MM FRACTION)	% SAND	% SILT + CLAY (<75 MICRON)	LL	PI	DENSITY (gm/cc)		SP. GRAVITY	VOID RATIO	UNCONFINED COMP. STREN Kg/Cm ² (C _u)	B _u Kg/C ²	φ ^o DIRECT SHEAR TRIAXIAL COMPRESSION TEST	COMPRESSION INDEX Cc = 0.30 (e _o = 0.27)	REMARKS	TYPE OF SAMPLE DS OR UDS
	OBSERVED SPT	CORRECTED										FIELD Density gm/cc	DRY Density gm/cc								
1.5	7	10		SM		10.7	0.00	85.3	34.7	N	P	1.80	1.61	2.65	0.65	-	-	30	-	SILTY SAND	DS
3.0	10	12		SM		8.7	0.00	84.7	35.3	N	P	1.82	1.66	2.65	0.60	-	-	31	-	SILTY SAND	DS
4.5	13	14		SM		11.1	0.00	92.4	8.6	N	P	1.84	1.64	2.65	0.61	-	-	31	-	SILTY SAND	DS
6.0	15	15		SM		10.7	0.00	88.0	12.0	N	P	1.88	1.68	2.64	0.57	-	-	32	-	SAND	DS
7.5	16	15		SM		9.5	0.00	99.7	0.3	N	P	1.85	1.67	2.62	0.57	-	-	32	-	SAND	DS
9.0	19	16		SM		12.0	0.00	98.5	1.5	N	P	1.90	1.68	2.64	0.57	-	-	32	-	SAND	DS
10.5	23	19		SM		12.0	0.00	86.2	13.8	N	P	1.90	1.68	2.65	0.58	-	-	33	-	SAND	DS
12.0	27	21		SM		12.0	0.00	92.7	7.3	N	P	1.92	1.70	2.66	0.57	-	-	32	-	SAND	DS
13.5	39	28		SM		12.0	0.00	92.7	7.3	N	P	1.96	1.73	2.64	0.52	-	-	33	-	SAND	DS
15.0	56	38		SM		11.8	0.00	93.2	6.8	N	P	1.98	1.76	2.62	0.49	-	-	32	-	SAND	DS

BORE LOG , BH10 , PLOT NO. 2 (70 ACRE)

Geo Globe Consultants

PROJECT- Soil Investigation for Construction of proposed structure.

LOCATION- HAPUR

BH NO:- 10

REFERENCE POINT (RL) :- NGL

DATE OF BORING :- 25.2.2024

DIA OF CASING:- 150 mm

LABORATORY TEST RESULTS

DEPTH FROM NGL (m)	SPT (N) BLOWS 30cm		STANDARD PENETRATION RESISTANCE CURVE	SYMBOLIC REPRESENTATION	I.S.C. GROUP	Level Of Water Table	% MOISTURE	% GRAVEL MODULES (-80 MM FRACTION)	% SAND	% SILT + CLAY (-75 MICRON)	LL	PI	DENSITY (gm/cc)		SP. GRAVITY	VOID RATIO	UNCONFINED COMP. STREN Kg/Cm ² (C _u)	C _u Kg/C	Φ° DIRECT SHEAR TRIAXIAL COMPRESSION TEST	COMPRESSION INDEX Cc = 0.30 (e ₀ = 0.27)	REMARKS	TYPE OF SAMPLE DS OR UDS
	OBSERVED SPT	CORRECTED											FIELD Density gm/cc	DRY Density gm/cc								
1.5	7	10		SM			10.7	0.00	65.3	34.7	N	P	1.80	1.61	2.65	0.65	-	-	30	-	SILTY SAND	DS
3.0	11	14		SM			8.7	0.00	64.7	35.3	N	P	1.82	1.66	2.65	0.60	-	-	31	-	SILTY SAND	DS
4.5	14	15		SM			11.1	0.00	91.4	8.6	N	P	1.84	1.64	2.65	0.61	-	-	31	-	SILTY SAND	DS
6.0	19	19		SM			10.7	0.00	88.0	12.0	N	P	1.88	1.68	2.64	0.57	-	-	32	-	SAND	DS
7.5	21	19		SM			9.5	0.00	99.7	0.3	N	P	1.85	1.67	2.62	0.57	-	-	32	-	SAND	DS
9.0	23	20		SM			12.0	0.00	98.5	1.5	N	P	1.90	1.68	2.64	0.57	-	-	32	-	SAND	DS
10.5	25	20		SM			12.0	0.00	86.2	13.8	N	P	1.90	1.68	2.65	0.58	-	-	33	-	SAND	DS
12.0	29	22		SM			12.0	0.00	92.7	7.3	N	P	1.92	1.70	2.66	0.57	-	-	32	-	SAND	DS
13.5	37	27		SM			12.0	0.00	92.7	7.3	N	P	1.96	1.73	2.64	0.52	-	-	33	-	SAND	DS
15.0	44	30		SM			11.6	0.00	93.2	6.8	N	P	1.98	1.76	2.62	0.49	-	-	32	-	SAND	DS

GEO GLOBE CONSULTANTS

Plot No. 777, Sector 82, JLPL, S.A.S.Nagar, Mohali



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BIBLIOGRAPHY:-

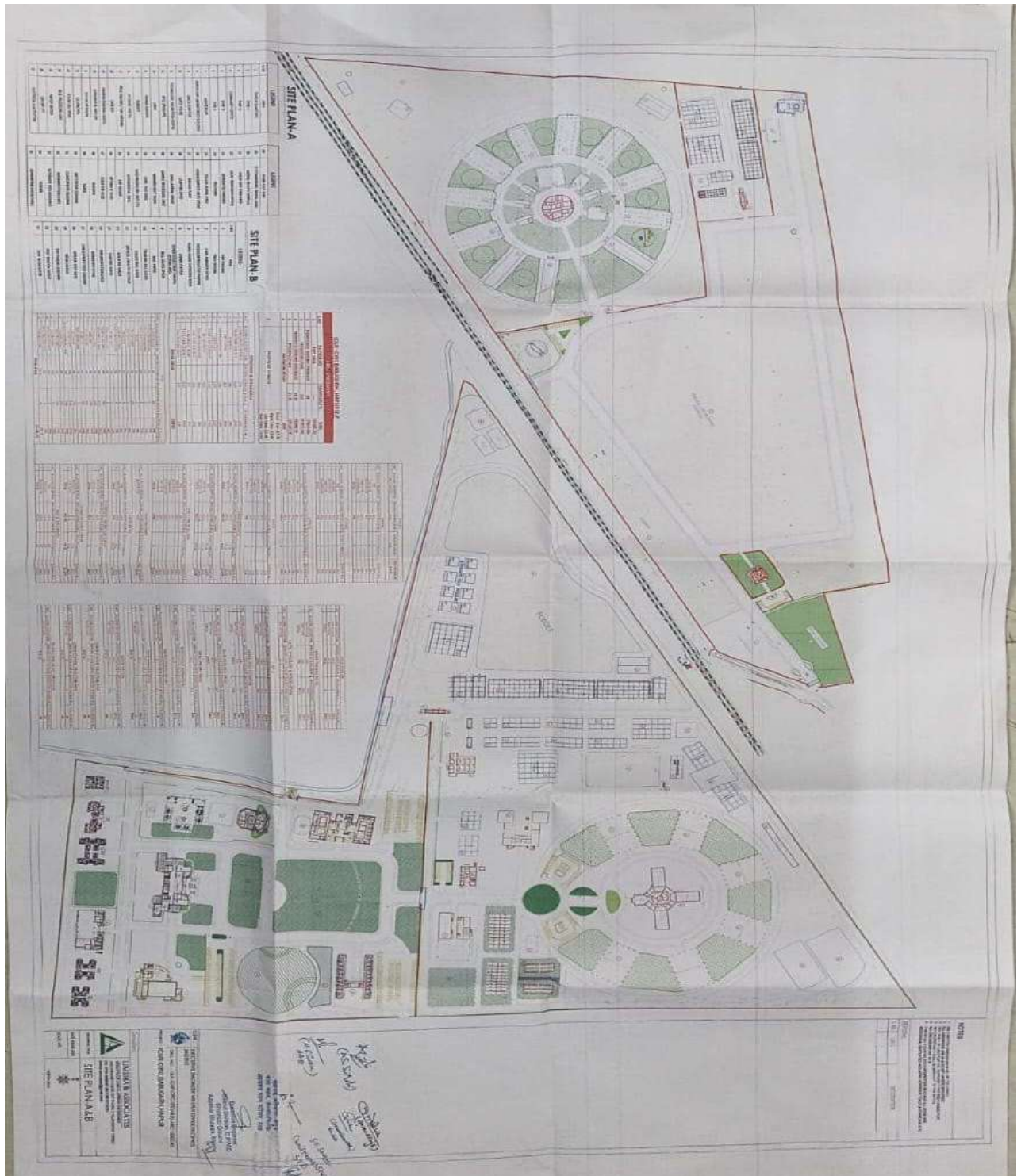
- 1) (IS 1892-1979): Code of practice for subsurface investigation for foundations
- 2) (IS: 2131) : Code of practice for Standard Penetration test
- 3) (IS 2720 part 4): Methods of test for soils part 4, grain size analysis
- 4) (IS 2720 part 5): Methods of test for soils part 5 Determination of liquid and plastic limits
- 5) (IS 2720 part 10): Methods of test for soils part 10, determination of unconfined compression test.
- 6) (IS 2720 part 11) : Methods of test for soils part 10, determination of unconfined compression test, determination of shear strength parameters of soil specimen tested in unconsolidated un drained triaxial compression without the measurement of pore water pressure (amendment 3) Reaffirmed 1990 CED 23
- 7) (IS 2720 part 15): Methods os test for soils part 15, Determination of consolidation properties.
- 8) (IS 2720 part 13): Methods of test for soils part 13, Direct Shear Test.
- 9) (IS 6403 -1981): Code of practice for determination of bearing capacity of shallow foundations.
- 10) Settlement Consideration :(IS: 8009 (Part-I)-1976 Reaffirmed 2003)



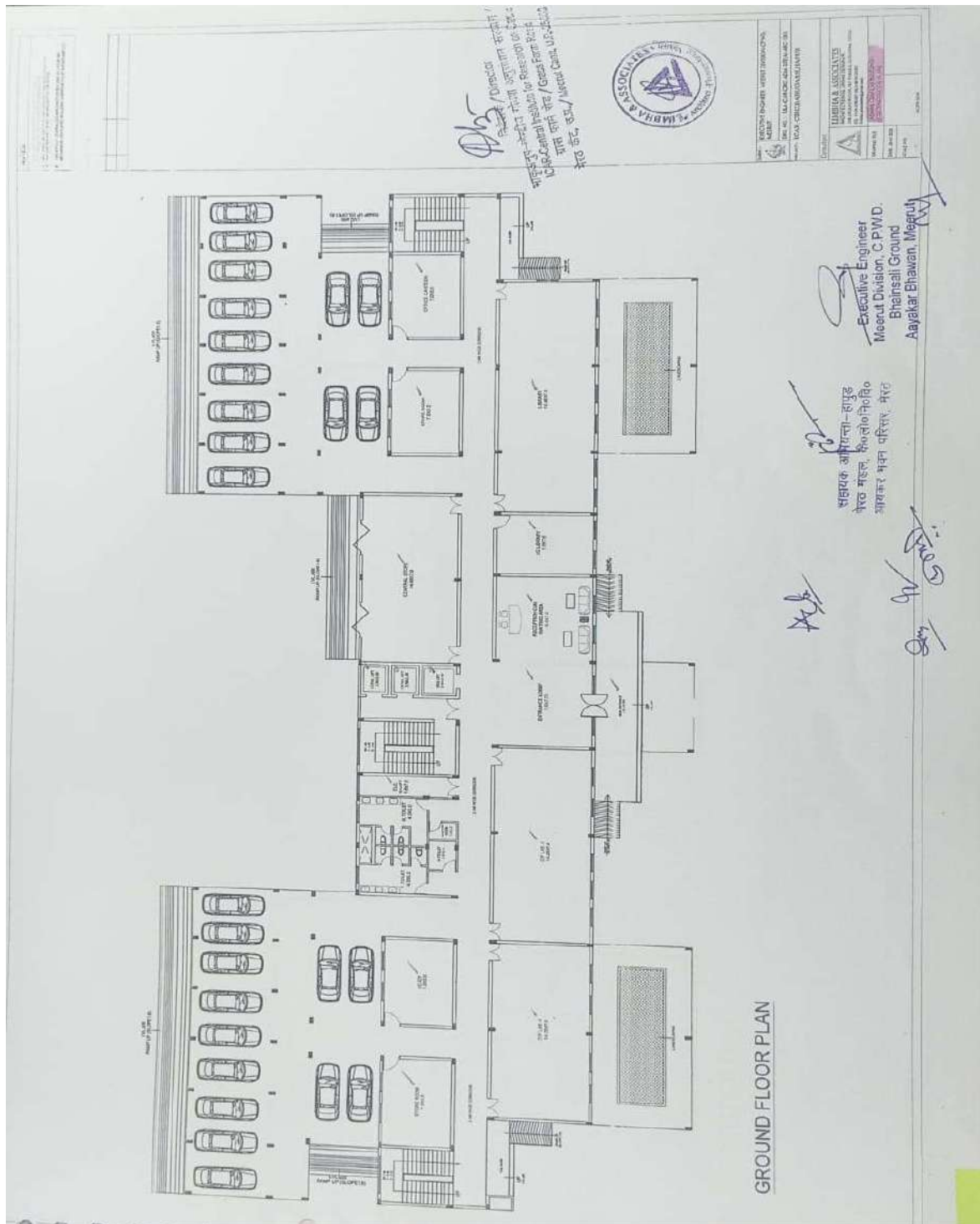
VOLUME-III
DRAWINGS
ADMIN CUM LABORATORY BUILDING
AND
FARMERS TRAINING HOSTEL

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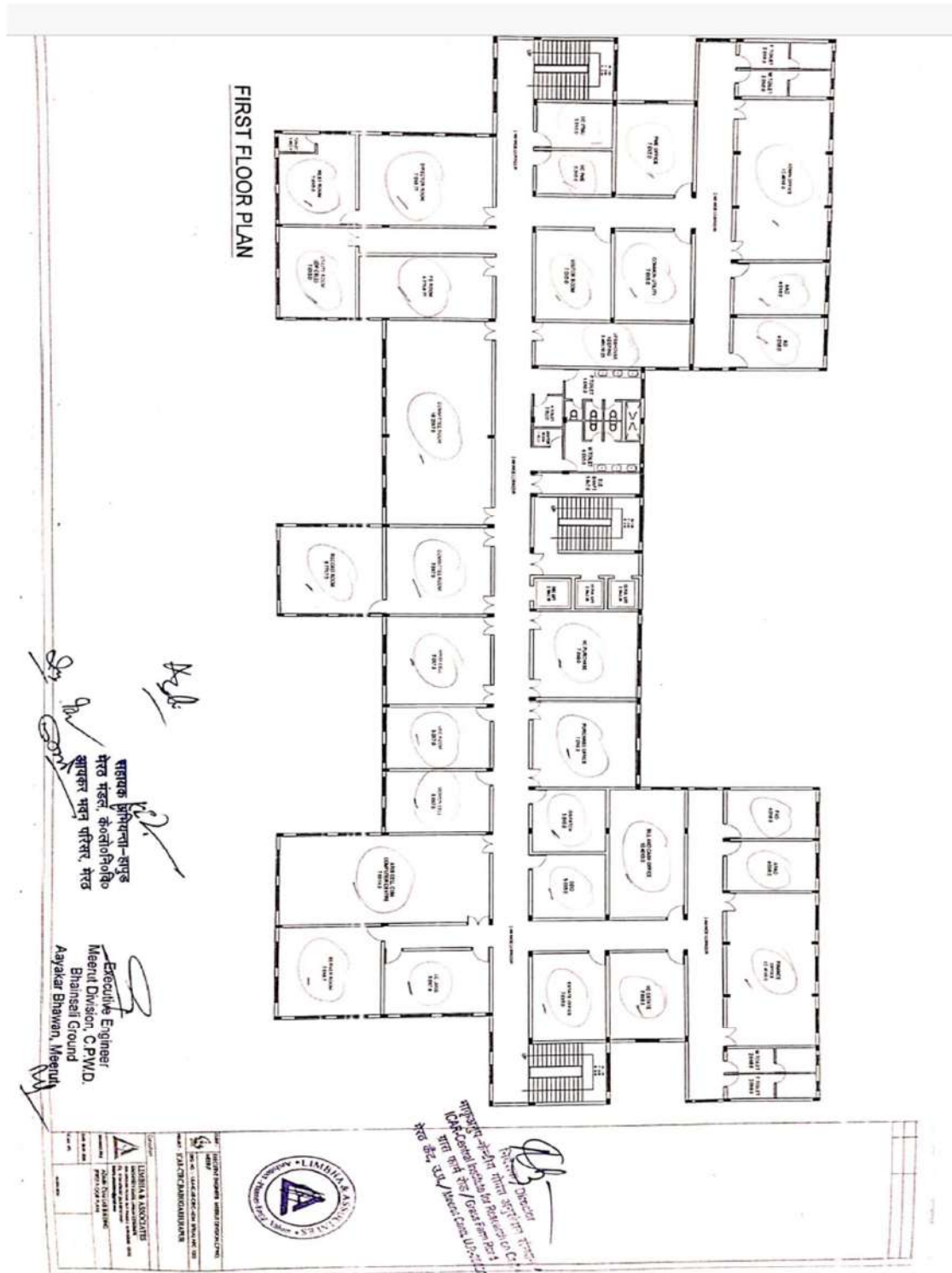
Site plan A & B



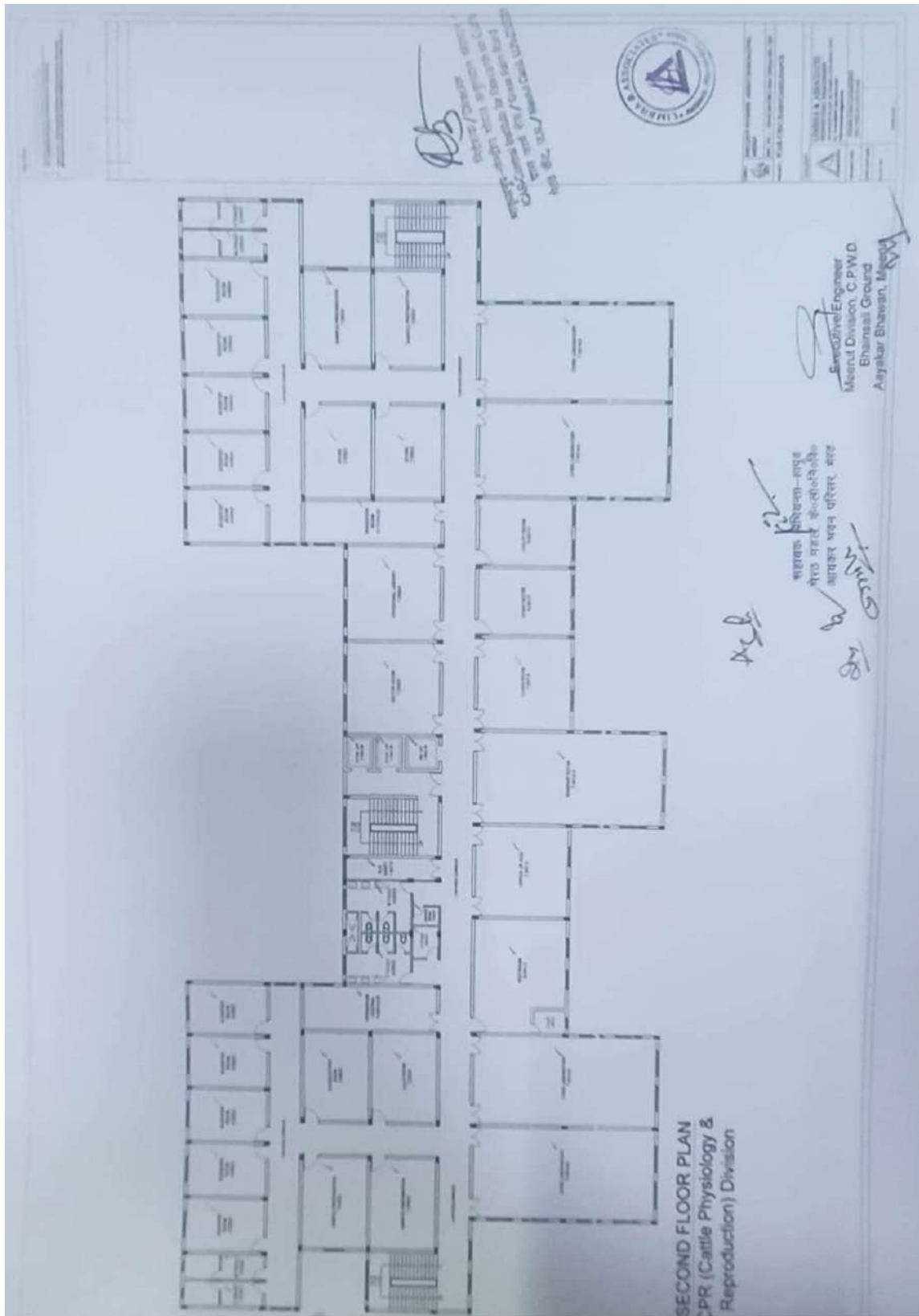
Admin cum lab building ground floor plan



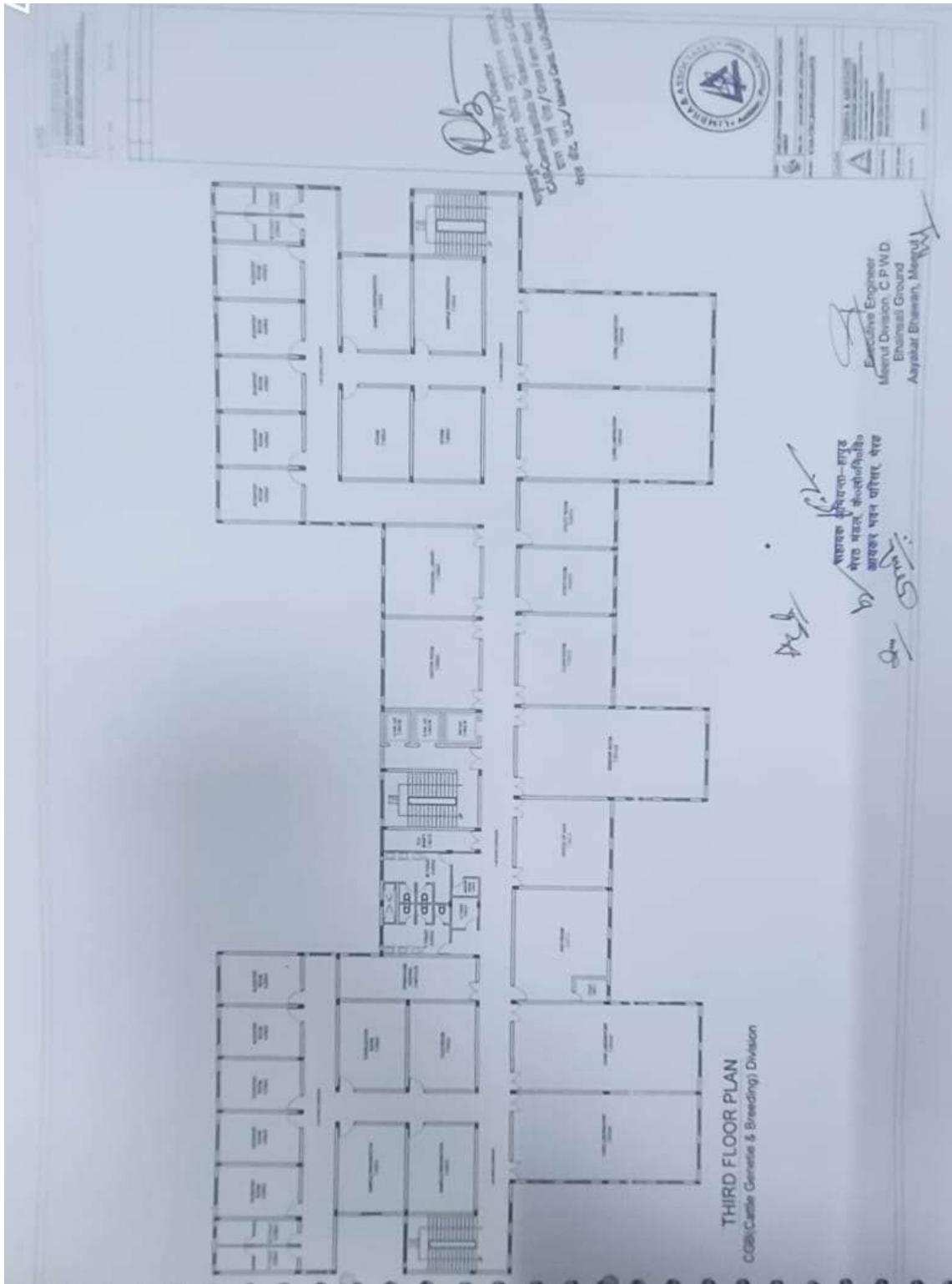
Admin cum lab building First floor plan



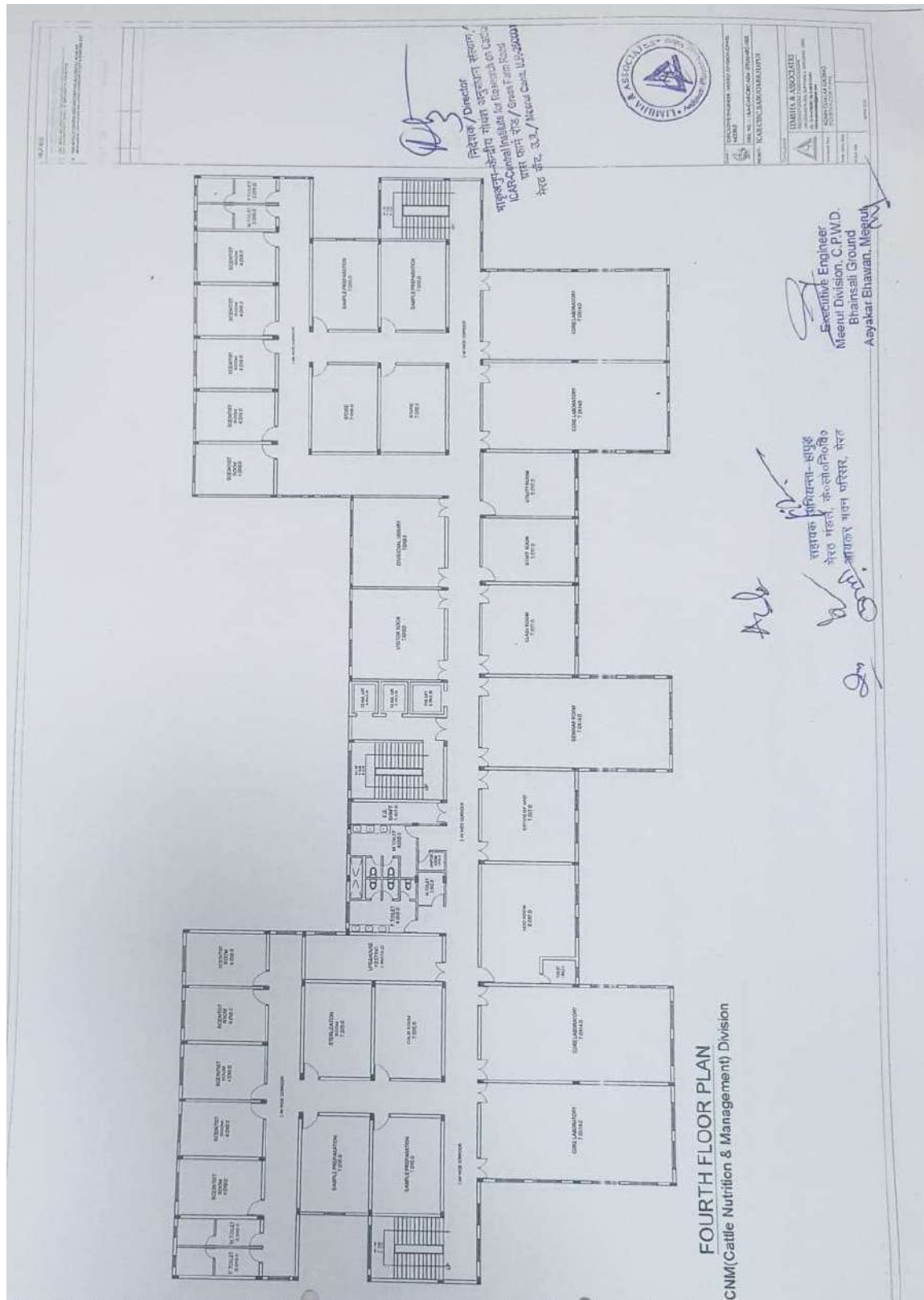
Admin cum lab building Second floor plan



Admin cum lab building third floor plan



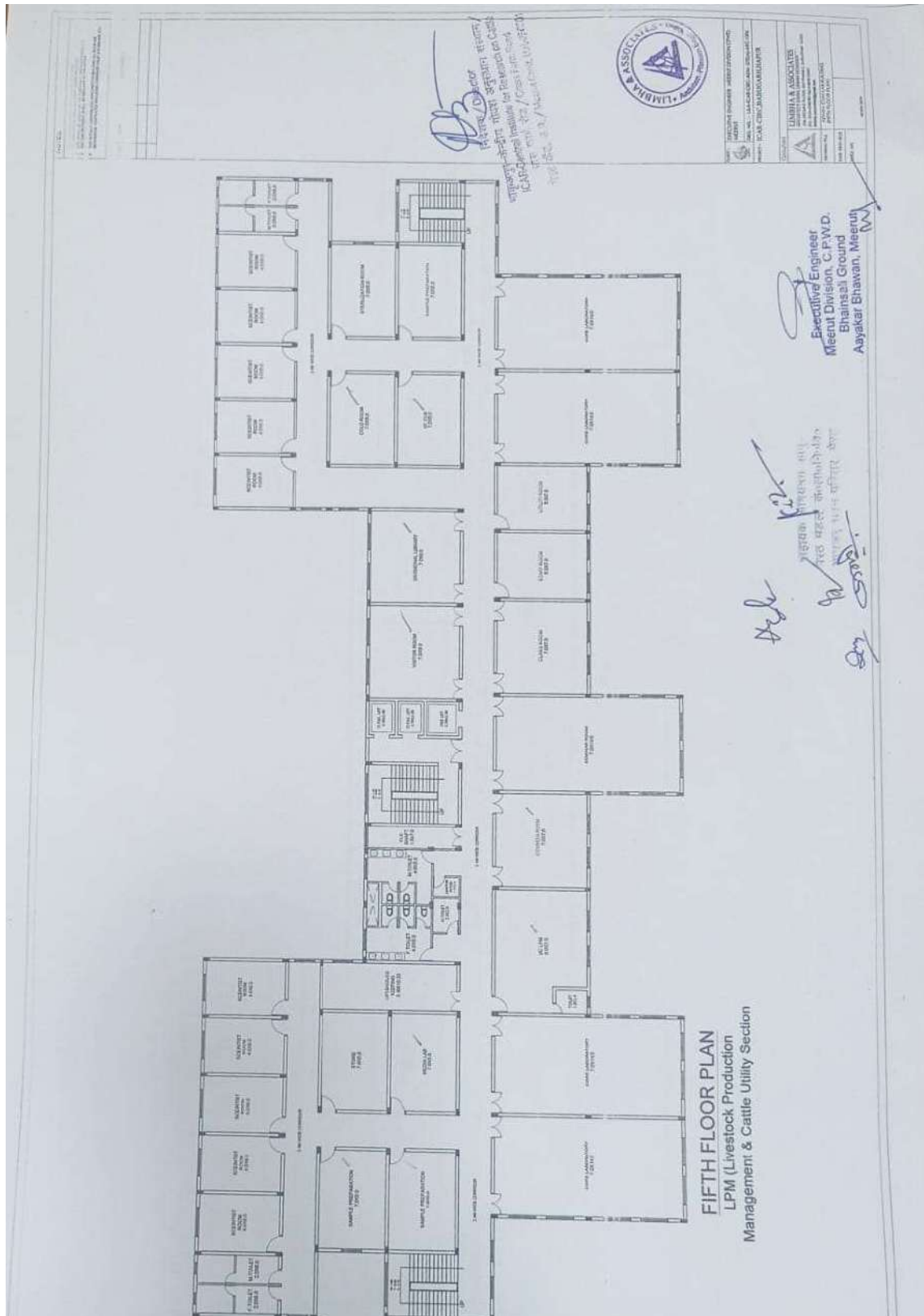
Admin cum lab building fourth floor plan



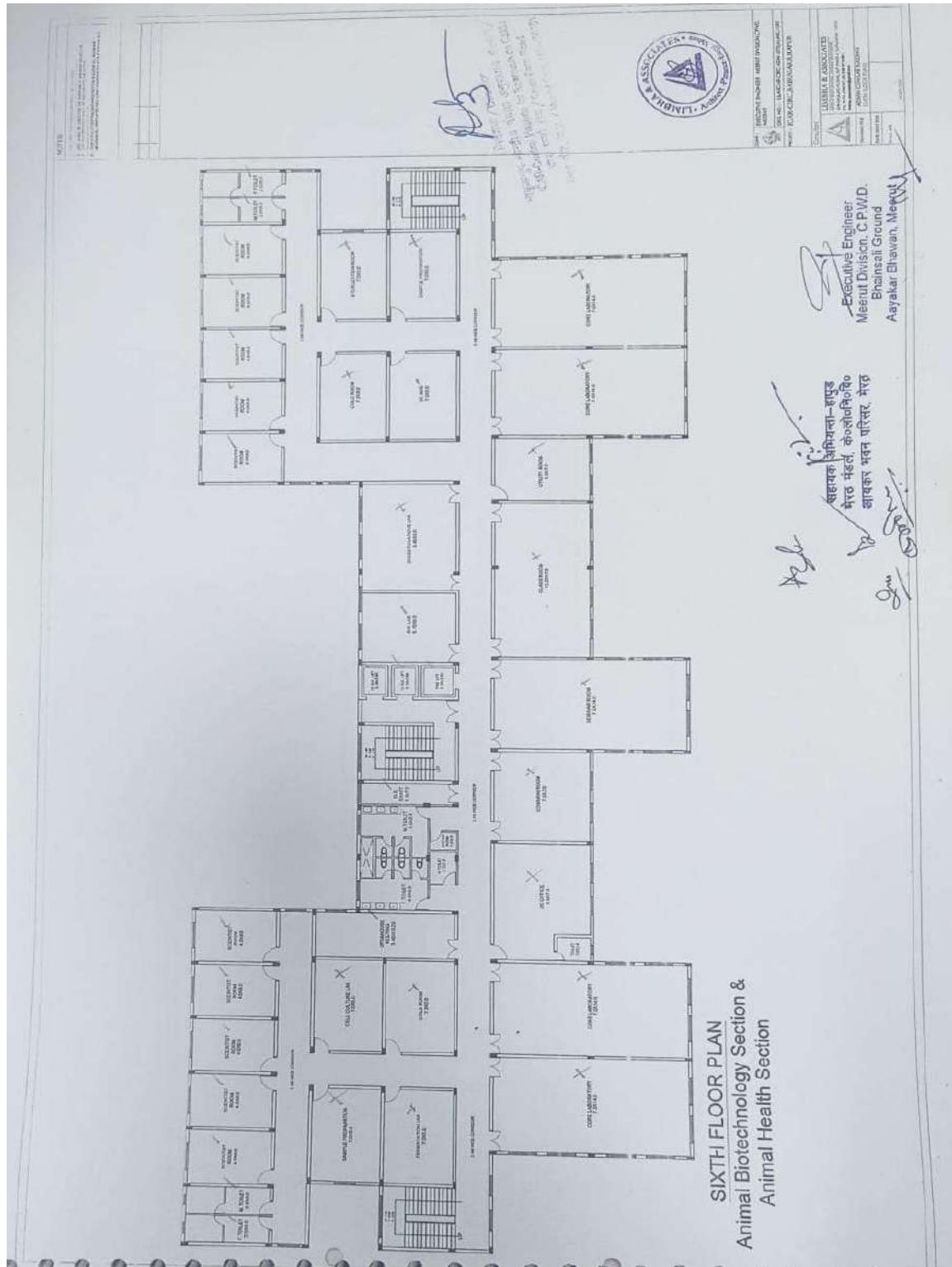
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$$AE(E)$$
 $EE(P)$

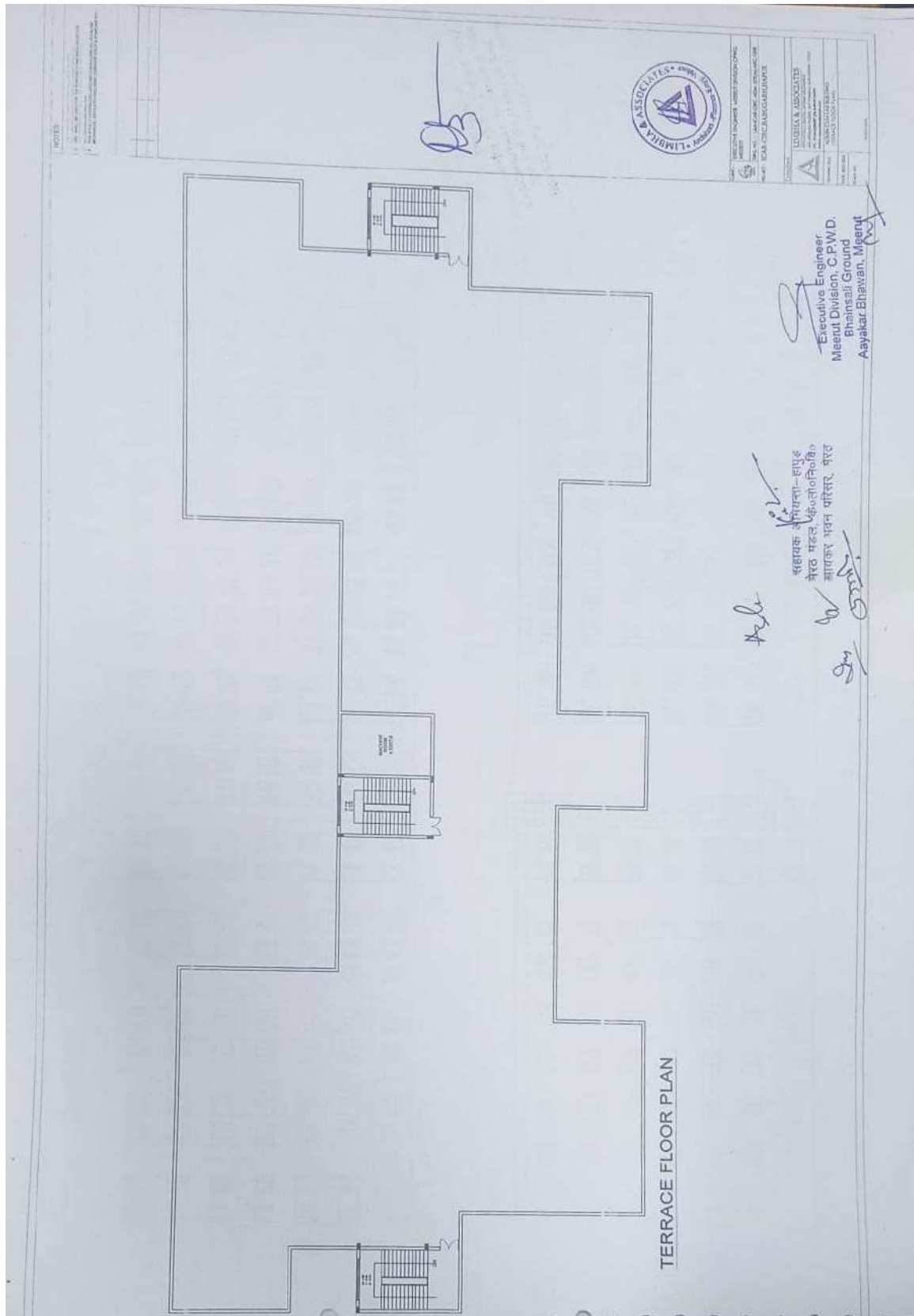
Admin cum lab building fifth floor plan

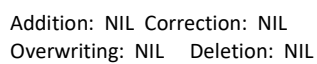


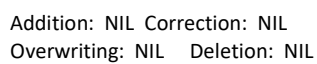
Admin cum lab building sixth floor plan

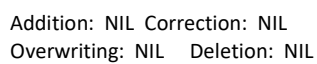


Admin cum lab building terrace plan



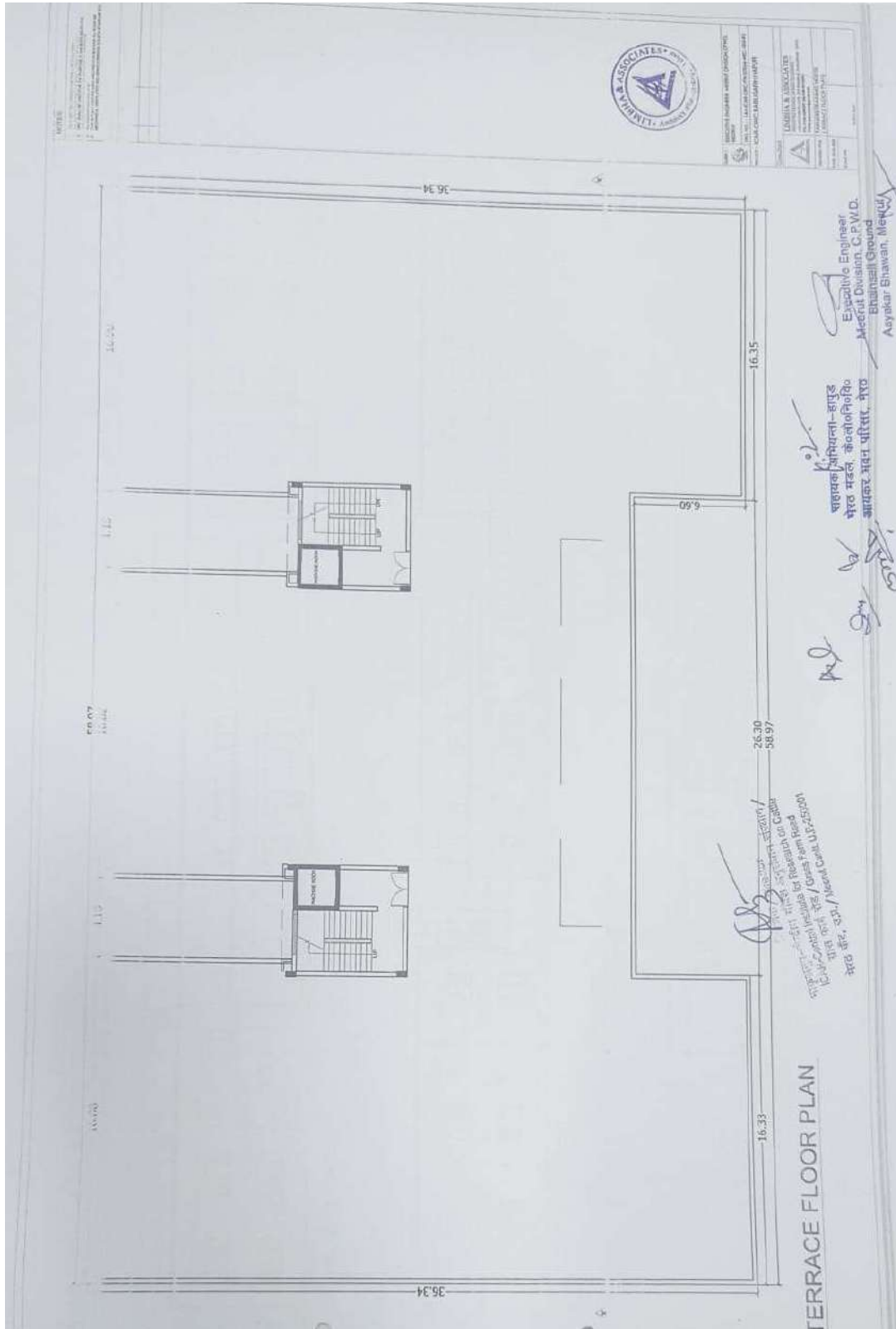


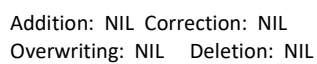






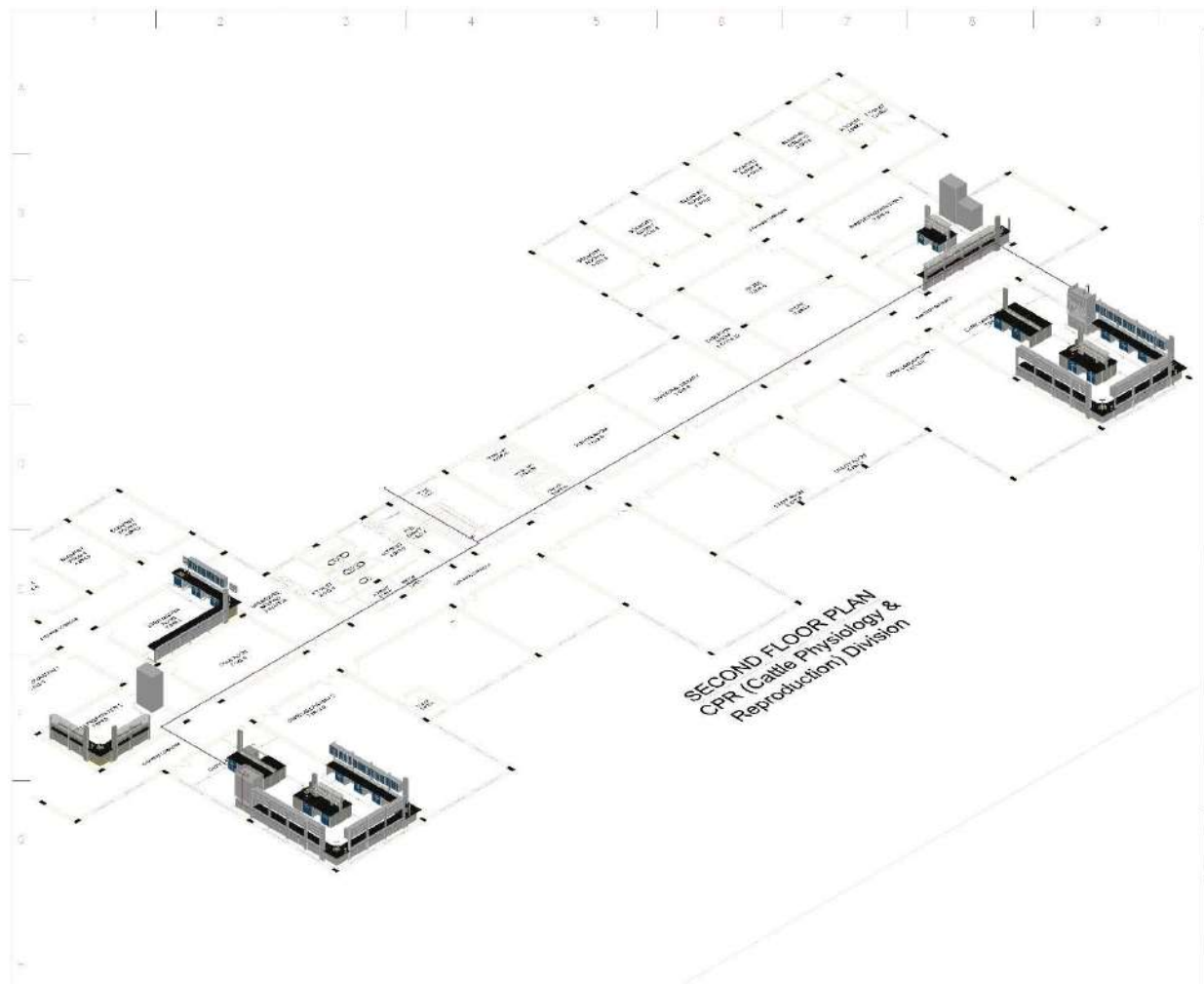
Farmer training hostel terrace plan

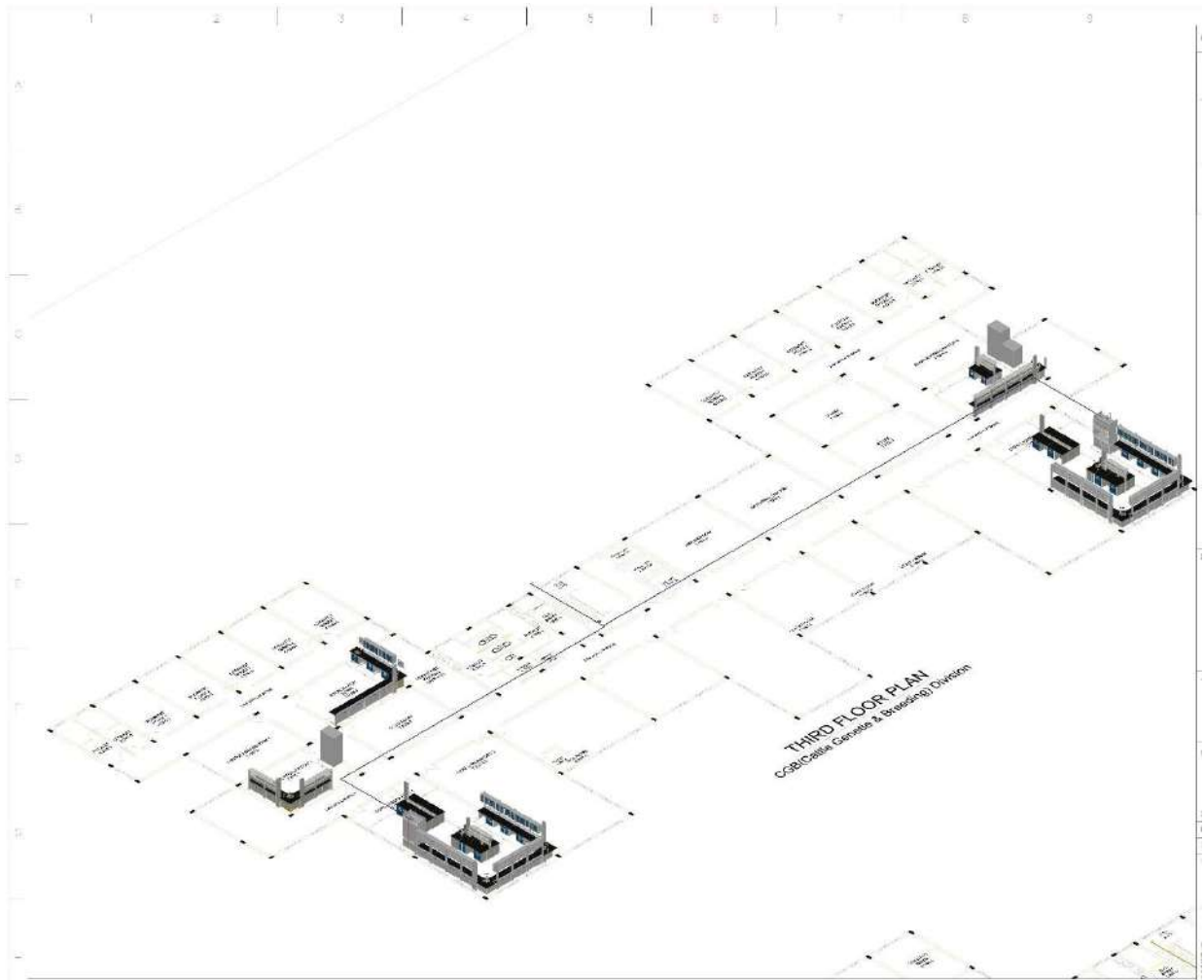


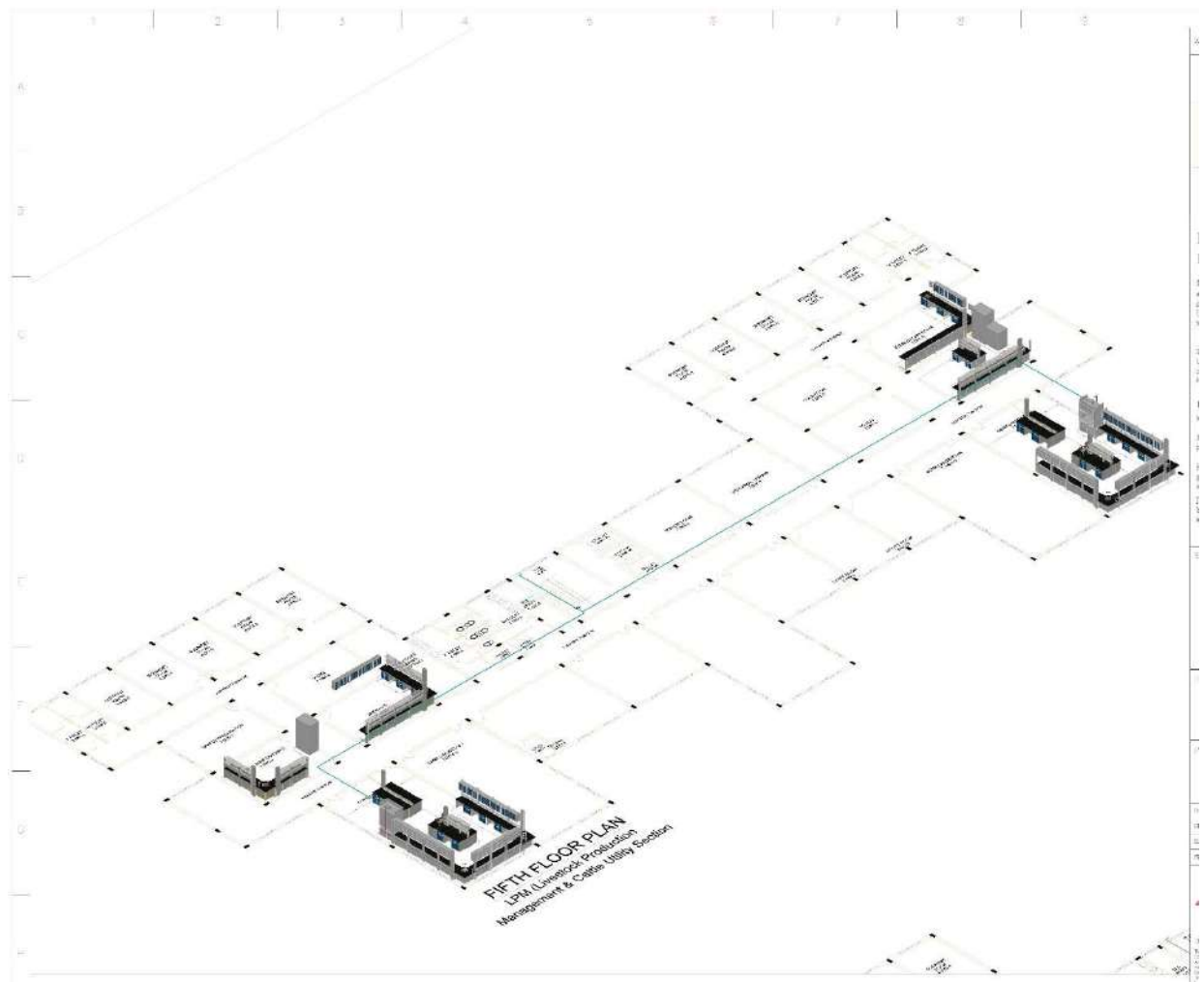


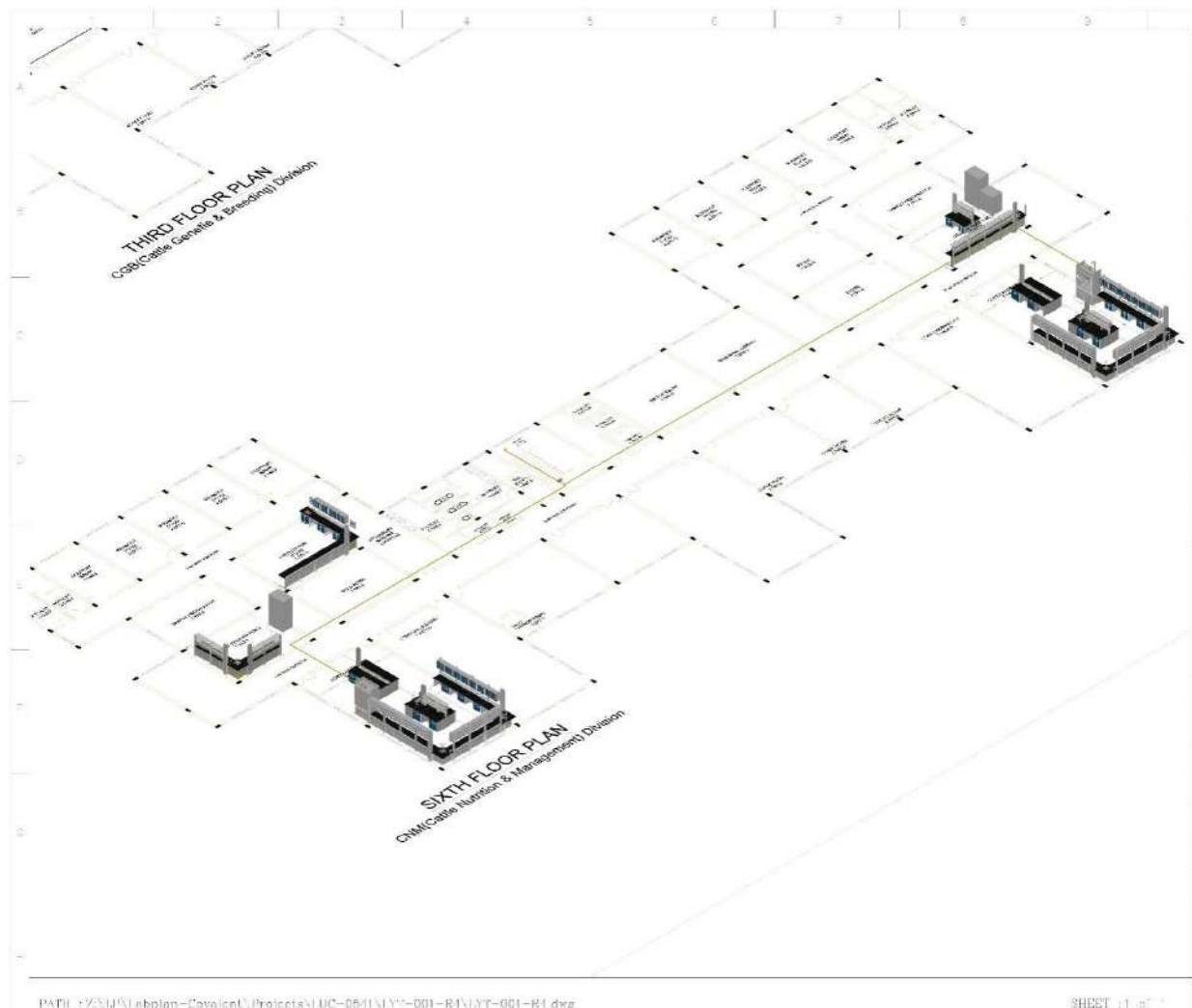
Farmer training hostel elevation (left side) & section











Reduced Level Sheet