



GOVERNMENT OF GNCTD PUBLIC WORKS DEPARTMENT

NOTICE INVITING TENDER

NIT No.: 05/CE(Projects)/PWD/2018-19

NAME OF WORK:

C/o Stage-I of Phase-II, Delhi Technological University at Bawana Road, Delhi (SH: -C/o Academic Blocks AB-3 & AB-4, Boys Hostel H-5 & Girls Hostels HG-5 & HG-6 and all external and internal services including external development and landscaping, and allied civil and E&M works).

Estimated cost	: Rs. 230,11,53,307/-
Earnest Money	: Rs. 2,40,11,533/-
Performance Guarantee	: 5% of Tendered Cost
Security Deposit	: 2.5% of Tendered Cost
Period of Completion	: 15 Months

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

INDEX

Name of work: C/o Stage-I of Phase-II, Delhi Technological University at Bawana Road, Delhi (SH: -C/o Academic Blocks AB-3 & AB-4, Boys Hostel H-5 & Girls Hostels HG-5 & HG-6 and all external and internal services including external development and landscaping, and allied civil and E&M works).

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No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

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NOTICE INVITING TENDER

Name of work:- C/o Stage-I of Phase-II, Delhi Technological University at Bawana Road, Delhi (SH: -C/o Academic Blocks AB-3 & AB-4, Boys Hostel H-5 & Girls Hostels HG-5 & HG-6 and all external and internal services including external development and landscaping, and allied civil and E&M works).

NIT No	:-	05/CE(Projects)/PWD/2018-19
ESTIMATED COST	: -	Rs. 230,11,53,307/-
(Civil work	: -	Rs. 184,89,10,965/-
Electrical work	: -	Rs. 45,22,42,342/-
EARNEST MONEY	: -	Rs 2,40,11,533/-
SECURITY DEPOSIT	: -	2.5% of Tendered Cost
PERFORMANCE GUARANTEE	: -	5% of Tendered Cost
TIME ALLOWED	: -	15 Months

Certified that the NIT contains Page No. 01 to 870 including cover page.

Assistant Engineer-I
Education Project Division-4,
PWD (GNCTD) New Delhi

Executive Engineer
Education Project Division-4
PWD (GNCTD) New Delhi

Assistant Engineer (E)
Housing Project Elect. Division
PWD (GNCTD), New Delhi

Executive Engineer (E)
Housing Project Elect. Division,
PWD (GNCTD), New Delhi

Assistant Project Manager (P)
O/o CPM (Housing)
PWD (GNCTD), New Delhi

Dy. Project Manager(P)
O/o CPM (Housing)
PWD (GNCTD), New Delhi

This NIT is approved for Rs. 230,11,53,307/- (Rs. Two Hundred Thirty Crores Eleven Lakhs Fifty Three Thousand Three Hundred Seven only)

**Chief Project Manager (Housing)
PWD (GNCTD), New Delhi**

Approved by Chief Engineer (Projects)

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

2.0 INFORMATION & INSTRUCTIONS FOR BIDDERS FOR E-TENDERING

TENDERS TO ENSURE THAT:-

1. Tender to be witnessed on **Page No. 45** of tender documents.
2. The tender/tenders containing conditions contrary to those specified in this document shall be liable to be summarily rejected and in such a situation the earnest money shall also be liable to be forfeited.
3. The contractor shall quote his percentage rates keeping in mind the specifications, terms and conditions, General, additional/particular and special conditions etc. And nothing shall be payable extra whatsoever, unless otherwise specified.
4. The contractor shall also furnish performance guarantee of 5% of the tendered amount in addition to the other deposits mentioned elsewhere in the contract for proper performance of the agreement. The performance guarantee shall be in the shape of FDR or Bank guarantee as per Performa given in **Annexure-IV/P-71**.
5. Copy of Enlistment order and certificate of work experience and other documents as specified in the press notice shall be scanned and uploaded to the e-tendering website within the period of bid submission. 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 (including NIT issuing EE/AE), CPWD/PWD Delhi with in the period of bid submission. (The EMD document shall only be issued from the place in which the office of receiving division office is situated). However, certified copy of all the scanned and uploaded documents as specified in press notice shall have to be submitted physically in division office of the Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sector-16, Rohini, New Delhi by the lowest bidder only.

The Earnest Money of **Rs.2,40,11,533/-** in the form as described in Press Notice, in demand draft and other documents related with Eligibility Criteria as described in Press Notice will be part of the “Eligibility Documents”.
6. The Financial Bid will be uploaded by the bidder(s). Financial bid of qualified tenders shall then be opened at Notified time, date and place in presence of tenderers or their representative.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

PRESS NOTICE
to be issued for Publication in Newspapers
Public Works Departments
Notice Inviting e-Tenders

The Executive Engineer, Education Project Division-4, PWD, GNCTD, Shaheed Sukhdev College, Sector-16, Rohini, Delhi-110089 on behalf of the President of India invites online percentage rate bids from eligible firms/contractors of repute having executed similar works and firms/contractors registered in the appropriate class of composite category in CPWD in two envelope/bid system for the following work:

Composite NIT No.:- 05/CE(Projects)/PWD/2018-19 Name of work:- C/o Stage-I of Phase-II, Delhi Technological University at Bawana Road, Delhi (SH: -C/o Academic Blocks AB-3 & AB-4, Boys Hostel H-5 & Girls Hostels HG-5 & HG-6 and all external and internal services including external development and landscaping, and allied civil and E&M works).

Estimated Cost:- Rs. 230,11,53,307/- (Composite) (i.e. **Rs. 184,89,10,965/-** for Civil work & **Rs. 45,22,42,342/-** for Electrical work) (The earnest money may be drawn in favour of Executive Engineer, BPD, B-122, PWD, Delhi.) for the work.
Earnest Money:- 2,40,11,533/- Period of Completion:- 15 Months, Last time and date of submission of bid :- 01.02.2019 at 3:00 PM, Time & date of opening bid:- at 3:30 PM on 01.02.2019. **Time and Date of Pre-bid meeting** at 11:00 AM on 25.01.2019 Venue: 12th Floor, MSO Building, I.P. Estate, New Delhi-110002.

The bid forms and the other details can be seen on website:

<https://govtprocurement.delhi.gov.in>

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

PRESS NOTICE

(Forming Part of NIT/Tender document and to be posted on web-site.)

INVITATION FOR BID

The Executive Engineer, Education Project Division-4, PWD, GNCTD, Shaheed Sukhdev College, Sector-16, Rohini, Delhi-110089 on behalf of the President of India invites online percentage rate bids from the eligible firms/contractors of repute having executed similar works and firms/contractors registered in the appropriate class of composite category in CPWD in two envelope/bid system for the following work:-

1. Details of work for tender.

S. No.	NIT No.	Name of work & Location	Estimated cost put to bid	Earnest Money	Period of Completion	Last date & time of Submission of bid, original EMD, copy of receipt for deposition of original EMD & other documents as specified in press	Time & date of opening of bid
1	2	3	4	5	6	7	8
1	05/CE(Projects)/PWD/2018-19	C/o Stage-I of Phase-II, Delhi Technological University at Bawana Road, Delhi (SH: -C/o Academic Blocks AB-3 & AB-4, Boys Hostel H-5 & Girls Hostels HG-5 & HG-6 and all external and internal services including external development and landscaping, and allied civil and E&M works).	Rs. 230,11,53,307/- (Composite) Rs. 184,89,10,965/- (Civil work) & Rs. 45,22,42,342/- (Electrical work)	Rs. 2,40,11,533/-	15 Months	01.02.2019 Up to 3:00 P.M. on	01.02.2019 Upto 3:30 P.M. on

2. Contractors not registered in the appropriate class of composite category in CPWD are required to fulfil the following requirements for being eligible to apply. Joint ventures and consortium are not accepted.

- (a) Should have satisfactorily completed the works as mentioned below during the last Seven years. The works completed upto previous day of last date of submission of tenders shall be considered.
- (i) Three similar works each costing not less than **Rs. 92.00 Crore** or two similar works each costing not less than **Rs. 138.00 Crore** one similar work costing not less than **Rs. 184.00 Crore**.

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- (b) Similar work shall mean “Construction of R.C.C. framed structure building with minimum five storeys (including the G/Floor) including internal electrification and at least one of the E&M services mentioned below under one agreement:-
(1) Fire Fighting, (2) Fire Alarm, (3) HVAC, (4) Lifts, (5) Electrical Substation, (6) DG Set”

Components of work executed other than those included in definition of similar work shall be deducted while calculating cost of similar work. Bidder shall submit abstract of cost of work in support of this.

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

3. All bidders shall fulfil the following requirement for being eligible:-
- (a) Should have had average **annual financial turnover on construction works at least of Rs. 250 Crore** during the immediate last three consecutive financial years ending **March 2018 (Scanned copy of Certificate from CA to be uploaded)**
 - (b) Should not have incurred any loss (**Profit after Tax should be positive**) in more than two years during the last five years ending 31st March 2018 (**Scanned copy of Certificate from CA to be uploaded**).
 - (c) Should have a solvency of **Rs.92.00/- Crore (Scanned copy of original solvency certificate from Bank to be uploaded)**
 - (d) The bidder should be financially sound and should not have applied or undergoing Corporate Debt Restructuring (CDR) and/or undergoing insolvency resolution proceedings as per the Insolvency and Bankruptcy code, 2016 on the last date of submission of bid. **The firm to submit an undertaking as specified in page 74 Annexure-VI by way of affidavit to this effect alongwith relevant documents.**
 - (e) **Escrow Account:**
The contractor shall open an escrow account with the scheduled bank for this particular work for the purpose of receiving all the payments under the Contract (s) and for utilization of payments from the Employer for disbursement to petty contractor, vendors etc of the Contractor. The Contractor shall maintain separate book of accounts for all payments under this contract and Engineer-in-Charge shall have access to these at all times access to bank statement of the account maintained separately for the work.
All payments from the Escrow A/c will be released only after vetting of the same by Engineer-in-Charge.
The escrow agreement as per **Annexure-VII page 75** shall be drawn with the bank immediately after award of the work and no payment shall be made until the agreement is signed.

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4. For components of E&M works, the eligibility criteria for specialized agencies to be associated by the main contractor after award of work will be as detailed below:

Sl. No.	Component of E&M Works	Estimated cost (Amount in Rs.)	Eligibility
1	Sub-Head - I - Internal Electrical Installation	8,27,34,481	Refer eligibility condition for E&M works
2	Sub Head - II - Fire Detection & PA System	2,31,47,761	Refer eligibility condition for E&M works
3	Sub Head - III - Cabling & LAN, EPABX System	5,81,54,771	Refer eligibility condition for E&M works
4	Sub Head - IV - UPS System	37,30,330	Refer eligibility condition for E&M works
5	Sub Head : V - CCTV SYSTEM	80,45,238	Refer eligibility condition for E&M works
6	Sub Head - VI - Solar Hot Water System	36,51,132	Refer eligibility condition for E&M works
7	Sub Head : VII - Lift	6,67,65,754	Refer eligibility condition for E&M works
8	SUB HEAD-VIII :- PART A - SUBSTATION EQUIPMENT & EXTERNAL LIGHTING.	3,76,91,498	Refer eligibility condition for E&M works
9	SUB HEAD-VIII :- PART B- DG SET	1,01,39,973	Refer eligibility condition for E&M works

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Sl. No.	Component of E&M Works	Estimated cost (Amount in Rs.)	Eligibility
10	Sub Head - IX - HVAC	11,13,82,172	Refer eligibility condition for E&M works
11	Sub Head - X - IBMS	2,01,63,562	Refer eligibility condition for E&M works

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- (i) The main contractor should either himself meet the eligibility criteria as defined in the bid document or he will have to associate with an agency for E&M package and has to submit details of 3 such agencies confirming to the eligibility condition as defined in the bid document in Part C forms A,B,C,D along with M.O.U. to Engineer-in-charge of minor component within the last time and date of submission of bid. Name of the agency(s) to be associated shall be approved by Engineer-in-charge of minor component within 21 days of the award of work. Within 10 days of approval by the Engineer-in-Charge of the minor component, the contractor shall enter into a tripartite agreement with the associate agency and the Engineer-in-Charge (minor component) failing which a penalty of Rs. 10000/- per day for each day of delay shall be levied and deducted from the dues of the main contractor.
 - (ii) Verifiable completion certificates of the work of registration/approval documents as the case may be, duly attested by the applicant shall be submitted. Valid Electrical Contractor's license, as the case may be, duly attested by the applicant shall also be submitted.
 - (iii) Self attested GST REGISTRATION documents in respect of the associated agencies shall be submitted along with the form Part C forms A,B,C,D.
4. 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.
 5. Press Notice for bidder(s) posted on website shall form part of bid document.
 6. The Bid documents consisting of plans, specifications, the schedule of quantities of various types of items to be executed and the set of terms and conditions of the contract to be complied with and other necessary documents can be seen and downloaded from website: **<https://govtprocurement.delhi.gov.in> free of cost.**
 7. 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 (including NIT issuing EE/AE), CPWD/PWD Delhi within the period of bid submission. (The EMD document shall only be issued from the place in which the office of receiving division office is situated) and uploading the MANDATORY SCANNED DOCUMENTS SUCH AS DEMAND DRAFT OR PAY ORDER OR BANKER'S CHEQUE OR DEPOSIT AT CALL RECEIPT OR FIXED DEPOSIT RECEIPTS AND BANK GUARANTEE OF ANY SCHEDULED Bank towards EMD in favour of **Executive Engineer, BPD, B-122, PWD, Delhi** as mentioned in NIT, receipt for deposition of original EMD to division office of any Executive Engineer (including NIT issuing EE/AE), CPWD/PWD Delhi and other documents as specified.
 8. Those contractors not registered on the website mentioned above, are required to get registered beforehand. If needed they can be imparted training on online bidding process as per details available on the website.

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9. The intending bidder must have valid class-III digital signature to submit the bid.
10. On opening date, the contractor can login and see the bid opening process. Tenderers shall be required to submit the bids in two envelopes.

Envelope-1:- Documents related to eligibility criteria.

Envelope-2:- Financial bid.

Envelope 1:-

The Eligibility Bid shall be opened first. Eligibility related documents shall be evaluated and parties qualified/disqualified by the competent authority.

Envelope 2:-

Financial bid of qualified tenderers shall then be opened at notified time, date and place in the presence of tenderers or their representatives. The time and date of opening of financial bid shall be communicated to the qualified bidders at a later date.

11. Contractor can upload documents in the form of JPG format and PDF format.
12. Certificate of Financial Turn Over: At the time of submission of bid contractor shall upload Affidavit/ Certificate from CA mentioning Financial Turnover of last 3 consecutive financial 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.
13. **Contractor must ensure to quote percentage rate on composite estimated cost of work in figures and words.**
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" (Zero).
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 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.
14. Pre Bid conference shall be held in the conference room of Engineer-in-Chief, PWD, 12th Floor, MSO Building, I.P. Estate, New Delhi-110002 on **25.01.2019 at 11:00 AM** to clear the doubts of intending bidder(s), if any.
15. 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.
16. **The bid submitted shall become invalid if ;**
 - (i) The bidder is found ineligible.

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- (ii) The bidder does not deposit original EMD with division office of any Executive Engineer, (including NIT issuing EE/AE), CPWD/PWD Delhi (The EMD document shall only be issued from the place in which the office of receiving division is situated.)
- (iii) The bidder does not uploaded all the documents (including GST registration) as stipulated in the bid document including the copy of receipt for deposition of original EMD.
- (iv) If any discrepancy is noticed between the documents as uploaded at the time of submission of bid and hard copies as submitted physically by the lowest bidder in the office of tender opening authority.

Executive Engineer

Education Project Division-4, PWD
Shaheed Sukhdev College,
Sector-16, Rohini, Delhi-110089
e-mail ID:- eepwddelhiedu4@gmail.com

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

List of Documents to be scanned and uploaded within the period of bid submission:

1. Scanned copy of Earnest money in prescribed form in favour of Executive Engineer, BPD, B-122, PWD Delhi.
2. Scanned copy of receipt for deposition of original EMD issued from division office of any Executive Engineer, PWD, (including NIT issuing EE/AE) CPWD/Delhi PWD Receipt of deposition of original EMD in the Proforma enclosed at page No. 15. (The EMD document shall only be issued from the place in which the office of receiving division is situated).
3. Scanned copy of Registration Certificate under GST.
4. Scanned copy of Acknowledgement of upto date filed GST return, as per NIT stipulation.
5. Certificates of Work Experience and performance report as per Form-C & E.
6. Certificate of Financial Turnover from CA.
7. Bank Solvency Certificate.
8. Statement of Profit & Loss from CA.
9. Any other Document as specified in the press notice.
10. Undertaking by way of Affidavit duly notarized regarding Corporate Debt Restructuring (CDR)/Insolvency resolution proceedings under Insolvency and Bankruptcy Code 2016 per **Annexure-VI/P-74** alongwith relevant documents.
11. Integrity Agreement as per page 30 to 37 of the Bid document.
12. Notarized undertaking by way of affidavit for similar work for main work (in case of non-CPWD contractors) and for works as defined on page **No. 114, 115 & 145, 146** “ I/We undertake and confirm that eligible similar works has/have not been got executive through another contractor on back to back basis. Further that if such a violation comes to the notice of the Department than I/we shall be debarred for tendering in CPWD/PWD 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”.

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

Performa of Receipt of deposition of original EMD

(Receipt No. / Date

Name of work: C/o Stage-I of Phase-II, Delhi Technological University at Bawana Road, Delhi (SH: -C/o Academic Blocks AB-3 & AB-4, Boys Hostel H-5 & Girls Hostels HG-5 & HG-6 and all external and internal services including external development and landscaping, and allied civil and E&M works).

1. NIT No. 05/CE(Projects)/PWD/2018-19
2. Estimated Cost: Rs. 230,11,53,307/-(Composite) (Civil work Rs. 184,89,10,965/-) and Electrical works Rs. 45,22,42,342/-)
Amount of Earnest Money Deposit :Rs. 2,40,11,533/-
3. Last date of submission of bid: 01.02.2019 upto 3:00 PM

(* To be filled by NIT approving authority/Executive Engineer at the time of issue of NIT and uploaded alongwith NIT)

Name of contractor#:.....

Form of EMD#:
.....

Amount of Earnest Money deposit#:.....

Date of submission of EMD#:
.....

**Signature, Name and designation of EMD
receiving officer (EE/AE(P)/AE/AAO)
alongwith office stamp**

(# To be filled by EMD receiving EE or NIT issuing EE/AE as the case may be)

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SECTION I**BRIEF PARTICULARS OF THE WORK**

1. Delhi Technological University campus has a size of 163.87 Acre (658600 Sqm.) First phase of construction was done for the target student population of 3000 at that time. Considering the increase in intake and starting of new courses, DTU decided to have further development of the campus in 4 phases. Under Phase-II, infrastructure for 9000 target students was decided to be constructed. The present scope envisages the construction of Academic blocks AB-3 & AB-4 and Hostel Blocks for Boys H-5 and for Girls HG-5 & HG-6. The campus area as per master plan is 163.87 Acre (658600 Sqm.) and total plinth area proposed under Part-I of Phase-II is 59403 sqm.including basement.
2. **Salient details of the work for which bids are invited are as under:**

S.No.	Name of work	Estimated cost	Period of completion
1.	C/o Stage-I of Phase-II, Delhi Technological University at Bawana Road, Delhi (SH: -C/o Academic Blocks AB-3 & AB-4, Boys Hostel H-5 & Girls Hostels HG-5 & HG-6 and all external and internal services including external development and landscaping, and allied civil and E&M works).	Rs.230,11,53,307/- (COMPOSITE) (CIVIL WORK RS. Rs.184,89,10,965/- AND ELECTRICAL WORKS Rs. 45,22,42,342/-)	<u>15 MONTHS</u>

3. The site is situated inside Delhi Technological University campus, Bawana Road, Delhi.
4. General features and major components of the work are as under:
 - (i) Academic Block
 - (ii) Boys Hostel Block
 - (iii) Girls Hostel Block
 - (iv) Sub station
 - (v) External Development
 - (vi) Landscaping and Horticulture work
 - (vii) External Internal water supply and sewerage system
 - (viii) Energy efficiency features of Green Building for **03 star GRIHA Ratings** and net zero waste/waste discharge.
 - (ix) Internal and external electrification and outdoor lighting and signages
 - (x) SITC of DG Set
 - (xi) Fire Fighting & Fire Alarm System

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- (xii) SITC of Lifts
 - (xiii) Electro- Mechanical services and bulk services
 - (xiv) HVAC
 - (xv) SITC of Electric Sub Station and Allied works.
 - (xvi) SITC of Water supply pumps & Equipment work.
 - (xvii) Solar Water Heating System.
 - (xviii) All site development works including Roads and paths.
 - (xix) All Allied Civil and E&M works.
5. Work shall be executed according to CPWD General Conditions of Contract - 2014 with upto date correction slip for Central P.W.D. Works available separately at printer's outlets. The bidder may obtain the address of the outlets from the Executive Engineer, Education Project Division-4, PWD, Shaheed Sukhdev College, Sector-16, Rohini, New Delhi.

No. of Correction –C NIL
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SECTION II

INFORMATION & INSTRUCTIONS FOR BIDDER(S)

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 bidder(s) 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 or email and those received late will not be entertained.
- 1.3 The bid should be type-written. The bidder should sign each page of the application.
- 1.4 Overwriting should be avoided. Correction if any, should be made by neatly crossing out, initialling, dating and rewriting with all corrections numbered and totalled. Pages of the eligibility criteria document should be machine numbered. Additional sheets, if any added by the contractor, should also be machine numbered by him. They should be submitted as a package with signed letter of transmittal.
- 1.5 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.
- 1.6 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. No information shall be entertained after submission of eligibility criteria document unless it is called for by the Employer.

2.0 Definitions:

- 2.1 In this document the following words and expressions have the meaning hereby assigned to them.
- 2.2 Employer: Means the President of India, acting through the Executive Engineer, Education Project Division-4, PWD, Shaheed Sukhdev College, Sector-16, Rohini, Delhi-110089

No. of Correction – C NIL
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2.3 Bidder: Means the individual, proprietary firm, firm in partnership, limited company private or public or corporation.

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

3.0 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 typewritten 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 typewritten names and current addresses, or, alternatively, by a partner holding power of attorney for the firm. In the later 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.

4.0 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 bidder(s).

5.0 Particulars provisional

The particulars of the work given in Section I are provisional. They are liable to change and must be considered only as advance information to assist the bidder.

6.0 Site visit

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

The Geo-technical Investigation Report, Architectural and Structural drawings can also be seen on any working day between 10.00 AM to 4.00 PM in the office of Executive Engineer, Education Project Division-4, PWD, Shaheed Sukhdev College, Sector-16, Rohini, Delhi-110089

7.0 The Geo-technical investigation report and the architectural/structural tender drawings attached with the NIT document are only indicative for giving a general idea of the project. Work is to be executed as per “good for

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

construction drawings” to be given to the successful bidder after award of work.

8.0 INITIAL CRITERIA FOR ELIGIBILITY

8.1 The Bidder not enlisted under the relevant class of composite category in CPWD should have experience of having satisfactorily completed the similar work(s) during the last Seven years. The work completed upto previous day of last date of submission of tender shall be considered. 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 officer not below the rank of Executive Engineer/Project Manager or equivalent.

- (i) Three similar works each costing not less than **Rs. 92.00 Crore** or completed two similar works each costing not less than **Rs. 138.00 Crore** or completed one similar work costing not less than **Rs. 184.00 Crore**.

Similar work shall mean “Construction of R.C.C. framed structure building with minimum five storeys (including the G/Floor) including internal electrification and at least one of the E&M services mentioned below under one agreement:-

(1) Fire Fighting, (2) Fire Alarm, (3) HVAC, (4) Lifts, (5) Electrical Substation, (6) DG Set”

Components of work executed other than those included in definition of similar work shall be deducted while calculating cost of similar work. Bidder shall submit abstract of cost of work in support of this.

The value of executed works shall be brought to current costing level by enhancing the actual value of work at simple rate of 7 % per annum; calculated from the date of completion to last date of receipt of applications for tenders.

- 8.2 The bidder should have had average annual financial turn over (gross) of Rs. Total estimated cost (Civil + Electrical) **Rs. 250 Crore** on construction works during the immediate last three consecutive financial years. This should be duly audited by a Chartered Accountant. Year in which no turnover is shown would also be considered for working out the average.
- 8.3 The bidder should not have incurred any loss (Profit after tax should be positive) in more than two years during the immediate last five consecutive financial years, duly certified by the Chartered Accountant.
- 8.4 The bidder should have a solvency of **Rs. 92.00 Crore** certified by his Bankers.
- 8.5 The bidder should have sufficient number of Technical and Administrative employees for the proper execution of the contract. The bidder should submit a list of these employees stating clearly how these would be involved in this work **within 15 days of award of work, failing which a penalty will be levied @ Rs. 15,000 per day of delay. The decision of Engineer in charge shall be binding and final in this regard.**
- 8.6 The bidder should be financially sound and should not have applied or be under Corporate Debt Restructuring (CDR)/ Insolvency proceedings**

No. of Correction – C NIL
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under the IBC code 2016 on the last date of submission of bid. The firm to submit an undertaking to this effect alongwith relevant documents.

8.7 Escrow Account:

The contractor shall open an escrow account with the scheduled bank for this particular work for the purpose of receiving all the payments under the Contract (s) and for utilization of payments from the Employer for disbursement to petty contractor, vendors etc of the Contractor. The Contractor shall maintain separate book of accounts for all payments under this contract and Engineer-in-Charge shall have access to these at all times and access to bank statement of the account maintain separately for the work. All payments from this account shall be released only on approval of the Engineer-in-Charge.

The escrow agreement as per Annexure-VII (or as supplied by the Bank) shall be drawn with the bank immediately after award of the work and no payment shall be made until the agreement is signed.

9.0 Evaluation criteria

9.1 The detailed submitted by the bidder(s) will be evaluated in the following manner:

9.1.1 The initial criteria prescribed in **para 8.1 to 8.5** above in respect of experience of **eligible** similar class of works completed, **loss, solvency** and financial turn over etc. will first be scrutinized and the bidder's eligibility for the work be determined.

Evaluation of performance:

Evaluation of the performance of contractors for eligibility shall be done by Chief Engineer (Projects), PWD or a Committee constituted by him. All the eligible similar works executed and submitted by the bidders may be got inspected by a Committee which may consists client or any other authority as decided by Chief Engineer (Projects), PWD the marks for the quality shall be given based on this inspection, if inspection is carried out.

9.1.2 The bidder(s) qualifying the initial criteria as set out in para 8.1 to 8.5 above will be evaluated for following criteria by scoring method on the basis of details furnished by them.

(a)	Financial strength (Form 'A' & 'B')	Maximum 20 marks
(b)	Experience in eligible similar nature of work completed during last seven years (Form 'C')	Maximum 20 marks
(c)	Performance on works (Form 'E') – Time over run	Maximum 20 marks
(d)	Performance on works (Form 'E') – Quality	Maximum 40 marks

Total 100 marks

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

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 the works for time overrun and quality shall be taken on the basis of performance report of the eligible similar works.

9.0 Financial information

Bidder should furnish the following financial information:

Annual financial statement for the last five year in (Form “A”) and solvency certificate in (Form “B”)

10.0 Experience in works highlighting experience in similar works

10.1 Bidder should furnish the following:

- (a) List of all works of similar nature successfully completed during the last seven years in (Form “C”).

11.0 Organisation information

Bidder is required to submit the information in respect of his organization in Forms “F”.

12.0 Letter of transmittal

The bidder should submit the letter of transmittal attached with the document.

13.0 Opening of Price bid

After evaluation of applications, a list of short listed agencies will be prepared. Thereafter the financial bids of only the qualified and technically acceptable bidder(s) shall be opened at the notified time, date and place in the presence of the qualified bidder(s) or their representatives. The bids shall remain valid for **90 days** from the last date of submission of bid.

14.0 Award criteria

14.1 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 to the bidder.
- (b) Reject any or all the applications without assigning any reason.

14.2 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.

SECTION III
INFORMATION REGARDING ELIGIBILITY
LETTER OF TRANSMITTAL

From:

To

The Executive Engineer

Education Project Division-4,
 PWD, GNCTD,
 Shaheed Sukhdev College,
 Sector-16, Rohini, Delhi-110089

Sub: Submission of bids for the work of C/o Stage-I of Phase-II, Delhi Technological University at Bawana Road, Delhi (SH: -C/o Academic Blocks AB-3 & AB-4, Boys Hostel H-5 & Girls Hostels HG-5 & HG-6 and all external and internal services including external development and landscaping, and allied civil and E&M works).

Sir,

Having examined the 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 statement made and information supplied in the enclosed forms A to H and accompanying statement are true and correct.
2. I/we have furnished all information and details necessary for eligibility and have no further pertinent information to supply.
3. I/we submit the requisite certified solvency certificate and authorize the Executive Engineer, Education Project Division-4, PWD, Shaheed Sukhdev College, Sector-16, Rohini, Delhi-110089 to approach the Bank issuing the solvency certificate to confirm the correctness thereof. I/we also authorize Executive Engineer, Education Project Division-4, PWD, Shaheed Sukhdev College, Sector-16, Rohini, Delhi-110089 to approach individuals, employers, firms and corporation to verify our competence and general reputation.
4. I/we submit the following certificates in support of our suitability, technical knowledge and capability for having successfully completed the following eligible similar works:

Name of Work	Certificate from
.....
.....

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 found to be incorrect.

Enclosures:

Seal of bidder

Date of submission:

Signature(s) of Bidder(s)

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

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 years duly certified by the Chartered Accountant, as submitted by the applicant to the Income Tax Department (Copies to be attached).

Years

2013-14	2014-15	2015-16	2016-17	2017-18

- (i) Gross Annual turnover on construction works.
(ii) Profit/Loss.

- II. Financial arrangements for carrying out the proposed work.
III. Solvency Certificate from Bankers of the bidder in the prescribed **Form "B"**.

Signature of Chartered Accountant with Seal

Signature of Bidder(s).

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

FORM “B”
FORM OF BANKERS’ CERTIFICATE FROM A SCHEDULED BANK

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

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

(Signature)
 For the Bank

NOTE:-

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

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

FORM 'C'
DETAILS OF ALL WORKS OF SIMILAR CLASS COMPLETED DURING THE
LAST SEVEN YEARS ENDING LAST DAY OF SUBMISSION OF TENDER

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 No. of officer 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

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

Signature of Bidder(s)

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

AE-I
(EPD-4)

EE
(EPD-4)

AE (P)
(CPM (Housing)

EE(P)
(CPM (Housing)

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

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
 - (ii) Actual date of completion
7. (a) Whether case of levy of compensation for delay has been decided or not
Yes/No
 (b) If decided, 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

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

FORM "F"
STRUCTURE & ORGANISATION

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

Organisation/Place of registration

Registration No.

- 1.
- 2.
- 3.
- 4.
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)

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

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

	Attributes	Evaluation
(a)	Financial strength (20 marks) (i) Average annual marks 16 Turnover (ii) Solvency marks 4 Certificate	(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
(b)	Experience in similar (20 marks) class of works	(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 (20 marks) works (time over run)	
	Parameter Calculation For	Score Maximum
	If TOR	1.00 2.00 3.00 20
	=	>3.50
	(i) Without levy of Compensation	20 15 10 10
	(ii) With levy of compensation	20 5 0
	(iii) Levy of compensation not decided	-5
		20 10 0 0
<p>TOR = AT/ST, where AT=Actual Time; ST=Stipulated Time. 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.</p>		
(d)	Performance of works (Quality)	(40 marks)
	(i) Outstanding	40
	(ii) Very Good	30
	(ii) Good	20
	(iv) Poor	0

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

INTEGRITY AGREEMENT

To,

ALL BIDDERS

Sub: NIT No: 05/CE(Projects)/PWD/2018-19

Name of work: C/o Stage-I of Phase-II, Delhi Technological University at Bawana Road, Delhi (SH: -C/o Academic Blocks AB-3 & AB-4, Boys Hostel H-5 & Girls Hostels HG-5 & HG-6 and all external and internal services including external development and landscaping, and alrks).

Dear Sir,

It is here by declared that PWD, GNCTD is committed to follow the principle of transparency, equity and competitiveness in public procurement.

The subject Notice Inviting Tender (NIT) is an invitation to offer made on the condition that the Bidder will sign the integrity Agreement, which is an integral part of tender/bid documents, failing which the tenderer /bidder will stand disqualified from the tendering process and the bid of the bidder would be summarily rejected.

This declaration shall form part and parcel of the Integrity Agreement and signing of the same shall be deemed as acceptance and signing of the Integrity Agreement on behalf of the PWD, GNCTD.

Yours faithfully

Executive Engineer

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

INTEGRITY AGREEMENT

To,

**Executive Engineer
EPD-4, PWD
Shaheed Sukhdev College,
Sector-16, Rohini, Delhi-110089**

Name of work: C/o Stage-I of Phase-II, Delhi Technological University at Bawana Road, Delhi (SH: -C/o Academic Blocks AB-3 & AB-4, Boys Hostel H-5 & Girls Hostels HG-5 & HG-6 and all external and internal services including external development and landscaping, and alrks).

Dear Sir,

I/We acknowledge that PWD, GNCTD is committed to follow the principles thereof as enumerated in the Integrity Agreement enclosed with the tender/bid document.

I/We agree that the Notice Inviting Tender (NIT) is an invitation to offer made on the condition that I/We will sign the enclosed integrity Agreement, which is an integral part of tender documents, failing which I/We will stand disqualified from the tendering process. I/We acknowledge that THE MAKING OF THE BID SHALL BE REGARDED AS AN UNCONDITIONAL AND ABSOLUTE ACCEPTANCE of this condition of the NIT.

I/We confirm acceptance and compliance with the Integrity Agreement in letter and spirit and further agree that execution of the said Integrity Agreement shall be separate and distinct from the main contract, which will come into existence when tender/bid is finally accepted by PWD, GNCTD. I/We acknowledge and accept the duration of the Integrity Agreement, which shall be in the line with Article 1 of the enclosed Integrity Agreement.

I/We acknowledge that in the event of my/our failure to sign and accept the Integrity Agreement, while submitting the tender/bid, PWD, GNCTD shall have unqualified, absolute and unfettered right to disqualify the tenderer/bidder and reject the tender/bid in accordance with terms and conditions of the tender/bid.

Yours faithfully

(Duly authorized signatory of the Bidder

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

INTEGRITY AGREEMENT

To be signed by the bidder and same signatory competent / authorised to sign the relevant contract on behalf of PWD.

This Integrity Agreement is made at on this day of 20.....

BETWEEN

President of India represented through Executive Engineer,,
(Name of Division) PWD,GNCTD
(Hereinafter referred as the (Address of Division)
'Principal/Owner ', which expression shall unless repugnant to the meaning or
context hereof include its successors and permitted assigns)

AND

..... (Name
and Address of the Individual/firm/Company) through
..... (Hereinafter referred to as the
(Details of duly authorized signatory) "Bidder/Contractor " and which expression
shall unless repugnant to the meaning or context hereof include its successors and
permitted assigns)

Preamble

WHEREAS the Principal / Owner has floated the Tender (NIT No.
.....) (hereinafter referred to as " Tender/Bid ") and intends to
award, under laid down organizational procedure, contract for
.....
..... (Name of work) hereinafter referred to as
the " Contract ".

AND WHEREAS the Principal/Owner values full compliance with all relevant laws
of the land, rules, regulations, economic use of resources and of
fairness/transparency in its relation with its Bidder(s) and Contractor(s).

AND WHEREAS to meet the purpose aforesaid both the parties have agreed to enter
into this Integrity Agreement (hereinafter referred to as " Integrity Pact " or "Pact "),
the terms and conditions of which shall also be read as integral part and parcel of
the Tender/Bid documents and Contract between the parties.

NOW, THEREFORE, in consideration of mutual covenants contained in this Pact,
the parties hereby agree as follows and this Pact witnesses as under:

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

Article 1: Commitment of the Principal/Owner

1. The Principal/Owner commits itself to take all measures necessary to prevent corruption and to observe the following principles:
 - a. No employee of the Principal/Owner, personally or through any of his/her family members, will in connection with the Tender, or the execution of the Contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.
 - b. The Principal/Owner will, during the Tender process, treat all Bidder(s) with equity and reason. The Principal/Owner will, in particular, before and during the Tender process, provide to all Bidder(s) the same information and will not provide to any Bidder(s) confidential / additional information through which the Bidder(s) could obtain an advantage in relation to the Tender process or the Contract execution.
 - c. The Principal/Owner shall endeavor to exclude from the Tender process any person, whose conduct in the past has been of biased nature.
2. If the Principal/Owner obtains information on the conduct of any of its employees which is a criminal offence under the Indian Penal code (IPC)/Prevention of Corruption Act, 1988 (PC Act) or is in violation of the principles herein mentioned or if there be a substantive suspicion in this regard, the Principal/Owner will inform the Chief Vigilance Officer and in addition can also initiate disciplinary actions as per its internal laid down policies and procedures.

Article 2: Commitment of the Bidder(s)/Contractor(s)

1. It is required that each Bidder/Contractor (including their respective officers, employees and agents) adhere to the highest ethical standards, and report to the Government / Department all suspected acts of fraud or corruption or Coercion or Collusion of which it has knowledge or becomes aware, during the tendering process and throughout the negotiation or award of a contract.
2. The Bidder(s)/Contractor(s) commits himself to take all measures necessary to prevent corruption. He commits himself to observe the following principles during his participation in the Tender process and during the Contract execution:
 - a. The Bidder(s)/Contractor(s) will not, directly or through any other person or firm, offer, promise or give to any of the Principal/Owner's employees involved in the Tender process or execution of the Contract or to any third person any material or other benefit which he/she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the Tender process or during the execution of the Contract.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

- b. The Bidder(s)/Contractor(s) will not enter with other Bidder(s) into any undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to cartelize in the bidding process.
 - c. The Bidder(s)/Contractor(s) will not commit any offence under the relevant IPC/PC Act. Further the Bidder(s)/Contractor(s) will not use improperly, (for the purpose of competition or personal gain), or pass on to others, any information or documents provided by the Principal/Owner as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.
 - d. The Bidder(s)/Contractor(s) of foreign origin shall disclose the names and addresses of agents/representatives in India, if any. Similarly Bidder(s)/Contractor(s) of Indian Nationality shall disclose names and addresses of foreign agents/representatives, if any. Either the Indian agent on behalf of the foreign principal or the foreign principal directly could bid in a tender but not both. Further, in cases where an agent participate in a tender on behalf of one manufacturer, he shall not be allowed to quote on behalf of another manufacturer along with the first manufacturer in a subsequent/parallel tender for the same item.
 - e. The Bidder(s)/Contractor(s) will, when presenting his bid, disclose (with each tender as per proforma enclosed) any and all payments he has made, is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the Contract.
3. The Bidder(s)/Contractor(s) will not instigate third persons to commit offences outlined above or be an accessory to such offences.
 4. The Bidder(s)/Contractor(s) will not, directly or through any other person or firm indulge in fraudulent practice means a wilful misrepresentation or omission of facts or submission of fake/forged documents in order to induce public official to act in reliance thereof, with the purpose of obtaining unjust advantage by or causing damage to justified interest of others and/or to influence the procurement process to the detriment of the Government interests.
 5. The Bidder(s)/Contractor(s) will not, directly or through any other person or firm use Coercive Practices (means the act of obtaining something, compelling an action or influencing a decision through intimidation, threat or the use of force directly or indirectly, where potential or actual injury may befall upon a person, his/ her reputation or property to influence their participation in the tendering process).

Article 3: Consequences of Breach

Without prejudice to any rights that may be available to the Principal/Owner under law or the Contract or its established policies and laid down procedures, the Principal/Owner shall have the following rights in case of breach of this Integrity

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Pact by the Bidder(s)/Contractor(s) and the Bidder/ Contractor accepts and undertakes to respect and uphold the Principal/Owner's absolute right:

1. If the Bidder(s)/Contractor(s), either before award or during execution of Contract has committed a transgression through a violation of Article 2 above or in any other form, such as to put his reliability or credibility in question, the Principal/Owner after giving 14 days notice to the contractor shall have powers to disqualify the Bidder(s)/Contractor(s) from the Tender process or terminate/determine the Contract, if already executed or exclude the Bidder/Contractor from future contract award processes. The imposition and duration of the exclusion will be determined by the severity of transgression and determined by the Principal/Owner. Such exclusion may be forever or for a limited period as decided by the Principal/Owner.
2. Forfeiture of EMD/Performance Guarantee/Security Deposit : If the Principal/Owner has disqualified the Bidder(s) from the Tender process prior to the award of the Contract or terminated/determined the Contract or has accrued the right to terminate/determine the Contract according to Article 3(1), the Principal/Owner apart from exercising any legal rights that may have accrued to the Principal/Owner, may in its considered opinion forfeit the entire amount of Earnest Money Deposit, Performance Guarantee and Security Deposit of the Bidder/Contractor.
3. Criminal Liability: If the Principal/Owner obtains knowledge of conduct of a Bidder or Contractor, or of an employee or a representative or an associate of a Bidder or Contractor which constitutes corruption within the meaning of Indian Penal code (IPC)/Prevention of Corruption Act, or if the Principal/Owner has substantive suspicion in this regard, the Principal/Owner will inform the same to law enforcing agencies for further investigation.

Article 4: Previous Transgression

1. The Bidder declares that no previous transgressions occurred in the last 5 years with any other Company in any country confirming to the anticorruption approach or with Central Government or State Government or any other Central/State Public Sector Enterprises in India that could justify his exclusion from the Tender process.
2. If the Bidder makes incorrect statement on this subject, he can be disqualified from the Tender process or action can be taken for banning of business dealings/ holiday listing of the Bidder/Contractor as deemed fit by the Principal/ Owner.
3. If the Bidder/Contractor can prove that he has resorted / recouped the damage caused by him and has installed a suitable corruption prevention system, the Principal/Owner may, at its own discretion, revoke the exclusion prematurely.

Article 5: Equal Treatment of all Bidders/Contractors/Subcontractors

1. The Bidder(s)/Contractor(s) undertake(s) to demand from all subcontractors a commitment in conformity with this Integrity Pact. The Bidder/Contractor shall be responsible for any violation(s) of the principles laid down in this agreement/Pact by any of its Sub- contractors/sub-vendors.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

2. The Principal/Owner will enter into Pacts on identical terms as this one with all Bidders and Contractors.
3. The Principal/Owner will disqualify Bidders, who do not submit, the duly signed Pact between the Principal/Owner and the bidder, along with the Tender or violate its provisions at any stage of the Tender process, from the Tender process.

Article 6- Duration of the Pact

This Pact begins when both the parties have legally signed it. It expires for the Contractor/Vendor 12 months after the completion of work under the contract or till the continuation of defect liability period, whichever is more and for all other bidders, till the Contract has been awarded.

If any claim is made/lodged during the time, the same shall be binding and continue to be valid despite the lapse of this Pacts as specified above, unless it is discharged/determined by the Competent Authority, PWD, GNCTD.

Article 7- Other Provisions

1. This Pact is subject to Indian Law, place of performance and jurisdiction is the Head quarters of the Division of the Principal/Owner, who has floated the Tender.
2. Changes and supplements need to be made in writing. Side agreements have not been made.
3. If the Contractor is a partnership or a consortium, this Pact must be signed by all the partners or by one or more partner holding power of attorney signed by all partners and consortium members. In case of a Company, the Pact must be signed by a representative duly authorized by board resolution.
4. Should one or several provisions of this Pact turn out to be invalid; the remainder of this Pact remains valid. In this case, the parties will strive to come to an agreement to their original intentions.
5. It is agreed term and condition that any dispute or difference arising between the parties with regard to the terms of this Integrity Agreement / Pact, any action taken by the Owner/Principal in accordance with this Integrity Agreement/ Pact or interpretation thereof shall not be subject to arbitration.

Article 8- LEGAL AND PRIOR RIGHTS

All rights and remedies of the parties hereto shall be in addition to all the other legal rights and remedies belonging to such parties under the Contract and/or law and the same shall be deemed to be cumulative and not alternative to such legal rights and remedies aforesaid. For the sake of brevity, both the Parties agree that this Integrity Pact will have precedence over the Tender/Contact documents with regard any of the provisions covered under this Integrity Pact. IN WITNESS WHEREOF the parties have signed and executed this Integrity Pact at the place and date first above mentioned in the presence of following witnesses:

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

..... (For and on behalf of
Principal/Owner) (For and on
behalf of Bidder/Contractor) WITNESSES:

1. (signature, name and address)
2. (signature, name and address)

Place:

Dated :

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

CPWD-6 FOR e-Tendering

1. Online Bids (Eligibility Documents and Percentage Rate Financial Bid) are invited on behalf of President of India from eligible Firm/Contractors of repute who have executed similar works and firms/contractor registered in the appropriate class of composite category in CPWD in two bid system for the work of C/o Stage-I of Phase-II, Delhi Technological University at Bawana Road, Delhi (SH: -C/o Academic Blocks AB-3 & AB-4, Boys Hostel H-5 & Girls Hostels HG-5 & HG-6 and all external and internal services including external development and landscaping, and allied civil and E&M works).

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 Cost **Rs. 230,11,53,307/- (Composite)** Civil work Rs. **184,89,10,965/-** & Elect. Rs. **45,22,42,342/-**. This estimate, however, is given merely as a rough guide.
 - 1.1.1 For Composite bid, besides indicating the combined estimated cost put to bid, should clearly indicate the estimate cost of each component separately. The eligibility of bidder(s) will correspond to the combined estimated cost of different components put to bid.
- 1.2 Intending bidder(s) not enlisted under the appropriate class of composite category in CPWD 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 Criteria of eligibility for non-CPWD contractors.

- (i) Three similar works each of value not less than Rs. 92.00 Crore or two similar works each of value not less than Rs.138.00 Crore or one similar work of value not less than Rs. 184.00 Crore in last 7 years. The works completed upto previous day of last date of submission of tenders shall be considered.

Similar work shall mean “Construction of R.C.C. framed structure building with minimum five storeys (including the G/Floor) including internal electrification and at least one of the E&M services mentioned below under one agreement:-

(1) Fire Fighting, (2) Fire Alarm, (3) HVAC, (4) Lifts, (5) Electrical Substation, (6) DG Set”

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Components of work executed other than those included in definition of similar work shall be deducted while calculating cost of similar work. Bidder shall submit abstract of cost of work in support of this.

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.

2. Agreement shall be drawn with the successful bidder(s) on prescribed Form No. CPWD 7 (or other Standard Form as mentioned) which is available as a Govt. of India Publication and also available on website www.cpwd.gov.in. Bidder(s) shall quote his Percentage Rate 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 **15 Months** from the date of start as defined in schedule 'F' or from the first date of handing over of the site, whichever is later, in accordance with the phasing, if any, indicated in the bid documents.
 - (i) The site for the work will be made available in parts.
 - (ii) The Architectural and preliminary Structural drawings are available the good for construction drawings shall be made available, as per requirement and as per approved programme of completion submitted by the contractor after award of work.
4. The bid document consisting of plans, specifications, the schedule of quantities of various types of items to be executed and the set of terms and conditions of the contract to be complied with and other necessary documents except Standard General Conditions of Contract-14, with up to date correction slips which can be seen on website of CPWD.
5. After submission of the bid the contractor can re-submit revised bid any number of times but before last time and date of submission of bid as notified.
6. When bids are invited in two stage system and if it is required to submit revised financial bid then it shall be mandatory to submit revised financial bid. If not submitted then the bid submitted earlier shall become invalid.
7. Earnest Money can be paid in the form of Treasury Challan or Demand Draft or Pay order or Banker's Cheque or Deposit at Call Receipt or Fixed Deposit Receipt (drawn in favour of **Executive Engineer, BPD, B-122, PWD, Delhi** shall be scanned and uploaded to 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 (including NIT issuing EE/AE), CPWD/PWD Delhi within the period of bid submission. (The EMD document shall be only be issued from the place in which the office of receiving division office is situated). 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 Executive Engineer in the NIT.

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

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

A part of earnest money is acceptable in the form of bank guarantee also. In such case, minimum 50% of earnest money or Rs. 20.00 Lakh whichever is less, shall have to be deposited in shape prescribed above, and balance may deposited be in shape of Bank Guarantee of any scheduled bank having validity for 90 days for single bid works and 120 days for two bid system or more from the last date of receipt of bids which is to be scanned and uploaded by the intending bidders.

The intending bidder has to fill all the details such as Banker's name, Demand Draft/Fixed Deposit Receipt /Pay Order/ Banker's Cheque/Bank Guarantee number, amount and date.

The amount of EMD can be paid by multiple Demand Draft / Pay Order /Banker's Cheque / Deposit at call receipt / Fixed Deposit Receipts along with multiple Bank Guarantee of any Scheduled Bank if EMD is also acceptable in the form of Bank Guarantee.

Copy of Enlistment Order and certificate of work experience and other documents as specified in the press notice shall be scanned and uploaded to the e-Tendering website within the period of bid submission. However, certified copy of all the scanned and uploaded documents as specified in Press Notice shall have to be submitted by the lowest bidder only 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, whose original EMD deposit with any division of CPWD/PWD Delhi and other documents scanned and uploaded are found in order.

The bid submitted shall be opened at **3:30 PM on 01.02.2019**

8. The bid submitted shall become invalid if:
 - (i) The bidder is found ineligible.
 - (ii) The bidder does not deposit originl EMD with division office of any Executive Engineer (including NIT issuing EE/AE), CPWD/PWD Delhi (The EMD documents shall only be issued from the place in which the office of receiving division office is situated.)
 - (iii) The bidder does not uploaded all the documents (including GST registration) as stipulated in the bid document including the copy of receipt for deposition of original EMD.
 - (iv) If any discrepancy is notice 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 tender opening authority.
 - (v) If a tenderer does not quote any percentage above/below on the total amount of the tender or a section/sub-head in percentage rate tender, the tender shall be treated as invalid and will not be considered as lowest tenderer.

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

9. The contractor whose tender is accepted, will be required to furnish performance guarantee of 5% (Five Percent) of the tendered amount within the period specified in Schedule F. This guarantee shall be in the form of cash (in case guarantee amount is less than Rs. 10000/-) or Deposit at Call receipt of any scheduled bank/Banker's cheque of any scheduled bank/Demand Draft of any scheduled bank/Pay order of any Scheduled Bank of any scheduled bank (in case guarantee amount is less than Rs.1,00,000/-) or Government Securities or Fixed Deposit Receipts or Guarantee Bonds of any Scheduled Bank or the State Bank of India in accordance with the prescribed form. **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 alongwith tender 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 qualifying 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 sub contractors, if any engaged by the contractor for the said work and Programme Chart (Time & Progress) within the period specified in schedule F.**
10. Intending Bidder(s) are strongly 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(s) 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 bidder(s) 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(s) 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. Nothing extra shall be paid to him on this account.
11. The competent authority on behalf of the President of India does not bind itself to accept the lowest or any other bid and reserves to itself the authority to reject any or all the bids received without the assignment of any reason. All bids in which any of the prescribed condition is not fulfilled or any

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

condition including that of conditional rebate is put forth by the bidder(s) shall be summarily rejected.

12. Canvassing whether directly or indirectly, in connection with bidder(s) is strictly prohibited and the bids submitted by the contractors who resort to canvassing will be liable for rejection.
13. 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 bidder(s) shall be bound to perform the same at the rate quoted.
14. The contractor shall not be permitted to bid for works in the CPWD/PWD Circle (Division in case of contractors of Horticulture/Nursery category) responsible for award and execution of contracts, in which his near relative is posted a Divisional Accountant or as an 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 contractor would render him liable to be removed from the approved list of contractors of this Department.
15. No Engineer of Gazetted Rank or other Gazetted Officer employed in Engineering or Administrative duties in an Engineering Department of the Government of India is allowed to work as a contractor for a period of one year after his retirement from Government service, without the prior permission of the Government of India in writing. This contract is liable to be cancelled if either the contractor or any of his employees is found any time to be such a person who had not obtained the permission of the Government of India as aforesaid before submission of the bid or engagement in the contractor's service.
16. The bid for the works shall remain open for acceptance for a period of **90 days** from the last date of submission of bid. If any bidder(s) withdraws his bid before the said period or issue of letter of acceptance, whichever is earlier, or makes any modifications in the terms and conditions of the bid which are not acceptable to the department, then the Government shall, without prejudice to any other right or remedy, be at liberty to forfeit 50% of the said earnest money as aforesaid. Further the bidder(s) shall not be allowed to participate in the rebidding process of the work.
17. This notice inviting Bid shall form a part of the contract document. The successful bidder(s)/contractor, on acceptance of his bid by the Accepting Authority shall within 15 days from the stipulated date of start of the work, sign the contract consisting of:-
 - a) The Notice Inviting Bid, all the documents including additional conditions, specifications and drawings, if any, forming part of the bid as uploaded at the time of invitation of bid and the rates quoted online at the time of

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

submission of bid and acceptance thereof together with any correspondence leading thereto.

- b) Standard C.P.W.D. Form 7 is applicable.

18. For Composite Bids.

- 18.1 The Executive Engineer in charge of the major component will call bids for the Composite work. The Earnest Money will be fixed with respect to the combined estimated cost put to tender for the Composite bid.
- 18.2 The bid document will include following three components:
- Part A:- CPWD-6, CPWD-7 including schedule A to F for the major component of the work, Standard General Conditions of Contract for CPWD 2014 as amended/modified up to last date of submission of bids.
- Part B:- General/specific conditions, specifications and schedule of quantities applicable to major component of the work.
- Part C:- Schedule A to F for minor component of the work. (Chief Engineer (Projects)/EE in charge of major component shall also be competent authority under clause 2 and clause 5 as mentioned in schedule A to F for major components), General/specific conditions, specifications and schedule of quantities applicable to minor component(s) of the work.
- 18.3 The bidder(s) must associate himself, with agencies of the appropriate class eligible to bid for each of the minor component individually.
- 18.4 The eligible bidder(s) shall quote percentage rates for all items of major component as well as for all items/sub-heads of minor components of work.
- 18.5 After acceptance of the bid by competent authority, the EE 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 EE 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/DDH in charge of minor component(s). EE of major component will operate part A and part B of the agreement. EE/DDH in charge of minor component(s) shall operate Part C along with Part A of the agreement.
- 18.6 Entire work under the scope of Composite bid including major and all minor components shall be executed under one agreement. However, tripartite agreement between the main contractor, department and specialized agency shall be executed by the main contractor through association of specialized agencies/firms duly approved by the Engineer-in-Charge for electrical component for specialised electrical work as per the eligibility criteria for the different sub-heads.
- 18.7 Security Deposit will be worked out separately for each component corresponding to the tendered amount of the respective component of work. The Earnest Money will be refunded after receipt of Performance Guarantee.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- 18.8 The main contractor has to associate agency(s) for minor component(s) conforming to eligibility criteria as defined in the bid document and has to submit detail of such agency(s) within prescribed time.
- 18.9 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 minor component. 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.
- 18.10 The main contractor has to enter into agreement with contractor(s) associated by him for execution of minor component(s). Copy of such agreement shall be submitted to EE/DDH in charge of each minor 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 agreement with the new contractor associated by him.
- 18.11 Running payment for the major component shall be made by EE of major discipline to the main contractor. Running payment for minor component shall be made by Engineer-in-charge of the discipline of minor component directly to the main contractor. In case main contractor fails to make the payment to contractor associated by him for minor component within **15 days** of receipt of each running account payment then on the written complaint of the contractor associated for such minor component(s), the Executive Engineer-in charge of minor component shall serve show cause notice to main contractor and after considering the reply of the same he may make payment directly to the contractor associated for minor component as per terms & conditions of the agreement drawn between main contractor and associated contractor for the minor component.
- 18.12 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.
- 18.13 The composite work shall be treated as complete when all the components of the work 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 by the concerned Executive Engineer(s)-in-charge of minor components of the work.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

CPWD-7**GOVERNMENT OF DELHI
PUBLIC WORKS DEPARTMENT**

STATE : DELHI BRANCH : B&R

ZONE : Chief Engineer (Projects) DIVISIONS : EPD-4
: HPED (E)
: D.D. (Hort.)

Percentage Rate Tender & Contract for Works

- (A) Tender for the work of C/o Stage-I of Phase-II, Delhi Technological University at Bawana Road, Delhi (SH: -C/o Academic Blocks AB-3 & AB-4, Boys Hostel H-5 & Girls Hostels HG-5 & HG-6 and all external and internal services including external development and landscaping, and allied civil and E&M works).

To be uploaded on website upto **03.00 PM on 01.02.2019**

To be opened online in the office of Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi-110089.

- (a) Technical Bid at **03.30 PM on 01.02.2019**
- (b) Financial Bid at **...***... PM on ...***....** -- will be intimated later to eligible bidders.

TENDER

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

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

We agree to keep the tender open for **(90) days** from the last date of submission of Bids and not to make any modifications in its terms and conditions. A sum of **Rs. 2,40,11,533/-** been deposited in receipt treasury challan/deposit at call receipt of schedule bank/demand draft of a schedule bank as earnest money. If I/We, fail to furnish the prescribed performance guarantee within prescribed period. Further, if I/we fail to commence work specified I/We agree that President of India or his successors in office shall without prejudice to any other right or remedy in law, be at liberty to forfeit

No. of Correction - C NIL
No. of Omissions - O NIL
No. of Insertions - I NIL

the said earnest money and the performance guarantee absolutely The said Performance Guarantee shall be a guarantee to execute all the works referred to in the tender documents upon the terms and conditions contained or referred to those in excess of that limit at the rates to be determined in accordance with the provision contained in clause 12.2, 12.3 and 12.5 of the tender form. Further, I/We agree that in case of forfeiture of Earnest Money or Performance Guarantee as aforesaid. I/We shall be debarred for participation in the re-tendering process of the work.

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

*

Dated: - _____ *

Signature of contractor

Postal Address*.....

Witness:-

Address:-

Occupation:-

.....*.....

...*.. To be filled by Contractor.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

ACCEPTANCE

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

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

- i) }
 ii) } *
 iii) }

For & on behalf of the President of India

Signature _____ * _____

Designation _____ * _____

Dated _____ * _____

*** To be filled by EE, EPD-4, PWD, GNCTD**

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

SCHEDULES:-**SCHEDULE 'A'**

Schedule of Quantities (enclosed) for Civil, Horticulture,
Electrical and Electrical & Mechanical Separate sheets
attached :-

As per schedule of quantity attached in NIT.

SCHEDULE 'B'

Schedule of materials to be issued to the contractor.

Sl. No.	Description of Item	Quantity	Rates in Figure & Words at which the material will be charged to the contractor	Place of Issue
1	2	3	4	5
--- NIL---				
Note :- All the materials to be arranged by the contractor as per the conditions attached and IS codes				

SCHEDULE 'C'

Tools and Plants to be hired to the contractor

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

SCHEDULE 'D'

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

SCHEDULE 'E'

Reference to General Conditions of the contract: - General conditions of contract for CPWD work-2014 with amendments issued upto last date of submission of tender.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

Name of work:- C/o Stage-I of Phase-II, Delhi Technological University at Bawana Road, Delhi (SH: -C/o Academic Blocks AB-3 & AB-4, Boys Hostel H-5 & Girls Hostels HG-5 & HG-6 and all external and internal services including external development and landscaping, and allied civil and E&M works).

Estimated Cost of work: -

Rs. 230,11,53,307/- (Composite)

For Civil work: Rs. 184,89,10,965/-

For Electrical works Rs. 45,22,42,342/-

Earnest Money: -

Rs. 2,40,11,533/-

Performance Guarantee:-

5% of Tendered value

Security Deposit:-

2.5% of Tendered value

SCHEDULE 'F'

(For Civil & Electrical Works.)

GENERAL RULES & DIRECTIONS

Officer inviting tender:

Executive Engineer, Education Project Division-4,
PWD, GNCTD, Shaheed Sukhdev College, Sec-16,
Rohini, Delhi-110089. e-mail-
eepwddelhiedu4@gmail.com

Maximum percentage for quantity of items of work to be executed beyond which rates are to be determined in accordance with Clauses 12.2 & 12.3:

See below

Definitions:

2(v) Engineer-in-Charge: -

Executive Engineer, Education Project Division-4,
PWD, Shaheed Sukhdev College, Sector-16, Rohini,
Delhi-110089.

2(viii) Accepting Authority

Chief Engineer (Projects), PWD, GNCTD, New Delhi.

2(x) Percentage on cost of materials and Labour to cover all overheads and profits:

15%

2(xi) Standard Schedule of Rates

DSR-2016 for Civil work and DSR-2018 for Electrical work with upto date correction slips.

(For Civil & Electrical works.)

2(xii) Department:-

PWD, GNCTD, Delhi.

9(ii) Standard CPWD Contract Form

GCC 2014, CPWD Form 7 modified & Corrected up to last date of submission of tender.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Clause 1

(i) Time allowed for submission of Performance Guarantee, Programme Chart (Time & Progress) and applicable labour licenses, registration with EPFO, ESIC and BOCW Welfare Board or proof & applying thereof from the date of issue of letter of acceptance

15 days

(ii) Maximum allowable extension with late fee @ 0.1% Per day of Performance Guarantee Amount beyond the period provided in (i) above

05 days**Clause 2**

Authority for fixing compensation under clause 2:-

Chief Engineer (Projects), PWD or successor thereof.

Clause 2A

Whether Clause 2A shall be applicable -

Yes**Clause 5**

Number of days from the date of issue of letter of acceptance for reckoning date of start

20 days

TABLE OF MILE STONE(S)

Mile Stones & Cumulative Time Period in months	Academic Block LGF+G+8	Boys Hostel Block B+G+11	Girls Hostel Block B+G+11	ESS, Plant Room single storey	External Development	Bulk Electrical Works	% of Tendered cost to be withheld in case of non-achievement of milestone
MILE STONE-I (3months)	All works upto plinth level including basement slab complete.	All works upto plinth level including basement slab complete.	All works upto plinth level including basement slab complete.		Site clearance, site dressing /levelling complete and setting up of site office for PWD and for contractor, installation of batch mixing plant and full mobilization of T & P at site.	Submission of Electrical Conduit Layout for all buildings and Bulk E & M Services. Submission of all electrical drawings of different E and M works including Technical details as per the NIT for different E and M equipments for approval.	1%

No. of Correction – C NIL
No. of Omissions – O NIL

No. of Insertions – I NIL

AE-I
(EPD-4)

EE
(EPD-4)

AE (P)
(CPM (Housing))

EE(P)
(CPM (Housing))

MILE STONE-II (6 months)	Complete RCC including UG RCC Tank and Electrical Conduiting Work for all E and M works upto 3rd Floor level complete. Brickwork /Plastering/Putty etc. upto 2nd floor level complete including wiring for different E and M works, laying for fire-fighting pipes and HVAC ducting.	Complete RCC and Electrical Conduiting Work for all E and M works upto 4th Floor level complete. Brickwork /Plastering/Putty etc. upto 2nd floor level complete including wiring for different E and M works, laying for fire-fighting pipes and HVAC ducting.	Complete RCC and Electrical Conduiting Work for all E and M works upto 4th Floor level complete. Brickwork /Plastering/Putty etc. upto 2nd floor level complete including wiring for different E and M works, laying for fire-fighting pipes and HVAC ducting..	All works upto plinth level complete.	All civil work for U/G Tank sump, including all external development works around plant room/ ESS.	Placing of complete orders for all the equipments/ machinery/ items for different E and M works.	1%
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No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

MILE STONE-III (9 months)	Complete RCC and Electrical Conduiting Work for all E and M works upto 8th Floor level. Brickwork /Plastering/ Putty/granite/stone/tile work etc. upto 6th floor level including wiring for different E and M works, laying for fire-fighting pipes and HVAC ducting. Flooring/ fixing of door and window frames/false ceiling etc including all finishing work except fixing of sanitary fixtures and final coat of paint upto 4rd floor level complete including completion of different E and M work except installation of fan and fitting.	Complete RCC and Electrical Conduiting Work for all E and M works upto 8th Floor level. Brickwork /Plastering/ Putty/granite/stone/tile work etc. upto 6th floor level including wiring for different E and M works, laying for fire-fighting pipes and HVAC ducting. Flooring/ fixing of door and window frames/false ceiling etc including all finishing work except fixing of sanitary fixtures and final coat of paint upto 4rd floor level complete including completion of different E and M work except installation of fan and fitting.	Complete RCC and Electrical Conduiting Work for all E and M works upto 8th Floor level. Brickwork /Plastering/ Putty/granite/stone/tile work etc. upto 6th floor level including wiring for different E and M works, laying for fire-fighting pipes and HVAC ducting. Flooring/ fixing of door and window frames/false ceiling etc including all finishing work except fixing of sanitary fixtures and final coat of paint upto 4rd floor level complete including completion of different E and M work except installation of fan and fitting.	All RCC, E and M Work and brickwork/plastering etc complete. Building work complete in all respects.	Construction of all roads upto sub-base level as per layout plan. Completion of all external fire fighting piping work and HVAC piping work.	Supply of Sub-station equipment, DG set, Lifts, HVAC equipment, Fire-fighting equipment, fire alarm equipments received at site.	1%
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No. of Correction –C NIL
No. of Omissions – O NIL

No. of Insertions –I NIL

MILE STONE-IV (12 months)	All RCC works complete including mummy and water tank, brickwork complete. All Flooring/fixing of door and window frames/false ceiling etc including all finishing work except fixing of sanitary fixtures and final coat of paint upto 6th floor level complete including completion of all E and M works.	All RCC and Electrical Conduiting Work for different E and M works complete upto 11 th floor. Brickwork/Plastering/ Putty work upto 9th floor level including wiring for different E and M works, laying for fire-fighting pipes and HVAC ducting. All Flooring/fixing of door and window frames/false ceiling etc including all finishing work except fixing of sanitary fixtures and final coat of paint upto 6th floor level complete including completion of different E and M work except installation of fan and fittings.	All RCC and Electrical Conduiting Work for different E and M works complete upto 11 th floor. Brickwork/Plastering/ Putty work upto 9th floor level including wiring for different E and M works, laying for fire-fighting pipes and HVAC ducting. All Flooring/fixing of door and window frames/false ceiling etc including all finishing work except fixing of sanitary fixtures and final coat of paint upto 6th floor level complete including completion of different E and M work except installation of fan and fittings.	SITC of all electrical equipments.	All site development works around the Academic Block complete.	Installation of Sub-station equipment, DG set, HVAC equipments, fire-fighting equipments, fire alarm equipments complete and Installation of lifts complete.	1%
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No. of Correction – C NIL
 No. of Omissions – O NIL

No. of Insertions – I NIL

AE-I
 (EPD-4)

EE
 (EPD-4)

AE (P)
 (CPM (Housing))

EE(P)
 (CPM (Housing))

MILE STONE-V (15 months)	All finishing, building work and E and M work including installation of fitting and fixture complete including fixing of sanitary fixtures, final coat of paint and installation of furniture complete in all respect. Building complete in all respects.	All finishing, building work and E and M work including installation of fitting and fixture complete including fixing of sanitary fixtures , final coat of paint and installation of furniture complete in all respect. . Building complete in all respects.	All finishing, building work and E and M work including installation of fitting and fixture complete including fixing of sanitary fixtures , final coat of paint and installation of furniture complete in all respect. Building complete in all respects.		All site development and external development works including landscape and horticulture complete around academic block and Hostel (Girls and Boys) Block complete.	All the E and M work as per the NIT completed and tested for all buildings including Hostel Blocks. Testing, commissioning of all the E and M services complete including approval from all the local bodies and statutory authorities and handing over all the installations to the department	1%
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No. of Correction –C NIL
No. of Omissions – O NIL

No. of Insertions –I NIL

Withheld amount shall be released if and when subsequent milestone is achieved within respective time specified. The main contractor will ensure that electrical components of the work are executed in time without giving any chance for slippage of milestone an account of delay in execution of associated electrical works by him. However, in case milestones are not achieved by the contractor for the work, the amount shown against milestone shall be withheld by the Engineer-in-Charge of the respective components.

Note: Intending tenderer shall submit alongwith the bid the detailed plan for deployment of resources and phasing of work to achieve physical milestones / stages indicated in the above table. These shall be formed part of the agreement after approval of the Engineer-in-Charge.

TIME ALLOWED FOR EXECUTION OF WORK **15 MONTHS**

AUTHORITY TO DECIDE:

<u>(I) EXTENSION OF TIME</u>	<u>CHIEF ENGINEER (PROJECTS), PWD, NEW DELHI (OR SUCCESSOR THEREOF). (MAJOR COMPONENT)</u>
<u>(II) RESCHEDULING OF MILE STONES</u>	<u>CHIEF ENGINEER (PROJECTS), PWD, NEW DELHI (OR SUCCESSOR THEREOF). (MAJOR COMPONENT)</u>
<u>SHIFTING OF DATE OF START IN CASE OF DELAY IN HANDING OVER OF SITE.</u>	<u>CHIEF ENGINEER (PROJECTS), PWD, NEW DELHI (OR SUCCESSOR THEREOF). (MAJOR COMPONENT)</u>

CLAUSE 6, 6A

CLAUSE APPLICABLE - (6 OR 6A):- 6A, APPLICABLE

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	1st Two R.A. Bills Rs. 5.00 Crores each Rest R.A. Bills Rs. 8.00 Crores each or as decided by Engineer-In-Charge.
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Clause 7 A

No Running Account shall be paid for the work till the applicable labour licenses, registration with EPFO, ESIC and BOCW Welfare Board whatever applicable are submitted by the contractor to the Engineer-in-Charge.

Clause 10A

List of testing equipment to be provided by the contractor at site lab:-	List of equipment attached on Page No. 64 & 65
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Clause 10B (ii):

Whether Clause 10 B (ii) shall be applicable –	Yes, Applicable
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Clause 10 C:	Not Applicable
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No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

Clause 10CA:

Applicable

S. No.	Material covered under this clause	Nearest Materials (other than cement*, reinforcement bars and the structural steel) for which All India Wholesale Price Index to be followed	Base Price and its corresponding period of all the material covered under clause 10CA	
			Base price	Corresponding Period
1	CEMENT (PPC)	NIL	Rs. 4,226/-	July, 2018
2	STEEL REINFORCEMENT BARS (I) TMT BARS FE 500D (PRIMARY MANUFACTURER)	NIL	Rs. 43,220/-	July, 2018
3	Structural steel	NIL	Rs. 44,565/-	July, 2018

*Includes cement component used in MRC brought at the site from outside approved RMC plants, if any.

Clause 10CC -

Applicable

Schedule of component of other Material, Labour, POL etc. for price escalation.	
Component of Civil and Electrical Materials (except material covered under Clause 10CA)/	40%
Component of Labour – Expressed as percent of total value of work.	25%
Component of P.O.L.- Expressed as percent of total value of work	NIL

Clause 11

Specifications to be followed for execution of Civil work :-

CPWD Specifications – 2009 Vol-I & II with upto date correction slip, relevant B.I.S. Codes and Morth Specification

Specifications to be followed for execution of Electrical work :-

CPWD General Specifications for Electrical works (Elect. Part-I) – 2013 Internal, Part-I, Part-II, Part-III, Part-IV, Part-V, Part-VI & Part-VII issued and amendment upto date and additional specifications of NIT and as per latest National/International Standards upto date as specified.

Clause 12

Type of Work:- Original Work

12.2. & 12.3 Deviation Limit beyond which clauses

12.2 & 12.3 shall apply for building work.

30%

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

AE-I
(EPD-4)

EE
(EPD-4)

AE (P)
(CPM (Housing))

EE(P)
(CPM (Housing))

- and electrical work
- 12.5 (i) Deviation Limit beyond which clauses 12.2 & 12.3 shall apply for foundation work (except earth work) 30%
- ii) Deviation Limit for items in earth work sub-head of DSR or Related items. 100%

Clause 16

Competent Authority for deciding reduced rates:

Civil & Electrical work: **Chief Engineer (Projects), PWD, New Delhi**

Clause 18

List of machinery, tools & plants to be deployed by the contractor at site:-

1.	Excavators (Porcelain- 60cum/hr capacity)	2 No.
2.	Dozer- 160HP	1 No.
3.	Hydraulic Excavator (3D)	2 No.
4.	Rock Breaker	2 No.
5.	Rock Excavator	2 No
6.	Needle Vibrators	12 Nos.(4 Electrical + 8 Petrol)
7.	Plate Vibrator	4 Nos.
8.	Bar Bending Machine	4 Nos.
9.	Drilling Machine	4 Nos.
10.	Bar Cutting Machine	4 Nos.
11.	Welding Machine	8 Nos.
12.	D.G. Set 100 KVA/125 KVA	3 Nos.
13.	Electric Pump	4 Nos.
14.	Grinding/Polishing Machine	6 Nos.
15.	Concrete Pump (30 cum/hr capacity)	4 Nos.
16.	Tower Crane	4 Nos.
17.	Building Hoist	5 Nos.
18.	Hopper Mixer	2 Nos.
19.	Truck/Tippers	4 Nos.
20.	Transit Mixer (6 cum capacity)	2 Nos.
21.	Fully Automatic batching and mixing plant at least 30 cum per hr. Capacity complete computer-programmable with printouts for admixture, concrete batching and other items.	1 No.
22.	Tandem Roller	1 Nos.
23.	Vibration Compactor	2 Nos.
24.	Sensor Paver Finisher for concrete roads.	1 Nos.
25.	Floor shuttering material	10,000 Sqm
26.	Water tanker with sprinkler (5000 ltr)	2 Nos.
27.	Core cutting machine	1 Nos.
28.	JCB	2 Nos.

The above listed T&P can be modified as per site requirement and directions of Engineer-In-Charge.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

Clause 20A - 20A.13(12) It Is mandatory to upload scanned 20A.13(12) copies of all the documents including GST if documents are not uploaded, then bid will become invalid and shall summarily be rejected 20A.12(10) The bid submitted shall become Annexure 20A.12(10) invalid if: 20A.12(10) (iii) The bidder does not upload all 20A.12(10) documents (including GST (ii) registration) as stipulated in the bid document including the copy of receipt for deposition of original EMD instrument. 20A.13.1. Certificate of Registration for GST and acknowledgement 0 upto date filed return as per NIT Stipulation. If the bidder has not obtained GST registration in the state in which the work is to be taken up, then in such a case the bidder shall upload following undertaking with the bid document "If work is awarded to me, I/we shall obtain GST registration certificate within one month from date of receipt of award letter or before payment of 1st R.A. bill." 20A.13.2. Certificate of Registration for GST and acknowledgement 0 upto date filed return as per NIT Stipulation. If the bidder has not obtained GST registration in the state in which the work is to be taken up, then in such a case the bidder shall upload following undertaking with the bid document "If work is awarded to me, I/we shall obtain GST registration certificate within one month from date of receipt of award letter or before payment of 1st R.A. bill."

CLAUSE 25

Constitution of Dispute- a) For total claims more than 25 lakh.

Redressal Committee :

- Chairman : (i) Pr. Chief Engineer (Education-Projects), PWD, New Delhi. (Chairman)
- Member : (ii) Director Works, in O/o E-in-C (P), PWD, New Delhi.
- Member : (iii) SE (Elect.), O/o Pr. CE (Projects) PWD, New Delhi
- (iv) EE EPD-4, in-charge of the work shall present case before DRC but shall not have any part in decision making.

(b) For total claims upto Rs. 25.00 Lakh.

- Chairman : (i) PM (Other Project), PWD, New Delhi. (Chairman)
- Member : (ii) SE (Elect.), in O/o Pr. CE (Projects), PWD, New Delhi.
- Member : (iii) Executive Engineer EPD-2, PWD New Delhi.
- (iv) The Executive Engineer in-charge of the work shall present the case before DRC but will not have any part in decision making.

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

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

AE-I
(EPD-4)

EE
(EPD-4)

AE (P)
(CPM (Housing))

EE(P)
(CPM (Housing))

Clause 36 (i)

Requirement of Technical Representative(s) and recovery Rate

For Civil Work :

Requirement of Technical Staff		Minimum Experience (Years)	Designation	Rate at which recovery shall be made from the contractor in the event of not fulfilling provision of clause 36 (i)
Qualification	Number			
Graduate Engineer (Major Component)	1	20 (and having experience of one similar nature of work)	Project Manager with degree in major discipline of Engineering	Rs. 1 Lac per month per person
Graduate Engineer	2	12 (and having experience of one similar nature of work)	Dy. Project Manager	Rs. 75,000/- per month per person
Graduate Engineer or Diploma Engineer	4	5 or 10 respectively	Project/ Site Engineer	Rs. 50,000/- per month per person
Graduate Engineer	1	8	Quality Engineer	Rs. 50,000/- per month per person
Diploma Engineer	1	8	Surveyor	Rs. 30,000/- per month per person
Graduate Engineer	1	6	Project Planning/billing Engineer	Rs. 50,000/- per month per person

For Electrical Works:

S. No.	Name of work	Requirement of Technical Staff		Minimum Experience (Years)	Designation	Recovery Rate in event of not fulfilling provision of clause 36 (i)
		Qualification	Nos.			
1	Internal EI External Electrification	(i) Graduate Engineer (Electrical)	1	5	Pr. Technical Representative	Rs. 60,000 per month per person
		(ii) Graduate Engineer (Electrical)	2	2	Project/Site Engineer	Rs. 40,000 per month per person
		OR Diploma Holder (Electrical)	2	5	Engineer	Rs. 30,000 per month per person

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

AE-I
(EPD-4)

EE
(EPD-4)

AE (P)
(CPM (Housing))

EE(P)
(CPM (Housing))

2	LAN Networking Work	(i) Graduate Engineer (Electronics) OR Diploma Holder (Electronics)	1 1	2 5	Project Planning / Site Engineer	Rs. 40,000 per month per person Rs. 30,000 per month per person
3	Fire alarm system	(i) Graduate Engineer (Electronics) OR Diploma Holder (Electronics)	1 1	2 5	Project Planning / Site Engineer	Rs. 40,000 per month per person Rs. 30,000 per month per person
4	HVAC	(i) Project Manager with Degree in corresponding Discipline of Engineering (Mechanical) (ii) Graduate Engineer (Mechanical) (iii) Graduate Engineer (Mechanical) OR Diploma Holder (Mechanical)	1 1 1 1	10 5 2 5	Pr. Technical Representative Technical Representative Project/Site Engineer and Project Planning/Billing Engineer	Rs. 60,000 per month per person Rs. 40,000 per month per person Rs. 30,000 per month per person Rs. 30,000 per month per person
5	Fire fighting & water supply	(i) Graduate Engineer (Fire/Mechanical) OR Diploma Holder (Fire/Mechanical)	1 1	2 5	Project Planning / Site Engineer	Rs. 40,000 per month per person Rs. 30,000 per month per person

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

6	Sub-station	(i) Graduate Engineer (Electrical)	1	5	Pr. Technical Representative	Rs. 60,000 per month per person
		(ii) Graduate Engineer (Electrical)	1	2		Rs. 40,000 per month per person
		OR Diploma Holder (Electrical)	1	5	Project Planning / Site Engineer And Engineer	Rs. 30,000 per month per person
7	EPABX	(i) Graduate Engineer (Electronics & Telecom)	1	2	Project Planning / Site/ Billing Engineer	Rs. 40,000 per month per person
		OR Diploma Holder (Electronics & Telecom)	1	5		Rs. 30,000 per month per person
8	Water Supply	Graduate Engineer	1	2	Pr. Technical Representative	Rs. 60,000 per month per person
		OR Diploma Holder	1	5	Project Planning / Site/ Billing Engineer	Rs. 30,000 per month per person

- (i) Assistant Engineers retired from Government services that are holding Diploma will be treated at par with Graduate Engineers.
- (ii) Diploma holder with minimum 10 year relevant experience with a reputed construction co. can be treated at par with Graduate Engineers for the purpose of such deployment subject to the condition that such diploma holders should not exceed 50% of requirement of degree engineers.

Note:- For E&M works, the associate firm will have to deploy the technical representatives having work experience as per the direction of Engineer-in-Charge.

Clause 42

- (i) (a) Schedule/statement for determining Theoretical quantity of cement & bitumen on the basis of Delhi Schedule of Rates

DSR-2016 with upto-date correction slips.

- (ii) **Variations permissible on theoretical quantities:**

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

AE-I
(EPD-4)

EE
(EPD-4)

AE (P)
(CPM (Housing))

EE(P)
(CPM (Housing))

- (a) Cement
For works with estimated cost put to tender not more than Rs. 5 lakh. **2% plus/minus.**
- For works with estimated cost put to tender more than Rs.5 lakh. **2% plus/minus.**
- (b) Bitumen All Works **2.5% plus 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**

RECOVERY RATES FOR QUANTITIES BEYOND PERMISSIBLE VARIATION

S.No.	Description of Item	Rates in figures and words at which recovery shall be made from the Contractor	
		Excess beyond permissible Variation	Less use beyond permissible variation
1	Cement (OPC) Cement (PPC)	N.A	Will not be allowed and liable to be rejected
2	Steel Reinforcement bars a. TMT bars Fe 500D (Primary Manufacturer).	N.A	Will not be allowed and liable to be rejected
3	Structural Sections	N.A	Will not be allowed and liable to be rejected

Executive Engineer

Education Project Division-4, PWD,
Shaheed Sukhdev College,
Sector-16,Rohini, Delhi-89

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

LIST OF EQUIPMENTS FOR SITE LABORATORY

PARTICULARS		ITEM	QUANTITY
I. Aggregate Testing			
	1.	Set of coarse sieves 30 cm dia (GI Sheet frames) with aperture size (40 mm, 25 mm, 20 mm, 16 mm, 17.5 mm, 10 mm, 4.75 mm all with lid and pan)	1 set
	a)	Motorised sieve shaker for the above sieves	1 No.
	2.	Set of fine sieves 20 cm dia of Brass with aperture size (4.75 mm, 2.36 mm, 1.18 mm, 600 mic, 300 mic, 150 mic, 75 mic, all with lid and pan)	1 set
	a)	Motorised sieve shaker for the above sieves	1 No.
	3.	Flakiness & Elongation Index Screen	1 No.
	4.	LOS angles abrasion testing Machine	1 No.
	5.	Bulk Density and voids of Aggregates Cylindrical Metal measures with capacity (3 ltr, 10 ltr, 15 ltr or 20 ltr)	1 No./each
	6.	Pycnometer 1000 ml capacity with Brass	1 No.
	7.	Hot -Air Blower (Hair Dryer)	1 No.
	8.	Aggregate impact value apparatus with automatic blow counter	1 No.
	9.	Hot-Plate 1000 to 2000 watts with regulator cum switch	1 No.
	10.	Drying Pans (Frying Pans)	2 Nos.
	11.	China clay dishes with dia 10 cm & 15 cm	2 Nos/each
	12.	Sieve Brushes	2 Nos.
II. Concrete Testing			
	1.	Concrete cube moulds 15x15x15 cm	60 Nos.
	2.	Pruning Rods 2 Kg weight length 40 cm and ramming face 25 mm ²	4 Nos.
	3.	Extra Bottom Plates for 15 cm cube mould	6 Nos.
	4.	Standard Vibration Table for cubes	2 Nos.
	5.	Compression Testing Machine with Electricity cum manually operated tamping unit with pressure guage preferably 30 cm dia, 0-150 tonne in 1 tonne divisions. Sensitivity 0.5 tonne (alongwith calibration certificate)	2 No.
	6.	Slump Test Apparatus Complete	3 Nos.
	7.	G.I. Tray approx 1 m x 1 m with sides 10 cm high for hand mixing of concrete	2 Nos.
	8.	Concrete temperature measuring thermometer	2 Nos.
III. Cement Testing			
	1.	Mortar cubes moulds 7.07x7.07x7.07 cm	10 No.
	2.	Standard sand grade I, II & III.	50 kgs/each
	3.	Mortar cube vibrator	1 No.
	4.	Vicat Needle Apparatus	1 No.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

PARTICULARS		ITEM	QUANTITY
	5.	Le-chatelier Apparatus	1 No.
IV. Weighing Equipment			
	1.	Digital Balance	1 No.
	2.	Physical Balance capacity 5 kg.	1 No.
	3.	Dial type spring balance having knob capacity 100 kgs reading to ½ kg.	1 No.
	4.	Weighing Platform Capacity 100kg	1 No.
	5.	Iron weights of 5kg., 2kg, 1kg, 500gm., 200gm, 100gm	2 Nos./ each
	6.	Brass Weights of 50gm, 20gm., 10gm, 5gm, 2gm, 1gm	2 Nos./each
V. Water measuring equipment			
	1.	Water bottles/canes 5ltr, 2ltr, 1ltr, 1/2ltr	4 Nos./each
	2.	Measuring cylinder capacity 100ml, 500ml, 250ml	4 Nos./each
	3.	Beakers with capacity 500ml, 200ml, 50ml.	2 Nos./each
	4.	Wash bottles Capacity 500 ml, 1000 ml.	2 Nos./each
	5.	Thermometers 0-100 degree centigrades	2 Nos.
VI. Laboratory Tools			
	1.	Hammer 1lb	2 Nos.
	2.	Rubber Hammer	2 Nos.
	3.	Measuring tape 3 mtr, 15 mtr	2 Nos/each
	4.	Depth gauge 20 cm	2 Nos.
	5.	Digital Vernier Calliper	2 Nos.
	6.	Micro screw 25 mm gauge	2 Nos.
	7.	Screw Driver	2 Nos.
VI. Additional Equipments			
	1.	Oven	1 No.
	2.	Any equipment desired by Engineer-in-charge	

Note: (1) In case any of the above equipment goes out of order or damaged, it shall be replaced by a proper working equipment by the contractor within 24 hours.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

Form of Earnest Money Deposit (Bank Guarantee Bond)

WHEREAS, contractor..... (Name of contractor) (hereinafter called "the contractor") has submitted his tender dated (date) for the construction of (name of work) (hereinafter called "the Tender")

KNOW ALL PEOPLE by these presents that we (Name of Bank) having our registered office at (hereinafter called "the Bank") are bound unto Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi -110089 (herein after called the Engineer-in-Charge) in the sum of Rs. (Rs. in words) for which payment well and truly to be made to the said Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi -110089 the Bank binds itself, his successors and assigns by these presents.

SEALED with the Common Seal of the said Bank this day of 20.... THE CONDITIONS of this obligation are:

- (1) If after Technical Bid opening of tender; the Contractor withdraws, his tender during the period of validity of tender (including extended validity of tender) specified in the Form of Tender;
- (2) If the contractor having been notified of the acceptance of his tender by the Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi -110089
 - (a) Fails or refuses to execute the Form of Agreement in accordance with the Instructions to contractor, if required;
OR
 - (b) Fails or refuses to furnish the Performance Guarantee, in accordance with the provisions of tender document and Instructions to contractor,
OR
 - (c) Fails or refuses to start the work, in accordance with the provisions of the contract and Instructions to contractor,
OR
 - (d) Fails or refuses to submit fresh Bank Guarantee of an equal amount of this Bank Guarantee, against Security Deposit after award of contract.

We undertak to pay to the Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi -110089 either up to the above amount or part thereof upon receipt of his first written demand, without the Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi -110089 having to substantiate his demand, provided that in his demand the Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi -110089 will note that the amount claimed by him is

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

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 tender as such deadline is stated in the Instructions to contractor or as if may be extended by the Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi - 110089 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 last date of receipt of tender.***

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

AE-I
(EPD-4)

EE
(EPD-4)

AE (P)
(CPM (Housing))

EE(P)
(CPM (Housing))

**GUARANTEE BONDS
ANNEXURE-I**

**GUARANTEE TO BE EXECUTED BY THE CONTRACTOR
FOR REMOVAL OF DEFECTS AFTER COMPLETION IN RESPECT OF
STONE WORK/ TILE WORK.**

The agreement made this..... day of Two Thousand betweenS/o(hereinafter called the GUARANTOR on the one part) and the President of India (hereinafter called the Government on the other part)

WHEREAS THIS agreement is supplementary to a contract (Hereinafter called the Contract) dated and made between the GUARANTOR ON THE ONE PART AND the Government on the other part whereby the contractor inter alias undertook to render the work in the said contract structurally stable , workmanship, finishing and use of sound materials.

AND WHEREAS THE GUARANTOR agreed to give a guarantee to the effect that the said work will remain structurally stable and guaranteed against faulty workmanship, finishing and materials.

NOW THE GUARANTOR hereby guarantee that work executed by him will remain structurally stable after the expiry of maintenance period prescribed in the contract for the minimum life of five years to be reckoned from the date after the expiry of maintenance period prescribed in the contract.

The decision of the Engineer-in-Charge with regard to nature and cause of defect shall be final.

During this period of guarantee, the guarantor shall make good all defects to the satisfaction of the Engineer-in-Charge calling upon him to rectify the defects failing which the work shall be got done by the Department by some other contractor at the Guarantor's cost and risk. The decision of the Engineer-in-Charge as to the cost payable by the Guarantor shall be final and binding.

That if the guarantor fails to make good all the defects, commits breach there under, then the guarantor will indemnify the principal and his successor against all loss, damage, cost expense or otherwise which may be incurred by him by reason of 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 both 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 BEHALF OF THE PRESIDENT OF INDIA BY in the presence of :-

1. 2.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

ANNEXURE-II

GUARANTEE TO BE EXECUTED BY THE CONTRACTOR
FOR REMOVAL OF DEFECTS AFTER COMPLETION IN RESPECT OF
WATER-PROOFING WORKS.

The agreement made this..... day of Two Thousand
 betweenS/o
(hereinafter called the GUARANTOR on the one part)
 and the PRESIDENT OF INDIA (hereinafter called the Government on the other part)

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

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

NOW THE GUARANTOR hereby guarantee that work executed 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 expiry of maintenance period prescribed in the contract.

The decision of the Engineer-in-Charge with regard to nature and cause of defect 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 calling upon him to rectify the defects failing which the work shall be got done by the Department by some other contractor at the Guarantor's cost and risk. The decision of the Engineer-in-Charge as to the cost payable by the Guarantor shall be final and binding.

That if the guarantor fails to execute the water proofing or commits breach thereunder, then the guarantor will indemnify the principal and his successor against all loss, damage, cost expense or otherwise which may be incurred by him by reason of 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 both 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 BEHALF OF THE PRESIDENT OF INDIA BY
 in the presence of :-

1.
2.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

ANNEXURE-III
GUARANTEE TO BE EXECUTED BY THE CONTRACTOR
FOR REMOVAL OF DEFECTS AFTER COMPLETION
IN RESPECT OF SANITARY INSTALLATIONS / WATER SUPPLY / DRAINAGE
WORK AND ALUMINIUM WORK

The agreement made this..... day of Two Thousand
 betweenS/o
(hereinafter called the GUARANTOR on the one part)
 and the PRESIDENT OF INDIA (hereinafter called the Government on the other part)

WHEREAS THIS agreement is supplementary to a contract (Hereinafter called the Contract) dated and made between the GUARANTOR ON THE ONE PART AND the Government on the other part, whereby the contractor inter alia, undertook to render the work in the said contract structurally stable, leak proof and sound material, workmanship, anodizing, colouring, sealing etc.

AND WHEREAS THE GUARANTOR agreed to give a guarantee to the affect that the said work will remain structurally stable, leak proof and guaranteed against faulty material and workmanship, defective anodizing / Powder coat colouring and finishing for years from the date of completion of work.

NOW THE GUARANTOR hereby guarantee that work executed by him will be free from any leakage, seepage, cracks in pipes and guaranteed against faulty material and workmanship, defective galvanising for five years to be reckoned from the date after the expiry of maintenance period prescribed in the contract.

The decision of the Engineer-in-Charge with regard to nature and cause of defect shall be final.

During this period of guarantee, the guarantor shall make good all defects and in case of any defect to satisfaction of 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 the Engineer-in-Charge calling upon him to rectify the defects failing which the work shall be got done by the Department by some other contractor at the guarantor's cost and risk. The decision of the Engineer-in-Charge as to the cost payable by the Guarantor shall be final and binding.

That if the guarantor fails to make good all defects or commits breach thereunder, then the guarantor will indemnify the principal and his successor against all loss, damage, cost expense or otherwise which may be incurred by him by reason of 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 both 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.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

ANNEXURE-IV
FORM OF PERFORMANCE SECURITY/
BANK GUARANTEE BOND

In consideration of the President of India (hereinafter called "the Government") having agreed under the terms and conditions of agreement No. _____ dated _____ made between _____ and _____ {hereinafter called "the said contractor(s)"} for the work _____

_____ (hereinafter called "the said agreement") having agreed to production of an 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 _____ do hereby undertake to (indicate the name of the Bank) 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, the said bank further undertake 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 _____ further agree that the guarantee (indicate the name of the Bank) 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

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

paid and its claims satisfied or discharged or till Engineer-in-Charge, on behalf of the Government, certifies that the terms and conditions of the said agreement have been fully and properly carried out by the said contractor(s) accordingly discharges this guarantee.

5. We_____ further agree with the Government that (indicate the name of the Bank)the Government shall have the fullest liberty without our consent and without affecting 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 forbear or enforce any of the terms and conditions relating to the said agreement and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said contractor(s) or for any forbearance, 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 or 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_____ lastly undertake not to (indicate the name of bank) revoke this guarantee except with the previous consent of the Government in writing.
8. This guarantee shall be valid upto_____ unless extended on demand by Government. Notwithstanding anything mentioned above, our liability against this Guarantee is restricted to Rs._____/-(Rupees_____only) and unless a claim in writing is lodged with us within 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.

Dated the _____ day of_____for_____Indicate the name of the Bank)

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

ANNEUXURE-V
AFFIDAVIT

I/ we have submitted a bank guarantee for the work :.....(Name of work)

Agreement No dated.....

From.....(Name of bank with full address)

to the Executive Engineer..... (Name of division)

With a view to seek exemption from payment of security deposit / performance guarantee / guarantee money for expansion joint/ Electrometric bearing/ bitumen mastic wok in cash. This bank guarantee expires on.....

I /we undertaken to keep the validity of the bank guarantee intact by getting it extended from time to time at my/ our own initiative upto a period Months after the recorded date of completion of the work or as directed by the Engineer-in-Charge.

i/we also indemnify the government against any losses arising out of..... non encashment of the bank guarantee if any

Deponent

Signature of contractor

The affidavit is to be given by the executants before a first class Magistrate.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

AE-I
(EPD-4)

EE
(EPD-4)

AE (P)
(CPM (Housing))

EE(P)
(CPM (Housing))

Annexure-VI
UNDERTAKING BY WAY OF AFFIDAVIT

From:

To

The Executive Engineer

Education Project Division-4, PWD,
 Shaheed Sukhdev College,
 Sector-16, Rohini, Delhi-110089

Name of work:- C/o Stage-I of Phase-II, Delhi Technological University at Bawana Road, Delhi (SH: -C/o Academic Blocks AB-3 & AB-4, Boys Hostel H-5 & Girls Hostels HG-5 & HG-6 and all external and internal services including external development and landscaping, and allied civil and E&M works).

Dear Sir,

We hereby confirm that we have not applied nor we are under Corporate Debt Restructuring nor under any proceeding for insolvency in NCLT or elsewhere as on the last date of submission of bid.

Thanking you,

<p>..... </p> <p>Signature, name and designation of authorized signatory</p> <p>For and on behalf of (Name of the applicant)</p>	<p>..... </p> <p>Name of the Statutory Auditor's firm: Seal of the audit firm: (Signature, name and designation and membership No. of authorized signatory)</p>
--	--

Note: This undertaking to be signed by the applicant and to be countersigned by the Statutory Auditor.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

AE-I
 (EPD-4)

EE
 (EPD-4)

AE (P)
 (CPM (Housing))

EE(P)
 (CPM (Housing))

Annexure-VII
ESCROW AGREEMENT
(See Clauses 3.49)

THIS ESCROW AGREEMENT is entered into on this the day of
 20....

AMONGST

- 1 LIMITED, a company incorporated under the provisions of the Companies Act, 1956 and having its registered office at (hereinafter referred to as the “Agency” which expression shall, unless repugnant to the context or meaning thereof, include its successors, permitted assigns and substitutes);
 - 2name and particulars of Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi -110089 and having its registered office atacting for and on behalf of the PWD, GNCTD as their duly authorised agent with regard to matters arising out of or in relation to this Agreement (hereinafter referred to as the “Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi -110089 ” which expression shall, unless repugnant to the context or meaning thereof, include its successors and substitutes);
 - 3name and particulars of the Escrow Bank and having its registered office at(hereinafter referred to as the “Escrow Bank” which expression shall, unless repugnant to the context or meaning thereof, include its successors and substitutes); and 4 The Public Works Department, GNCTD, (hereinafter referred to as the “PWD” which expression shall, unless repugnant to the context or meaning thereof, include its administrators, successors and assigns). WHEREAS:
- (A) The PWD, GNCTD has entered into an Agreement dated with the Agency for C/o Stage-I of Phase-II, Delhi Technological University at Bawana Road, Delhi (SH:- C/o Academic Blocks AB-3 & AB-4, Boys Hostel H-5 & Girls Hostels HG-5 & HG-6 and all external and internal services including external development and landscaping, and allied civil and E&M works).

NOW, THEREFORE, in consideration of the foregoing and the respective covenants and agreements set forth in this Agreement, the receipt and sufficiency of which is hereby acknowledged, and intending to be legally bound hereby, the Parties agree as follows:

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

AE-I
 (EPD-4)

EE
 (EPD-4)

AE (P)
 (CPM (Housing))

EE(P)
 (CPM (Housing))

1 DEFINITIONS AND INTERPRETATION

1.1 Definitions

In this Agreement, the following words and expressions shall, unless repugnant to the context or meaning thereof, have the meaning hereinafter respectively assigned to them:

“Agreement” means this Escrow Agreement and any amendment thereto made in accordance with the provisions contained herein;

“Cure Period” means the period specified in this Agreement for curing any breach or default of any provision of this Agreement by the Agency, and shall commence from the date on which a notice is delivered by the PWD, GNCTD or the Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi -110089 as the case may be, to the Agency asking the latter to cure the breach or default specified in such notice; “Escrow Account” means an escrow account established in terms of and under this Agreement, and shall include the Sub-Accounts; “Escrow Default” shall have the meaning ascribed thereto in Clause 6.1; “Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi -110089” means the person referred to as the Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi -110089 in the foregoing Recitals; “Parties” means the parties to this Agreement collectively and “Party” shall mean any of the Parties to this Agreement individually; 1.2 Interpretation

- 1.2.1 References to Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi -110089 shall, unless repugnant to the context or meaning thereof, mean references to the Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi -110089 acting for and on behalf of PWD, GNCTD.
- 1.2.2 The words and expressions beginning with capital letters and defined in this Agreement shall have the meaning ascribed thereto herein, and the words and expressions used in this Agreement and not defined herein but defined in the Agreement shall, unless repugnant to the context, have the meaning ascribed thereto in the Agreement.
- 1.2.3 References to Clauses are, unless stated otherwise, references to Clauses of this Agreement.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

2 ESCROW ACCOUNT

2.1 Escrow Bank to act as trustee

2.1.1 The Agency hereby appoints the Escrow Bank to act as trustee for the PWD, GNCTD, the Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi -110089 and the Agency in connection herewith and authorizes the Escrow Bank to exercise such rights, powers, authorities and discretion as are specifically delegated to the Escrow Bank by the terms hereof together with all such rights, powers, authorities and discretion as are reasonably incidental hereto, and the Escrow Bank accepts such appointment pursuant to the terms hereof.

2.1.2 The Agency hereby declares that all rights, title and interest in and to the Escrow Account shall be vested in the Escrow Bank and held in trust for the PWD, GNCTD, the Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi -110089 and the Agency, and applied in accordance with the terms of this Agreement. No person other than the PWD, GNCTD, the Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi -110089 and the Agency shall have any rights hereunder as the beneficiaries of, or as third party beneficiaries under this Agreement.

2.2 Acceptance of Escrow Bank

The Escrow Bank hereby agrees to act as such and to accept all payments and other amounts to be delivered to and held by the Escrow Bank pursuant to the provisions of this Agreement. The Escrow Bank shall hold and safeguard the Escrow Account during the term of this Agreement and shall treat the amount in the Escrow Account as monies deposited by the Agency, PWD, GNCTD with the Escrow Bank. In performing its functions and duties under this Agreement, the Escrow Bank shall act in trust for the benefit of, and as agent for, the PWD, GNCTD, the Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi -110089 and the Agency or their nominees, successors or assigns, in accordance with the provisions of this Agreement.

2.2.1 Within 15 (Fifteen) days from the date of this Agreement, the Agency shall open and establish the Escrow Account with the (name of Branch) Branch of the Escrow Bank. The Escrow Account shall be denominated in Rupees.

2.2.2 The Escrow Bank shall maintain the Escrow Account in accordance with the terms of this Agreement and its usual practices and applicable regulations, and pay the maximum rate of interest payable to similar customers on the balance in the said account from time to time.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- 2.2.3 The Escrow Bank and the Agency shall, after consultation with the Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi - 110089 agree on the detailed mandates, terms and conditions, and operating procedures for the Escrow Account, but in the event of any conflict or inconsistency between this Agreement and such mandates, terms and conditions, or procedures, this Agreement shall prevail.
- 2.2.4 The Account Bank shall operate the Account in the manner as defined Below: The Account Bank has operated jointly by PWD & Ltd., both the parties will jointly issue letter signed by one authorized representatives of each party. On presenting this request letter to bank, bank will make payments to instructed party by RTGS / NEFT.
- 2.2.5 The Department and Agency jointly shall be entitled to give any instructions to the Account Bank in respect of the operation, lying and available therein. The Account Bank shall not be required to ascertain the authority of the Department and Agency giving the instruction to the Account Bank in terms of any agreement / arrangement entered into by it with the client or any other person. Such instructions shall be binding on all the parties.
- 2.3 Escrow Bank's fee The Escrow Bank shall be entitled to receive its fee and expenses in an amount, and at such times, as may be agreed between the Escrow Bank and the Agency. For the avoidance of doubt, such fee and expenses shall be paid by agency and shall be appropriated from the Escrow Account in accordance with Clause 4.1. 2.5 Rights of the parties

The rights of the PWD, GNCTD, the Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi -110089 and the Agency in the monies held in the Escrow Account are set forth in their entirety in this Agreement and the PWD, GNCTD, the Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi -110089 and the Agency shall have no other rights against or to the monies in the Escrow Account.

3 DEPOSITS INTO ESCROW ACCOUNT

Payments due to (name of agency) & as deemed appropriate by PWD will be deposited in the escrow account.

3.1 Interest on deposits

The Escrow Bank agrees and undertakes that all interest accruing on the balances of the Escrow Account shall be credited to the Escrow Account; provided that the Escrow Bank shall be entitled to appropriate therefrom the fee and expenses due to it from the Agency to the Escrow Account.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

4. WITHDRAWALS FROM ESCROW ACCOUNT

- 4.1 No disbursement will be made from the account without the written approval of Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi -110089 .
- 4.2 Withdrawals during Suspension Notwithstanding anything to the contrary contained in this Agreement, the PWD, GNCTD may exercise all or any of the rights of the Agency during the period of Suspension. Any instructions given by the PWD, GNCTD to the Escrow Bank during such period shall be complied with as if such instructions were given by the Agency under this Agreement and all actions of the PWD, GNCTD hereunder shall be deemed to have been taken for and on behalf of the Agency.

5 OBLIGATIONS OF THE ESCROW BANK

- 5.1 Segregation of funds Monies and other property received by the Escrow Bank under this Agreement shall, until used or applied in accordance with this Agreement, be held by the Escrow Bank in trust for the purposes for which they were received, and shall be segregated from other funds and property of the Escrow Bank.

5.2 Communications and notices

In discharge of its duties and obligations hereunder, the Escrow Bank:

- (a) may, in the absence of bad faith or gross negligence on its part, rely as to any matters of fact which might reasonably be expected to be within the knowledge of the Agency upon a certificate signed by or on behalf of the Agency;
- (b) may, in the absence of bad faith or gross negligence on its part, rely upon the authenticity of any communication or document believed by it to be authentic;
- (c) shall, within 5 (five) business days after receipt, deliver a copy to the Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi -110089 of any notice or document received by it in its capacity as the Escrow Bank from the Agency or any other person hereunder or in connection herewith; and
- (d) shall, within 5 (five) business days after receipt, deliver a copy to the Agency of any notice or document received by it from the Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi -110089 in connection herewith.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

5.3 No set off

The Escrow Bank agrees not to claim or exercise any right of set off, banker's lien or other right or remedy with respect to amounts standing to the credit of the Escrow Account. For the avoidance of doubt, it is hereby acknowledged and agreed by the Escrow Bank that the monies and properties held by the Escrow Bank in the Escrow Account shall not be considered as part of the assets of the Escrow Bank and being trust property, shall in the case of bankruptcy or liquidation of the Escrow Bank, be wholly excluded from the assets of the Escrow Bank in such bankruptcy or liquidation.

5.4 Regulatory approvals

The Escrow Bank shall use its best efforts to procure, and thereafter maintain and comply with, all regulatory approvals required for it to establish and operate the Escrow Account. The Escrow Bank represents and warrants that it is not aware of any reason why such regulatory approvals will not ordinarily be granted to the Escrow Bank.

6 ESCROW DEFAULT

6.1 Escrow Default

6.1.1 Following events shall constitute an event of default by the Agency (an "Escrow Default") unless such event of default has occurred as a result of Force Majeure or any act or omission of the agency :

- (a) the Agency causes the Escrow Bank to transfer funds to any account of the Agency in breach of the terms of this Agreement and fails to cure such breach by depositing the relevant funds into the Escrow Account or any Sub-Account in which such transfer should have been made, within a Cure Period of 5 (five) business days; or
- (b) the Agency commits or causes any other breach of the provisions of this Agreement and fails to cure the same within a Cure Period of 5 (five) business days.

6.1.2 Upon occurrence of an Escrow Default, the consequences thereof shall be dealt with under and in accordance with the provisions of the Agreement.

7 TERMINATION OF ESCROW AGREEMENT

7.1 Duration of the Escrow Agreement

This Agreement shall remain in full force and effect so long as any sum remains to be advanced or is outstanding from the Agency in respect of the debt, guarantee or financial assistance received by it from the PWD, GNCTD or any of its obligations to the PWD, GNCTD remain to be discharged, unless terminated earlier by consent of all the Parties or otherwise in accordance with the provisions of this Agreement.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

7.2 Substitution of Escrow Bank

The Agency may, by not less than 45 (forty five) days prior notice to the Escrow Bank, the PWD, GNCTD and the Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi -110089 , terminate this Agreement and appoint a new Escrow Bank, provided that the new Escrow Bank is acceptable to the Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi -110089 and arrangements are made satisfactory to the Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi -110089 for transfer of amounts deposited in the Escrow Account to a new Escrow Account established with the successor Escrow Bank. The termination of this Agreement shall take effect only upon coming into force of an Escrow Agreement with the substitute Escrow Bank.

7.3 Closure of Escrow Account

The Escrow Bank shall, at the request of the Agency and the Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi -110089 made on or after the payment by the Agency of all outstanding amounts under the Agreement and upon confirmation of receipt of such payments, close the Escrow Account and Sub-Accounts and pay any amount standing to the credit thereof to the Agency. Upon closure of the Escrow Account hereunder, the Escrow Agreement shall be deemed to be terminated.

8 INDEMNITY

8.1 General indemnity

8.1.1 The Agency will indemnify, defend and hold the PWD, GNCTD, Escrow Bank harmless against any and all proceedings, actions and third party claims for any loss, damage, cost and expense arising out of any breach by the Agency of any of it's obligations under this Agreement or on account of failure of the Agency to comply with Applicable Laws and Applicable Permits.

8.1.2 The PWD, GNCTD will indemnify, defend and hold the Agency harmless against any and all proceedings, actions and third party claims for any loss, damage, cost and expense arising out of failure of the PWD, GNCTD to fulfil any of its obligations under this Agreement materially and adversely affecting the performance of the Agency's obligations under the Agreement or this Agreement other than any loss, damage, cost and expense arising out of acts done in discharge of their lawful functions by the PWD, GNCTD, its officers, servants and agents.

8.1.3 The Escrow Bank will indemnify, defend and hold the Agency harmless against any and all proceedings, actions and third party claims for any loss, damage, cost and expense arising out of failure of the Escrow Bank to fulfil its obligations under this Agreement materially and adversely affecting the performance of the Agency's obligations under the Agreement other than any

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

loss, damage, cost and expense, arising out of acts done in discharge of their lawful functions by the Escrow Bank, its officers, servants and agents.

8.2 Notice and contest of claims

In the event that any Party hereto receives a claim from a third party in respect of which it is entitled to the benefit of an indemnity under Clause 9.1 or in respect of which it is entitled to reimbursement (the “Indemnified Party”), it shall notify the other Party responsible for indemnifying such claim hereunder (the “Indemnifying Party”) within 15 (fifteen) days of receipt of the claim and shall not settle or pay the claim without the prior approval of the Indemnifying Party, which approval shall not be unreasonably withheld or delayed. In the event that the Indemnifying Party wishes to contest or dispute the claim, it may conduct the proceedings in the name of the Indemnified Party and shall bear all costs involved in contesting the same. The Indemnified Party shall provide all cooperation and assistance in contesting any claim and shall sign all such writings and documents as the Indemnifying Party may reasonably require.

9 No third party beneficiaries

This Agreement is solely for the benefit of the Parties and no other person or entity shall have any rights hereunder.

10 Waiver

10.1 Waiver by any Party of a default by another Party in the observance and performance of any provision of or obligations under this Agreement:

- (a) Shall not operate or be construed as a waiver of any other or subsequent default hereof or of other provisions of or obligations under this Agreement;
- (b) Shall not be effective unless it is in writing and executed by a duly authorised representative of the Party; and
- (c) Shall not affect the validity or enforceability of this Agreement in any manner.

10.2 Neither the failure by any Party to insist on any occasion upon the performance of the terms, conditions and provisions of this Agreement or any obligation thereunder nor time or other indulgence granted by any Party to another Party shall be treated or deemed as waiver of such breach or acceptance of any variation or the relinquishment of any such right hereunder. 11 No third party beneficiaries

This Agreement is solely for the benefit of the Parties and no other person or entity shall have any rights hereunder.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

11 Survival

11.1 Termination of this Agreement:

- a. shall not relieve the Parties of any obligations hereunder which expressly or by implication survive termination hereof; and
- b. except as otherwise provided in any provision of this Agreement expressly limiting the liability of either Party, shall not relieve either Party of any obligations or liabilities for loss or damage to the other Party arising out of, or caused by, acts or omissions of such Party prior to the effectiveness of such termination or arising out of such termination.

11.2 All obligations surviving the cancellation, expiration or termination of this Agreement shall only survive for a period of 3 (three) years following the date of such termination or expiry of this Agreement.

12 Severability

If for any reason whatever any provision of this Agreement is or becomes invalid, illegal or unenforceable or is declared by any court of competent jurisdiction or any other instrumentality to be invalid, illegal or unenforceable, the validity, legality or enforceability of the remaining provisions shall not be affected in any manner, and the Parties will negotiate in good faith with a view to agreeing to one or more provisions which may be substituted for such invalid, unenforceable or illegal provisions, as nearly as is practicable to such invalid, illegal or unenforceable provision. Failure to agree upon any such provisions shall not be subject to dispute resolution under Clause 10.1 of this Agreement or otherwise.

13 Successors and assigns

This Agreement shall be binding on and shall inure to the benefit of the Parties and their respective successors and permitted assigns.

14 Notices

All notices or other communications to be given or made under this Agreement shall be in writing and shall either be delivered personally or sent by courier or registered post with an additional copy to be sent by facsimile or e-mail. The address for service of each Party, its facsimile number or e-mail are set out under its name on the signing pages hereto. A notice shall be effective upon actual receipt thereof, save that where it is received after 5.30 (five thirty) p.m. on a business day, or on a day that is not a business day, the notice shall be deemed to be received on the first business day following the date of actual receipt. Without prejudice to the foregoing, a Party giving or making a notice or communication by facsimile or e-mail shall promptly deliver a copy thereof personally, or send it by courier or registered post to the addressee of such notice or communication. It is hereby agreed and

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No. of Omissions – O NIL
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acknowledged that any Party may by notice change the address to which such notices and communications to it are to be delivered or mailed. Such change shall be effective when all the Parties have notice of it.

15 Language

All notices, certificates, correspondence and proceedings under or in connection with this Agreement shall be in English.

16 Authorized representatives

Each of the Parties shall, by notice in writing, designate their respective authorized representatives through whom only all communications shall be made. A Party hereto shall be entitled to remove and/or substitute or make fresh appointment of such authorized representative by similar notice.

17 Original Document

This Agreement may be executed in four counterparts, each of which when executed and delivered shall constitute an original of this Agreement.

IN WITNESS WHEREOF THE PARTIES HAVE EXECUTED AND DELIVERED THIS AGREEMENT AS OF THE DATE FIRST ABOVE WRITTEN.

THE COMMON SEAL OF AGENCY has been affixed pursuant to the resolution passed by the Board of Directors of the Agency at its meeting held on the day of 20..... hereunto affixed in the presence of, Director, who has signed these presents in token thereof and, Company Secretary / Authorized Officer who has countersigned the same in token thereof \$:

SIGNED, SEALED AND SIGNED, SEALED AND DELIVERED DELIVERED
For and on behalf of For and on behalf of ESCROW BANK by: PUBLIC
WORKS DEPARTMENT, GNCTD by: (Signature) (Signature) (Name) (Name)
(Designation) (Designation) (Address) (Address) (Fax No.) (Fax No.) (e-mail
address) (e-mail address)

In the presence of:

- 1.
- 2.

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SALIENT HIGHLIGHTS OF THE TENDER AND OBLIGATION OF THE CONTRACTOR

Name of work : C/o Stage-I of Phase-II, Delhi Technological University at Bawana Road, Delhi (SH: -C/o Academic Blocks AB-3 & AB-4, Boys Hostel H-5 & Girls Hostels HG-5 & HG-6 and all external and internal services including external development and landscaping, and allied civil and E&M works).

1. The buildings are being designed for rated green building for i.e. **Three Star rating by GRIHA, MNRE.**
2. The Contractor shall take full responsibility for the adequacy, stability and safety of all site operations, of all methods of construction, manufacture, and of all the Works, irrespective of any approval or consent by the Employer.
3. The Contractor shall comply with all Applicable Laws and Applicable Permits of Central Govt. and Delhi Govt. (including renewals as required) in the performance of its obligations under this Contract. Nothing extra will be paid to Contractor on these accounts.

4 Obligations relating to sub-contracts, and any other contracts

- 4.1.1 The Contractor shall not sub-contract or sublet any Works. However, it may enter into contracts for the supply and installation of Materials, Plant, equipment, road furniture, safety devices and labour, as the case may be, for such Works. For the avoidance of doubt, the Parties agree that all obligations and liabilities under this Contract shall at all times remain with the Contractor.
- 4.1.2 It is expressly agreed that the Contractor shall, at all times, be responsible and liable for all its obligations under this Contract notwithstanding anything contained in the contracts with its Sub-contractors or any other contract that may be entered into by the Contractor, and no default under any such contract shall excuse the Contractor from its obligations or liability hereunder.

5. Contractor's care of the Works

The Contractor shall bear full risk in and take full responsibility for the care of the Works and of the Materials, goods and equipment for incorporation therein from the Commencement Date until the Completion Certificate is issued, except to the extent that any loss of or damage to the same shall have arisen from any default or neglect of the Employer. The Contractor 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:

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- a) Take full responsibility for the adequacy, stability, safety and security of the Works, Plant, Goods, Contractor's Equipment, Temporary Works, operations on Site and methods of manufacture, installation, construction and transportation;
- b) 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 Contractor), comply with all relevant safety regulations, including provision of safety gear, and insofar as the Contractor 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.
- c) Provide and maintain all lights, guards, fences and warning signs and watchmen when and where necessary or required by the Employer or by laws or by any relevant authority 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; and
- d) 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.

6 Housing, Electricity, water and other services

No accommodation is available at the site of work and no labour huts shall be allowed within the right of way of road. The contractor has to make his own arrangements for housing, stores and field offices, accommodations for his labour and other employees etc. Contractor should visit the site and see in what manner he is able to arrange the above. He shall submit a site layout plan indicating the locations of various site facilities like Contractor's site office, Stores etc. to be created by him at his cost for the execution of work. The Contractor shall be responsible for procuring of all power, water and other services that it may require at his own cost and expense.

The land for labour camps, storage, casting yard, batching plant, office etc. shall be arranged by the contractor. The lease / rent charges shall be borne by the contractor. The Employer shall extend necessary help and issue necessary recommendations etc. to the concerned department for temporary allotment of land during construction period. If the land belongs to PWD (if available), the same shall be provided at the prevailing rates specified by Delhi Development Authority. The contractor shall vacate the land after completion of work in same condition as was at the time of allotment.

In case agency arranges land from Govt. Source, PWD may enter into Tripartite agreement with land owner / executing agency and PWD. If agency arranges land from private owner then PWD will not enter into Tripartite

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agreement. In such cases for excise duty purpose, PWD will issue necessary certificate that precase items like segment etc. is for the bonafied use of Govt.

7. SITE OFFICE

- 7.1 The contractor shall construct the following porta cabin type temporary site office accommodations at site for the supervisory staff of department (PWD) as per relevant item of BOQ.
- (i) Two temporary cabins (1 cabins contains of 3 Independent rooms each measuring 4.26x4.26 sqm with attached toilet).
 - (ii) One cabin for common conference room measuring 4.26x8.52 sqm for meeting with attached toilet.
 - (iii) Hall measuring 4.26x8.52 sqm. with common toilets.
 - (iv) One room of size 4.26x4.26 Sqm.
- 7.2 The site office accommodation shall be provided with all necessary furniture, fitted with all electrical items like light, fans, Air conditioners etc. and complete wiring, water supply, sewerage and drainage etc. The structure shall be of Porta Cabin type. The contractor shall provide the office accommodation within 60 days from the date of commencement of work failing which the compensation on @ Rs. 5,000/- per day of delay shall be recovered from the contractor.
- 7.3 The contractor shall arrange to maintain the site offices which includes watch and ward, day to day up keeping of the building and surroundings, periodic white washing/ colour washing of the building including utilities, payment of electrical/ water supply bills etc.
- 7.4 The cost of construction, cost of all furniture, fittings/fixtures /electrical fittings, etc. and cost of maintenance and the related service charges of the building, payment of electricity bills/water charges etc.(till completion of project) is deemed to be included in the quoted rate. After completion of work, the site office shall be demolished by the contractor and will take away any usable material, fixtures, furniture, etc. and nothing extra shall be paid for demolition etc. This site office accommodation shall be maintained properly till completion of work and no claim what so ever shall be entertained on the ground whether the delay in completion of work has been attributable to the Department or to the contractor.

8. Particular condition for Maintaining by Laws of NGT and Housekeeping Work

- a) Housekeeping is the act of keeping the working environment cleared of all unnecessary waste, thereby providing a first-line of defence against accidents and injuries.

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- b) General Housekeeping shall be carried out by the contractor and ensured at all times at Work Site, Construction Depot, Casting Yard, Fabrication Yard, Workshop, Batching Plant, Labour Camp, Stores, Offices and toilets/urinals etc.
- c) The contractor shall be responsible to provide segregated containers for disposal of debris at required places and regular cleaning of the same.
- d) Full height of barricades etc. shall be erected around the site in order to prevent the surrounding area from excavated soil, rubbish etc, which may cause inconvenience to and endanger the public. The barricade especially those exposed to public shall be aesthetically maintained by regular cleaning and painting as directed by the Employer. Regular cleaning of the barricades will be done once every fifteen days and the barricades will be re-painted once every six months. These shall be maintained in one line and level.
- e) The structural dimension of the barricade, material and composition, its color scheme, PWD logo and other details shall be in accordance with the drawing and the direction of Employer.
- f) All stairways, passageways and gangways shall be maintained without any blockages or obstructions. 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.
- g) 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.
- h) No parking of trucks/trolleys, cranes and trailers etc. shall be allowed on roads, which may obstruct the traffic movement.
- i) 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.
- j) Water logging or bentonite spillage on roads shall not be allowed.
- k) Proper and safe stacking of material are of paramount importance at yards, 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.
- l) Flammable chemicals, compressed gas cylinders etc. shall be safely stored.
- m) Unused/surplus cables, steel items and steel scrap lying scattered at different places within the working areas shall be removed to identify locations (s).

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- n) All wooden scrap, empty wooden cable drums and other combustible packing materials, shall be removed from the site. Lumber with protruding nails shall be bent / removed and properly stacked.
- o) The contractor shall arrange all necessary measures to prevent mosquitoes breeding (Chickengunia, Dengue, Malaria etc.) at site/labor camp/office premises by regular fogging and avoiding stagnation of water.
- p) The contractor shall arrange all necessary measures to prevent dust pollution in and around the working site/labor camp etc. and strictly follow the guidelines of Hon'ble NGT.

In case of any notice penal action will be taken and the contractor shall be penalized at Rs. 10,000/- per single violation/ non-compliance compounded to a maximum of Rs. 1,00,000/- at any single instance of above mentioned provisions except of Traffic management. The decision of Employer, regarding violation and the number of instances, shall be final and binding on the contractor. The compliance of above provisions is deemed to be included in the quoted amount of the contractor and no claim / payment whatsoever shall be entertained on this account.

9. SPECIFIC CONDITIONS OF CONTRACT TO GREEN BUILDING PRACTICE

The contractor shall strictly adhere to the following conditions as part of his contractual obligations:-

- 9.1 **Site** - the contractor shall ensure that adequate measures are taken for the prevention of erosion of the top soil during the construction phase. The contractor shall implement the Erosion and Sedimentation Control Plan (ESCP) as part of the larger Construction Management Plan (CMP). The contractor shall obtain the Erosion and Sedimentation Control Plan (ESCP) Guidelines from the Engineer in Charge and then prepare working plan for the following month activities as a CAD drawing showing the construction management, staging & ESCP. At no time soil should be allowed to erode away from the site and sediments should be trapped where necessary.
- 9.2 The contractor shall ensure that all the top soil excavated during construction works is neatly stacked and is not mixed with other excavated earth. The contractors shall take the clearance of the Engineer in Charge before any excavation. Top soil should be stripped to a depth of 20 cm (centimetres) from the areas to be disturbed, for example proposed area for buildings, roads, paved areas, external services and area required for construction activities etc. It shall be stockpiled to a maximum height of 40 cm in designated areas, covered or stabilized with temporary seeding for erosion prevention and shall be reapplied to site during plantation, landscaping etc. of the proposed vegetation. Top soil shall be separated from subsoil, debris and stones larger than 50 mm (millimetre) diameter. The stored top soil may be used as finished grade for planting areas.

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- 9.3 The Contractor should follow the construction plan as proposed by the Architect / Engineer-in-Charge to minimize the site disturbance such as soil pollution due to spilling. Use staging and spill prevention and control plan to restrict the spilling of the contaminating material on site. Protect top soil from erosion by collection storage and reapplication of top soil, constructing sediment basin, contour trenching, mulching etc.
- 9.4 No excavated earth shall be removed from the campus unless suggested otherwise by Engineer in Charge. All subsoil shall be reused in backfilling/landscape, etc as per the instructions of the Engineer in Charge. The surplus excavated earth shall be disposed of by the contractor at his own cost for reuse. A certificate of reuse as required by the Engineer-in-Charge shall be submitted by the contractor.
- 9.5 The contractor shall not change the natural gradient of the ground unless specifically instructed by the Engineer in Charge. This shall cover all natural features like water bodies, drainage gullies, slopes, mounds, depressions, etc. Existing drainage patterns through or into any preservation area shall not be modified unless specifically directed by the Engineer-in-charge.
- 9.6 The contractor shall not carry out any work which results in the blockage of natural drainage.
- 9.7 The contractor shall ensure that existing grades of soil shall be maintained around existing vegetation and lowering or raising the levels around the vegetation is not allowed unless specifically directed by the Engineer-in-charge
- 9.8 Contractor shall reduce pollution and land development impacts from automobiles use during construction.
- 9.9 Overloading of trucks is unlawful and creates the erosion and sedimentation problems, especially when loose materials like stone dust, excavated earth, sand etc. are moved. Proper covering must take place. No overloading shall be permitted.
- 9.10 The dismantle material/ building rubbish received from dismantling/demolishing shall be dumped to the dumping ground as directed by the Engineer-in-Charge in properly covered truck with precaution. Agency shall submit the hard copy of photograph showing the properly covered truck disposing the dismantled material/building rubbish.
- 9.11 Agency/contractor shall not dump the construction material on the metalled road and shall keep the construction material on the physically demarcated space as directed by the Engineer-in-Charge.
- 9.12 All the building material responsible for pollution shall be brought at site from sources covered by tarpaulin and shall take all precautionary measure to ensure that no dust particles are permitted to pollute the air quality,

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failure of which Agency shall be liable to pay damages as decided by Engineer-in-Charge. The decision of Engineer-in-Charge shall be final & binding.

- 9.13 All the trucks or vehicles of any kind, which are used for construction purposes and/or are carrying construction materials like cement, sand and other allied material shall be fully covered in the process of transporting the material.

- 9.14 There shall be no burning of leaves, plastic etc. at construction site.

9.15 CONSTRUCTION PHASE AND WORKER FACILITIES

The contractor shall specify and limit construction activity in pre-planned/ designated areas and shall start construction work after securing the approval for the same from the Engineer in Charge. This shall include areas of construction, storage of materials, and material and personnel movement.

9.16 PRESERVE AND PROTECT LANDSCAPE DURING CONSTRUCTION

The contractor shall ensure that no trees, existing or otherwise, shall be harmed and damage to roots should be prevented during trenching, placing backfill, driving or parking heavy equipment, dumping of trash, oil, paint, and other materials detrimental to plant health. These activities should be restricted to the areas outside of the canopy of the tree, or, from a safe distance from the tree/plant by means of barricading. Trees will not be used for support; their trunks shall not be damaged by cutting and carving or by nailing posters, advertisements or other material. Lighting of fires or carrying out heat or gas emitting construction activity within the ground, covered by canopy of the tree is not to be permitted.

- 9.17 The contractor shall take steps to protect trees or saplings identified for preservation within the construction site using tree guards of approved specification.
- 9.18 Contractor should limit all construction activity within the specified area as per the Construction Management Plan (CMP) approved by Engineer in Charge.
- 9.19 The contractor shall avoid cut and fill in the root zones, through delineating and fencing the drip line (the spread limit of a canopy projected on the ground) of all the trees or group of trees. Separate the zones of movement of heavy equipment, parking, or excessive foot traffic from the fenced plant protection zones.
- 9.20 The contractor shall ensure that maintenance activities during construction period shall be performed as needed to ensure that the vegetation remains healthy.

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- 9.21 Contractor shall be required to develop and implement a waste management plan, quantifying material diversion goals. He shall establish goals for diversion from disposal in landfills and incinerators and adopt a construction waste management plan to achieve these goals. A project-wide policy of nothing leaves the Site, should be followed, in such a case when strictly followed, care would automatically be taken in ordering and timing of materials such that excess does not become waste. The Contractor ingenuity is especially called towards meeting this prerequisite/ credit (as per IGBC LEED India, New Construction v1.0 & GRIHA, MNRE). Consider recycling cardboard, metal, brick, acoustical tile, concrete, plastic, clean wood, glass, gypsum wallboard, carpet and insulation. Designate a specific area(s) on the construction site for segregated or commingled collection of recyclable material, and track recycling efforts throughout the construction process. Identify construction haulers and recyclers to handle the designated materials. The diversion may include donation of materials to charitable organizations and salvage of materials on-site.
- 9.22 Contractor shall collect all construction waste generated on site. Segregate these wastes based on their utility and examine means of sending such waste to manufacturing units which use them as raw material or other site which require it for specific purpose. Typical construction debris could be broken bricks, steel bars, broken tiles, spilled concrete and mortar etc.
- 9.23 The contractor shall provide potable water for all workers
- 9.24 The contractor shall provide the minimum level of sanitation and safety facilities for the workers at their camp/labour site. The contractor shall ensure cleanliness of workplace with regard to the disposal of waste and effluent; provide clean drinking water and latrines and urinals as per applicable standard. Adequate toilet facilities shall be provided for the workman within easy access of their place of work. The total no. to be provided shall not be less than 1 per 30 employees in any one shift. Toilet facilities shall be provided from the start of building operations, connection to a sewer shall be made as soon as practicable. Every toilet shall be so constructed that the occupant is sheltered from view and protected from the weather and falling objects. Toilet facilities shall be maintained in a sanitary condition. A sufficient quantity of disinfectant shall be provided. Natural or artificial illumination shall be provided.
- 9.25 The contractor shall ensure that air pollution due to dust/generators is kept to a minimum, preventing any adverse effects on the workers and other people in and around the site. The contractor shall ensure proper screening, covering stockpiles, covering brick and loads of dusty materials, wheel-washing facility, gravel pit, and water spraying. Contractor shall ensure the following activities to prevent air pollution during construction:
- (i) Clear vegetation only from areas where work will start right away

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- (ii) Vegetate / mulch areas where vehicles do not ply.
- (iii) Apply gravel / landscaping rock to the areas where mulching / paving is impractical
- (iv) Identify roads on-site that would be used for vehicular traffic. Upgrade vehicular roads (if these are unpaved) by increasing the surface strength by improving particle size, shape and mineral types that make up the surface & base. Add surface gravel to reduce source of dust emission. Limit amount of fine particles (smaller than 0.075mm) to 10 - 20%
- (v) Water spray, through a simple hose for small projects, to keep dust under control. Fine mists should be used to control fine particulate. However, this should be done with care so as not to waste water. Heavy watering can also create mud, which when tracked onto paved public roadways, must be promptly removed. Also, there must be an adequate supply of clean water nearby to ensure that spray nozzles don't get plugged.
- (vi) Water spraying shall be done on:
 - (a) Any dusty materials before transferring, loading and unloading
 - (b) Area where demolition work is being carried out
 - (c) Any un-paved main haul road
 - (d) Areas where excavation or earth moving activities are to be carried out
- (vii) The contractor shall ensure that the speed of vehicles within the site is limited to 10 km/hr.
- (viii) All material storages should be adequately covered and contained so that they are not exposed to situations where winds on site could lead to dust / particulate emissions.
- (ix) Spills of dirt or dusty materials will be cleaned up promptly so the spilled material does not become a source of fugitive dust and also to prevent of seepage of pollutant laden water into the ground aquifers. When cleaning up the spill, ensure that the clean-up process does not generate additional dust. Similarly, spilled concrete slurries or liquid wastes should be contained / leaned up immediately before they can infiltrate into the soil / ground or runoff in nearby areas.
- (x) Provide colour coated GI Sheet barricading at site of not less than 6 metre height complete with necessary MS framework for support as per requirements of local bodies/authorities/NGT as per direction of Engineer-in-charge.
- (xi) Provide dust screens, sheeting or netting to scaffold along the perimeter of the building
- (xii) Cover stockpiles of dusty material with impervious sheeting
- (xiii) Cover dusty load on vehicles by impervious sheeting before they leave the site

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- 9.26 Contractor shall be required to provide an easily accessible area that serves the entire building and is dedicated to the separation, collection and storage of materials for recycling including (at a minimum) paper, corrugated cardboard, glass, plastics, and metals. He shall coordinate the size and functionality of the recycling areas with the anticipated collections services for glass, plastic, office paper, newspaper, cardboard, and organic wastes to maximize the effectiveness of the dedicated areas. Consider employing cardboard balers, aluminium can crushers, recycling chutes, and collection bins at individual workstations to further enhance the recycling program
- 9.27 The contractor shall ensure that no construction leachate (e.g. cement slurry etc.), is allowed to percolate into the ground. Adequate precautions are to be taken to safeguard against this including, reduction of wasteful curing processes, collection, basic filtering and reuse. The contractor shall follow requisite measures for collecting drainage water run-off from construction areas and material storage sites and diverting water flow away from such polluted areas. Temporary drainage channels, perimeter dike/swale, etc. shall be constructed to carry the pollutant-laden water directly to the treatment device or facility (municipal sewer line).
- 9.28 Staging (dividing a construction area into two or more areas to minimize the area of soil that will be exposed at any given time) should be done to separate undisturbed land from land disturbed by construction activity and material storage.
- 9.29 The contractor shall comply with the safety procedures, norms and guidelines (as applicable) as outlined in the document Part 7 Constructional practices and safety, 2005, National Building code of India-2016, Bureau of Indian Standards. A copy of all pertinent regulations and notices concerning accidents, injury and first-aid shall be prominently exhibited at the work site. Depending upon the scope & nature of work, a person qualified in first-aid shall be available at work site to render and direct first-aid to casualties. A telephone may be provided to first-aid assistant with telephone numbers of the hospitals displayed. Complete reports of all accidents and action taken thereon shall be forwarded to the competent authorities.
- 9.30 The contractor shall ensure the following activities for construction workers safety, among other measures:
- (i) Guarding all parts of dangerous machinery.
 - (ii) Precautionary signs for working on machinery
 - (iii) Maintaining hoists and lifts, lifting machines, chains, ropes, and other lifting tackles in good condition.
 - (iv) Durable and reusable formwork systems to replace timber formwork and ensure that formwork where used is properly maintained.
 - (v) Ensuring that walking surfaces or boards at height are of sound construction and are provided with safety rails or belts.
 - (vi) Provide protective equipment; helmets etc.

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- (vii) Provide measures to prevent fires. Fire extinguishers and buckets of sand to be provided in the fire-prone area and elsewhere.
 - (viii) Provide sufficient and suitable light for working during night time.
- 9.31 The storage of material shall be as per standard good practices as specified in Part 7, Section 2. Storage, stacking and Handling practices, NBC-2016 and shall be to the satisfaction of the Engineer in Charge to ensure minimum wastage and to prevent any misuse, damage, inconvenience or accident. Watch and ward of the Contractors materials shall be his own responsibility. There should be a proper planning of the layout for stacking and storage of different materials, components and equipments with proper access and proper manoeuvrability of the vehicles carrying the materials. While planning the layout, the requirements of various materials, components and equipments at different stages of construction shall be considered.
- 9.32 The contractor shall provide for adequate number of garbage bins around the construction site and the workers facilities and will be responsible for the proper utilisation of these bins for any solid waste generated during the construction. The contractor shall ensure that the site and the workers facilities are kept litter free. Separate bins should be provided for plastic, glass, metal, biological and paper waste and labelled in both Hindi and English with suitable symbols.
- 9.33 The contractor shall prepare and submit .Spill prevention and control plans. before the start of construction, clearly stating measures to stop the source of the spill, to contain the spill, to dispose the contaminated material and hazardous wastes, and stating designation of personnel trained to prevent and control spills. Hazardous wastes include pesticides, paints, cleaners, and petroleum products.
- 9.34 Contractor shall collect & submit the relevant material certificates for materials with high recycled (both post-industrial and post-consumer) content, including materials like RMC mix with fly-ash, glass with recycled content, calcium silicate boards etc..
- 9.35 Contractor shall collect the relevant material certificates for rapidly renewable materials such as bamboo, wool, cotton insulation, agrifiber, linoleum, wheat board, strawboard and cork etc.
- 9.36 Where possible, the contractor shall select materials/vendors, harvested and manufactured regionally, within a 800-km radius of the project site.
- 9.37 Contractor shall adopt an IAQ (Indoor Air Quality) management plan to protect the HVAC system during construction, control pollutant sources, and interrupt pathways for contamination. He shall sequence installation of materials to avoid contamination of absorptive materials such as insulation, carpeting, ceiling tile, and gypsum wallboard. He shall also protect stored on-site or installed absorptive materials from moisture damage.

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- 9.38 The contractor shall ensure that a flush out of all internal spaces is conducted prior to handover. This shall comprise an opening of all doors and windows for 14 days to vent out any toxic fumes due to paints, varnishes, polishes, etc.
- 9.39 Contractor shall make efforts to reduce the quantity of indoor air contaminants that are odorous or potentially irritating harmful to the comfort and well-being of installer and building occupants. Contractor shall ensure that the VOC (Volatile Organic Compounds) content of paints, coatings and primers used must not exceed the VOC content limits mentioned below:

Paints

Non-flat - 150 g/L

Flat (Mat) - 50 g/L

Anti corrosive/ anti rust - 250 g/L

Coatings / Clear wood finishes

Varnish - 350 g/L

Lacquer - 550 g/L

Floor coatings - 100 g/L

Stains - 250 g/L

Sealers

Waterproofing sealer - 250 g/L

Sanding sealer - 275 g/L

Other sealers - 200 g/L

The VOC (Volatile Organic Compounds) content of adhesives and sealants used must be less than VOC content limits mentioned:

Architectural Applications VOC Limit (g/l less water)

Indoor Carpet adhesives - 50 g/L

Carpet Pad Adhesives - 50 g/L

Wood Flooring Adhesive - 100 g/L

Rubber Floor Adhesives - 60 g/L

Sub Floor Adhesives. 50 g/L

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Ceramic Tile Adhesives - 65 g/L

VCT and Asphalt Tile adhesives - 50 g/L

DryWall and Panel Adhesives - 50 g/L

Structural Glazing Adhesives - 100 g/L

Multipurpose Construction Adhesives. 70 g/L

Substrate Specific Application VOC Limit (g/l less water)

Metal to Metal - 30 g/L

Plastic Foams - 50 g/L

Porous material (except wood) - 50 g/L

Wood - 30 g/L

Fiber Glass. 80 g/L

9.40 Wherever required, Contractor shall meet and carry out documentation of all activities on site, supplementation of information, and submittals in accordance with IGBC LEED India New Construction v1.0 & GRIHA program standards and guidelines. Towards meeting the aforementioned building environmental rating standard(s) expert assistance shall be provided to him upon request.

9.41 Whenever required, as per directions of Engineer-in-Charge, NGT/Local Authorities/Pollution Control Board, the contractor shall install equipment to monitor the particulate matter in air on site such as PM 2-5, PM 10 etc. Nothing extra shall be paid for the same.

9.42 **Water Use during Construction**

Contractor should spray curing water on concrete structure and shall not allow free flow of water. Concrete structures should be kept covered with thick cloth/gunny bags and water should be sprayed on them. Contractor shall do water ponding on all sunken slabs using cement and sand mortar.

9.43 The Contractor shall remove from site all rubbish and debris generated by the Works and keep Works clean and tidy throughout the Contract Period. All the serviceable and non-serviceable (malba) material shall be segregated and stored separately. The malba obtained during construction shall be collected in well formed heaps at properly selected places, keeping in a view safe condition for workmen in the area. Materials which are likely to cause dust nuisance or undue environmental pollution in any other way, shall be removed from the site at the earliest and till then they shall be suitably covered. Glass & steel should be dumped or buried separately to prevent injury. The work of removal of debris should be carried out during day. In case of poor visibility artificial light may be provided.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- 9.44 The contractor shall provide O & M Manuals wherever applicable.
- 9.45 The contractor shall make himself conversant with the Site Waste Management Program Manual and actively contribute to its compilation by estimating the nature and volume of waste generated by the process/installation in question.

9.46 MATERIALS & FIXTURES FOR THE PROJECT

Contractor will produce wherever feasible certificate regarding distance of the source of the relevant material.

- (a) Unless otherwise stated cement used at site for reinforced concrete, precast members, mortar, plaster, building blocks, etc shall be PPC (Portland Pozzolana Cement). The PPC must meet the requirements of IS 1489 (Part I) as regards to fly ash content in cement. The contractor shall obtain from the PPC manufacturer the certificate regarding fly ash content in the PPC in each batch of consignment.
- (b) The contractor shall ensure that all paints, polishes, adhesives and sealants used both internally and externally, on any surface, shall be Low VOC products. The contractor shall get prior approval from the Engineer in Charge before the application of any such material.
- (c) All plumbing and sanitary fixtures installed shall be as per the direction of the Engineer in Charge and shall adhere to the minimum LPM (litres per minute) and LPF (litres per flush) mentioned. The contractor shall employ 100% zero ODP (ozone depletion potential) insulation; HCFC (hydro-chlorofluorocarbon)/ and CFC (chlorofluorocarbon) free HVAC and refrigeration equipments and/halon-free fire suppression and fire extinguishing systems.

9.47 RESOURCES CONSUMED DURING CONSTRUCTION

- a. The contractor shall ensure that the water and electricity is not wasted during construction. The Engineer in Charge can bring to the attention any such wastage and the contractor will have to ensure that such bad practices are corrected.
- b. The contractor shall install necessary meters and measuring devices to record the consumption of water, electricity and diesel on a monthly basis for the entire tenure of the project.
- c. The contractor shall ensure that all run-off water from the site, during construction is collected and reused to the maximum.
- d. The contractor shall use treated recycled water of appropriate quality standards for construction, if available.
- e. No lights shall be turned on during the period between 6:00 AM to 6:00 PM, without the permission of the Engineer in Charge.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

9.48 CONSTRUCTION WASTE

- a) All construction debris generated during construction shall be carefully segregated and stored in a demarcated waste yard. Clear, identifiable areas shall be provided for each waste type. Employ measures to segregate the waste on site into inert, chemical, or hazardous wastes.
- b) All construction debris shall be used for road preparation, back filling, etc, as per the instructions of the Engineer in Charge, with necessary activities of sorting, crushing, etc.
- c) No construction debris shall be taken away from the site, without the prior approval of the Engineer in Charge.
- d) The contractor shall recycle the unused chemical/hazardous wastes such as oil, paint, batteries, and asbestos.
- e) If and when construction debris is taken out of the site, after prior permissions from the Engineer in Charge, then the contractor shall ensure the safe disposal of all wastes and will only dispose of any such construction waste in approved dumping sites.

9.49 Documentation

- a) The contractor shall, during the entire tenure of the construction phase, submit the following records to the Engineer in Charge on a fortnightly basis:
 - i) Digital photographs of the works at site, the workers facilities, the waste and other material storage yards, pre-fabrication and block making works etc by the 5th of each month.
 - ii) The contractor shall submit a monthly progress report by the 7th of each month with photographs and a video film detailing the upto date progress of work in the last month.
- b) The contractor shall submit a document after construction of the buildings, a brief description along with photographic records to show that other areas have not been disturbed during construction with clear photographs of different locations on the site before start of work and after completion of work. The document should also include brief explanation and photographic records to show erosion and sedimentation control measures adopted along with (Document CAD drawing showing site plan details of existing vegetation, existing buildings, existing slopes and site drainage pattern, staging and spill prevention measures, erosion and sedimentation control measures and measures adopted for top soil preservation during construction). This documentation should be submitted within 30 days of the physical completion of work at site or as per direction of Engineer-in-Charge, failing which a compensation of Rs. 1.00 lac would be levied and recovered from the contractor.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

- d) The report in para (c) above shall also contain a detailed as built quantification of the following:
- i. Total materials used,
 - ii. Total top soil stacked and total reused
 - iii. Total earth excavated
 - iv. Total waste generated,
 - v. Total waste reused,
 - vi. Total water used,
 - vii. Total electricity, and
 - viii. Total diesel consumed.
- e) The contractor shall submit to the Engineer in Charge, within 30 days of award of work, a site plan along with a narrative to demarcate areas on site from which top soil has to be gathered, designate area where it will be stored, measures adopted for top soil preservation and indicate areas where it will be reapplied after construction is complete.
- f) The contractor shall submit to the Engineer in Charge, a detailed narrative (not more than 250 words) on provision for safe drinking water and sanitation facility for construction workers and site personnel along with details in para (e) above and provide supporting document from the manufacturer of the cement specifying the flyash content in PPC used in reinforced concrete.
- g) The report in para (c) above shall contain details for all material brought to site for construction purposes, including manufacturers certifications, verifying information, and test data, where Specifications sections require data relating to environmental issues including but not limited to:
- (i) Source of products: Supplier details and location of the supplier.
 - (ii) Project Recyclability: Submit information to assist Owner and Contractor in recycling materials involved in shipping, handling, and delivery, and for temporary materials necessary for installation of products.
 - (iii) Recycled Content: Submit information regarding product post industrial recycled and post consumer recycled content, Use the Recycled Content Certification Form, to be provided by the Commissioning Authority appointed for the Project.
 - iv) Product Recyclability: Submit information regarding product and products components recyclability including potential sources accepting recyclable materials where ever applicable.
- h) Provide final certification of well-managed forest of origin to provide final documentation of certified sustainably harvested status: Acceptable wood, certified sustainably harvested, certifications shall include:

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

- (i) Clean tech: Provide pollution clearance certificates from all manufacturers of materials
- (ii) Indoor Air quality and Environmental Issues: Submit emission test data, sourced from the manufacturers, produced by acceptable testing laboratory listed in Quality Assurance Article for materials as required in each specific Specification section.
- (a) Certifications from manufacturers of Low VOC paints, adhesives, sealant and polishes used at this particular project site.
- (b) Certification from manufacturers of composite wood products/agro fibre products on the absence of added urea formaldehyde resin in the products supplied to them to this particular site.
- (c) Submit environmental and pollution clearance certificates for all diesel generators installed as part of this project. Provide total support to Engineer in Charge and Green Building Consultants appointed by the Engineer in charge in completing all Green Building Rating related formalities, including signing of forms, providing signed letters in the contractor's letterhead whenever required.

9.50 EQUIPMENT

- a) To ensure energy efficiency during and post construction all pumps, motors and engines used during construction or installed, shall be subject to approval of the Engineer-in-Charge.
- b) All lighting installed by the contractor around the site and at the labour quarters during construction shall be LED bulbs of the appropriate illumination levels. This condition is a must, unless specifically prescribed.

The contractor is expected to go through all other conditions of the LEED & GRIHA rating stipulations. Failure to adhere to any of the above mentioned items, without approval of the Engineer in Charge, shall be deemed as a violation of contract and the contractor shall be held liable for penalty as per terms of the agreement.

In case any penalty is imposed by any Hon'ble Court, NGT or any other authority due to non-compliance of any statutory order, or law or guidelines or pollution control or environmental norms, the same will be borne by the contractor.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

9.51 Submission of Pollution Control Plan

The contractor shall submit the detailed action plan for control of pollution and for adherence to all the environmental guidelines/Laws/statutes/Court Orders/NGT orders/orders of pollution control authorities through the entire period of construction at site. The detailed action plan shall be submitted to the Engineer-in-Charge within 15 days of the stipulated date of start of work and shall be got approved from the Engineer-in-Charge.

The contractor shall arrange for control measures of all dust/noise/emission from the construction activities at site of work and shall install screens/curtains/ covers/dust trappers etc. as per guidelines/orders of the NGT/Court of law/ statutory authorities etc.

No hindrance shall be allowed, arising out of any stay/stopping of work from any court/statutory authority/NGT/Govt. Authorities as a consequence of the contractor not adhering to any pollution control guideline/law/order of the state bodies during the construction period. Nothing shall be paid to the contractor on account of expenses for any dust/pollution/emission control measures at the site of work or any delay in work due to any orders passed by any court/ statutory authority/Govt. Authorities during the period of construction.

An amount of **Rs. 5,000/-** per day will be withhold from the dues of the contractor for each day of delay beyond 15 days of the stipulated date of start of work for non-submission of pollution control plan.

The contractor is strongly advised to study all dust/Noise/emission/pollution control norms/laws/Court Orders including norms for installation of barricades at construction site, before bidding for the work and quote his rates accordingly for any liability which may arise on this account during the period of construction. The contractor will be solely responsible for such liability and nothing extra shall be paid from any consequence of the above due to failure of the contractor to comply with such laws/regulations/norms.No claim regarding the same, shall be entertained by the department.

10. Lighting

The contractor shall provide sufficient site lighting, of the right type and at the right place for it to be properly effective. Lighting ought not to introduce the risk of electric shock. Therefore, 230 V 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. Luminaries should be robust, resistant to corrosion and rain proof especially at the point of the

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

cable entry. The correct type of lamp for each luminaries should always 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 illuminate the work site & other area as directed by Employer including temporary lighting arrangement for movement of traffic on the existing/ diversion road. The compliance of above provisions are deemed to be included in the quoted amount of the contractor and no claim/ payment whatsoever shall be entertained on this account.

11. Royalty

Royalty at the prevalent rates shall be paid by the Contractor or the RMC supplier as per the terms of supply between them, on all materials such as boulders, metals, all sizes stone aggregates, brick aggregate, coarse and fine sand, moorum, river sand, gravels and bajri etc. collected by him for the execution of the work, directly to the revenue authority of the state government concerned. Further, contractor needs to submit proof of submission of fully royalty to the state government or local authority. Nothing extra shall be payable on this account to the contractor. No claim shall be entertained by the department on this account.

12. Traffic Management

- a) 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. 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 conspicuity of workmen at all times shall be increased so as to protect from speeding vehicular traffic. The contractor has to take steps to:
 - i. Warn the road user clearly and sufficiently in advance.
 - ii. Provide proper lighting on roads/ diversions for safety of vehicles and pedestrians.
 - iii. Provide safe and clearly marked lanes for guiding road users.
 - iv. Provide safe and clearly marked buffer and work zones.
 - v. Provide adequate measures that control driver behaviour through construction zones
- b) Permission from competent authorities
 - i. Wherever operations undertaken are likely to interface with public traffic, specific traffic management plans shall be drawn up and implemented by the contractor in consultation with the approval of local police authorities, and /or the concerned metropolitan/civil authorities as the case may be.
 - ii. The rates quoted by the contractor shall be deemed to be inclusive of all the related cost including the cost of road widening for traffic management purpose.
- b) 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 and nothing shall be paid on this account. The road construction and maintenance signs which fall into the same three major categories as do other traffic signs that are Regulatory Signs, Warning Signs and

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

Direction (or guidelines) Signs shall only be used. The IRC: 67 - 2012 (Code of Practice for

Road Signs) provide a list of traffic signs. The size, colours and placement of sign shall confirm to IRC: 67 – 2012. Nothing shall be paid on this account.

13. Safety and Personal Protective Equipment's (PPEs)

- a) The contractor shall provide required PPEs to workmen to protect against safety and/or health hazards. Primarily PPEs are required for the following protection:
- i. Head Protection (Safety helmets)
 - ii. Foot Protection (Safety footwear, Gumboot, etc.)
 - iii. Body Protection (High visibility clothing (waistcoat/jacket, Apron, etc.
 - iv. Personal fall protection (Full body harness, Rope-grap fall arrester, etc.)
 - v. Eye protection (Goggles, Welders glasses, etc.)
 - vi. Hand protection (Gloves, finger coats, etc.)
 - vii. Respiratory Protection (Nose mask, SCBAs, etc.)
 - viii. Hearing protection (Ear plugs, Ear muffs, etc.)

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

- b) All construction workers should be provided with high visibility jackets with reflective tapes confirming to the requirement specified under BS EN 471: 1994. The conspicuity of workmen at all times shall be increased so as to protect them from speeding vehicular traffic. The contractor 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.
- c) In addition to the above, any other PPE required for any specific jobs like, welding and cutting, working at height, tunneling etc. shall also be provided to all workmen and also ensure that all workmen use the PPEs properly while on the job. The contractor shall not pay any cash amount in lieu to PPE to the workers/subcontractors and expect them to buy and use during work. The contractor shall at all-time maintain a minimum of 10% spare PPEs and safety appliances and properly record and show to the Employer during the inspections. It is always the duty of the contractor to provide required PPEs for all visitors. Towards this required quantity of PPEs shall be kept always at the security post.
- d) **Visitors to Site**
No visitor is allowed to enter the site without the permission of the Employer. All authorized visitors should report at the site office and contractor shall provide visitor's helmet (White helmet with visitor sticker) and other PPEs like safety shoe, reflective jacket, respiratory protection etc. as per requirement of the site. All visitors shall be accompanied at all times by a responsible member of the site personnel. The contractor shall be fully responsible for all visitors' safety and health within the site.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- e) For violation of the any of the above provisions in this section (Section 14) shall attract penal action for each single violation (Single Violation means noncompliance by any worker/ individual) unless otherwise specified. The decision of Engineer-In-Charge shall be final and binding.

14. EXPLOSIVE AND INFLAMMABLE MATERIALS

If explosives or inflammable materials are to be used for execution of the works, the contractor shall at his expense obtain such licenses as may be required for storing and using explosive and/or inflammable materials. Contractor shall at his own cost locate, construct and maintain magazines if such are required for storage in accordance with the requirements of the appropriate rules in force for their use and safety

- 15 The contractor (s) shall make his own arrangement for electricity and water required for the execution of work and nothing extra shall be paid for the same. However, the Engineer-in-Charge shall recommend the application to the BSES for electric connection, if desired. Necessary payment shall be made by the contractor directly to the department concerned. In case BSES fails to sanction the electric connection or delays the sanction for electric connection, the contractor shall make his own arrangement by providing diesel generators of adequate capacity at his own cost.
- 16 For water supply, contractor shall make his own arrangements including boring of tube well with necessary clearance from DJB and all local authorities as per rules and nothing extra shall be paid by the Department for arrangement of water or on its treatment as per IS : 456- 2000/ CPWD Specification 2009 volume-I to II.
17. All the materials including cement and steel (T.M.T. Bars) will be arranged by the contractor himself.
18. The contractor shall arrange concrete pump wherever necessary to expedite the progress of work. Nothing extra shall be paid on this account.
19. For lifting of concrete or other construction materials to various levels, tower cranes/ mechanical hoist of appropriate size/capacity shall be deployed by the contractor. Nothing extra shall be paid on this account.
20. The contractor shall quote the percentage rate on composite estimated cost in figures and words accurately so that there is no discrepancy in rates written in figures and words and totals. In case of discrepancy, procedure specified in the contract document of CPWD shall be followed.

21. Quality Assurance

- 21.1 The contractor shall submit a Quality Assurance Plan with 30 days of award of works. The contractor shall ensure quality control measures on different aspects of construction including materials, workmanship and correct construction methodologies to be adopted and work in close coordination with the TPQAA (Third Party Quality Assurance Agency) appointed by PWD.
- 21.2 The contractor shall get the source of various raw materials namely aggregate, cement, sand, steel, water etc. to be used on the work, approved from the Engineer-in-Charge and trial mixes for controlled concrete shall be

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

done using the approved materials. The contractor shall stick to the approved source unless it is absolutely unavoidable. Any change shall be done with the prior approval of the Engineer-in-Charge for which tests etc. shall be done by the contractor at his own cost to the satisfaction of Engineer-in-charge.

- 21.3 Similarly, the contractor shall submit brand/make of various materials to be used for the approval of the Engineer-in-Charge along with samples and once approved, he shall stick to it. Any change will have to be got approved from engineer in charge in advance.
- 21.4 The contractor shall submit shop drawings of staging and shuttering arrangement, stone cladding and other works including mock work as desired by Engineer-in-Charge for his approval before execution. The contractor shall also submit bar bending schedule for approval of Engineer-in-Charge before execution.
- 21.5 The contractor shall depute Quality Manager exclusively for enforcement of quality control. Such Quality Manager should be a qualified engineer with minimum Eight years of similar experience. For other staff to be deployed for quality assurance, the contractor may refer to clause 36(i) under schedule "F" attached.
- 21.6 The tests, as necessary, shall be conducted in the following laboratory. The samples shall be taken for carrying out all of any of the tests stipulated in the particular specifications and as directed by the Engineer-in-Charge or his authorized representative.
 - a) IIT Delhi
 - b) CRRI, Delhi
 - c) National Council for Cement and Building Materials, Ballabh Garh.
 - d) Delhi Technology University (Formerly known as Delhi College of Engineering).
 - e) CPWD Lab, Delhi.
 - f) Shree Ram Testing Laboratories Delhi
 - g) Any other NABL approved lab as approved by the NIT approving authority.

22. Scaffolding

For facia work, outer finishing and other RCC works etc. double steel scaffolding having two sets of vertical supports with steel staircase for inspection of works by engineer in charge shall be used. The supports shall be sound and strong, tied together with horizontal piece over which scaffolding planks shall be fixed.

- 23 The contractor shall strictly follow the guidelines mentioned in Construction and Demolition Waste Management Rules, 2016 and its upto date amendment. The contractor shall follow all guidelines of environment and pollution as per laid down norms and should follow the direction of Honble NGT and direction given by CPCB (Central Pollution Control Board) under section 33 (A) of (water prevention and control of pollution) Act-1974 as amended to date.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

GENERAL CONDITIONS

1. Except for the items, for which particular specifications are given or where it is specifically mentioned otherwise in the description of the items in the schedule of quantities, the work shall generally be carried out in accordance with the CPWD Specifications 2009 Vol-I & II with upto date corrections slips for Civil work, CPWD General Specifications for Electrical works (Elect. Part-I) – 2013 Internal, Part-I, Part-II, Part-III, Part-IV, Part-V, Part-VI & Part-VII issued and amendment upto date and additional specifications of NIT and as per latest National/International Standards upto date correction slips (hereinafter to be referred to as CPWD specifications) and instructions of Engineer-in-Charge. Wherever CPWD Specifications are silent, the latest IS Codes/Specifications shall be followed.
2. A reference made to any CPWD/IRC/Indian Standard Specifications in these documents, shall imply to the latest version of that standard, including such revisions / amendments as issued by the CPWD/IRC/Bureau of Indian Standards upto last date of receipt of tenders. The Contractor shall keep at his own cost all such publications of relevant Indian Standard applicable to the work at site.
3. The contractor shall have to make approaches to the construction-site, if so required, and keep them in good condition for transportation of labour and materials as well as inspection of works by the Engineer-in-Charge/Senior Officers of PWD, GNCTD. Nothing extra shall be paid on this account.
4. Samples including brand / quality of materials and fittings to be used in the work shall be got approved, well in advance of actual execution as per direction of Engineer-in-Charge and shall be preserved till the completion of the work.
5. Unless otherwise specified in the schedule of quantities, the rates tendered by the contractor shall be all inclusive and shall apply to all leads, lifts, depths & all heights, floors including terrace, and nothing extra shall be payable on this account.
6. The rates for all items of work shall, unless clearly specified otherwise, include cost of all labour, material, tools and plants and other inputs involved in the execution of the item.
7. The contractor(s) shall quote all inclusive percentage rates inclusive of GST/ all taxes/levies/royalty/duties/toll etc. in the schedule of quantities and nothing extra shall be payable for any of the conditions and specifications mentioned in the tender documents unless specifically specified otherwise.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

8. Unless otherwise specified in the schedule of quantities the rates for all items shall be considered as inclusive of pumping / bailing out water, if necessary for which no extra payment shall be made.
9. The rate for all items, in which the use of cement is involved, is inclusive of charges for curing.
10. The foundation trenches shall be kept free from water while works below ground level are in progress.

11. **SAMPLES FOR TESTING**

- 11.1 Samples of materials required for testing shall be provided free of charge by the contractor. The cost of tests shall be borne by the contractor / department in the manner indicated below:-

- (a) By the contractor, if the results show that the material does not conform to relevant Specifications.
- (b) By the department, if the results show that the material conforms to relevant specifications.

All other expenditure required to be incurred for taking samples; conveyance, packing etc. shall be borne by the contractor himself.

- 11.2 However, if any load testing or special testing is to be done for concrete whose strength is doubtful, the cost of the same shall be borne by the contractor.
- 11.3 In case there is any discrepancy in frequency of testing as given in list of mandatory tests and that in individual sub-heads of work as per CPWD Specifications higher of the two frequencies of testing shall be followed and nothing extra shall be payable on this account.
- 11.4 The contractor has to establish field laboratory at site as specified in CPWD Specifications and as per list on page **No. 64 to 65** including all necessary equipment for field tests at his own cost within one month from the award of work. A penalty of Rs. 10,000/- per day would be levied and recovered from the contractor for each day of delay after 30 days from award of work for failure to establish the field laboratory.
12. The work shall be executed and measured as per metric dimensions given in the schedule of quantities, drawings etc. (FPS units wherever indicated are for guidelines only).
13. Payment for items of "RCC work", brick work and concrete work above different floor shall be made at the rates provided for these items. For operation of these rates, the floor level shall be considered as top of the main

No. of Correction – C NIL
No. of Omissions – O NIL
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structural slab in that floor viz Top of RCC slab in main room and not top of any sunk or depressed floor for toilet slabs.

14. The rate of items of flooring is inclusive of providing sunken flooring in bathrooms, kitchen, etc. and nothing extra on this account shall be payable.
15. Any legal or financial implications resulting out of disposal of earth shall be sole responsibility of the contractor. Nothing extra shall be paid on this account.
16. The work should be planned in a systematic manner so that chase cuttings in the walls, ceilings and floors are minimized. Wherever absolutely essential, the chase shall be cut using chase cutting machines. Chases will not be allowed to be cut using hammer / chisel. The electrical boxes should be fixed in walls simultaneously while raising the brick work. The contractor shall ensure proper coordination of various disciplines viz. sanitary & water supply, electrical, fire-fighting and any other services.
17. All the hidden items such as water supply lines, drainage pipes, conduits, sewers etc. are to be properly tested as per the design conditions submitted before covering.
18. The contractor should submit for approval of Engineer-in-Charge workshop drawings and samples of the work to be performed under the specified items of work before actually commencing the mass execution of the work under the item and within the time limit intimated by the Engineer-in-Charge. Nothing extra shall be payable on this account.
19. The contractor shall make his own arrangement for electricity and water required for the execution of the work and nothing extra shall be paid for the same. However Engineer-in-Charge shall recommend the application for water and electric connection. The contractor shall make necessary payment direct to the department concerned.
20. In case, if there is any discrepancy in Hindi & English version in the tender documents then only English version shall be treated as correct.

21. Maintenance of Register of Tests

- (i) All the registers of tests carried out at construction site or in outside laboratories shall be maintained by the contractor which shall be issued to the contractor by Engineer-in-Charge in the same manner as being issued to PWD field staff.
- (ii) All samples of materials including cement concrete cubes shall be taken jointly with contractor by JE/Third Party Quality Assurance Agency (TPQAA) appointed by the PWD and out of this at least 50% samples

No. of Correction – C NIL
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shall be taken in presence of AE in charge. If there is no JE, all samples of materials including cement concrete cubes shall be taken by AE jointly with contractor in the presence of TPQAA. All the necessary assistance shall be provided by the contractor. Cost of samples materials is to be borne by the contractor and he shall be responsible for safe custody of samples to be tested at site.

- (iii) All the tests if field lab setup at construction site shall be carried out by the Engineering staff deployed by the contractor which shall be 100% witnessed by JE/TPQAA and 50% of tests shall be witnessed by AE –in-Charge. At least 10% of the tests are to be witnessed by the Executive Engineer.
 - (iv) All the entries in the registers will be made by the designated Engineering Staff of the contractor and same should be regularly reviewed by JE/TPQAA/AE/EE/C.E.(Proj.).
 - (v) Contractor shall be responsible for safe custody of all the test registers.
22. 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. These registers should be duly checked by AE (P) in division office and receipts of registers should also be acknowledged by Accounts Officer by signing the copies and register to confirm receipt in Division office.
- If all the test registers and hindrance register is not submitted along with each alternate R/A Bill & Final Bill, it will be responsibility of EE & AAO that no payment is released to the contractor.
23. Contractor will prepare a **Sample Hostel Room both in boys and girls hostel and sample class room/ lecture room in academic block including toilets** completely finished with complete fittings and accessories for approval by the competent authority within **6 months** from the date of start of the work. A penalty of Rs.10,000/- per day per sample room will be imposed on the contractor in case of any delay.
24. **Mandatory implementation of Dust Mitigation measures for all construction and demolition activities for projects requiring Environmental Clearance:-**
25. Payment of all RA and final bills shall be made to the contractors only after verification and certification by the Executive Engineer based on the invoice issued by the operator of the C&D processing facility submitted by the contractor alongwith the bills regarding purchase of the C&D recycled material.
26. No building or infrastructure project requiring Environmental Clearance shall be implemented without approved Environmental Management Plan inclusive of dust mitigation measures.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

27. Roads leading to or at construction sites must be paved and blacktopped (i.e. metallic roads).
28. No excavation of soil shall be carried out without adequate dust mitigation measures in place.
29. No loose soil or sand or Construction & Demolition Waste or any other construction material that causes dust shall be left uncovered.
30. Wind-breaker of appropriate height i.e. 1/3rd of the building height and maximum upto 10 meters shall be provided. Penalty of Rs.1,00,000/- per day for not erecting barricading after 30 days of start of work.
31. Water sprinkling system shall be put in place.
32. Dust mitigation measures shall be displayed prominently at the construction site for easy public viewing.
33. Grinding and cutting of building material in open area shall be prohibited.
34. Construction material and waste should be stored only within earmarked area and road side storage of construction material and waste shall be prohibited.
35. No uncovered vehicles carrying waste processing material and waste shall be permitted.
36. Construction and Demolition waste processing and disposal site shall be identified and required dust mitigation measures be notified at the site.

37. Maintenance of Material at Site (MAS) Register

- i) All the MAS Registers including cement and Steel Registers shall be maintained by Contractor which shall be issued to the contractor by Engineer-in-Charge in the same manner as being issued to PWD field staff.
- ii) Each of the entry of receipt of material at site shall be 100% test checked by JE or by AE if there is no JE.
Each MAS register shall be checked by JE at least twice a week and at least once a week by AE. If there is no JE then MAS registers will be checked by AE at least twice a week.
- iii) Cement Register shall be reviewed by EE at least once in a month

38. Recording of Hindrance & Maintenance of Hindrance Register

- 38.1** Whenever any hindrance whether on part department or on part of contractor, comes to the notice of the Assistant Engineer, he will at once make a note of such hindrance in the register kept at site, and immediately make a report to the Executive Engineer within a week.
- 38.2** The following points will be kept in mind while entering the hindrances in the Hindrance Register:

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- a) The entry of date of start of hindrance and date of removal of hindrance will be made on the same day as the hindrance takes place or the cause of the hindrance is removed, respectively.
- b) The Executive Engineer will work out the over lapping period, net if hindrance and weightage of each hindrance within 15 days of removal of the cause of hindrance.
- c) The items of work affected due to any hindrance will be clearly mentioned in the Hindrance Register by the Assistant Engineer, and the weightage should be allowed on this basis.
- d) Each hindrance should be entered in the hindrance Register, which will be authenticated by the Executive Engineer and Contractor.
- e) The hindrance to work on part of contractor is also to be entered in the Hindrance Register.**
- f) The hindrance will be recorded carefully in the Hindrance Register after considering its effect on completion of work.
- g) In case any hindrance is occurred on account of any stay order of any Hon'ble Court or NGT or any other authority due to non-compliance of any statutory order or law or guidelines on pollution control or environmental norms by the contractor, the same shall be recorded as hindrance to work created by contractor.

- 38.3 Review of hindrance register shall be compulsory in division office by EE and AAO at the time of payment of each Alternate Running Account Bill and final bill and certificate shall be recorded that all up to date hindrances on part of department and contractor have been recorded in the hindrance register.
- i) The net delay on part of department or contractor shall be worked out after considering all the hindrances recorded in the hindrance register.
 - ii) The Chief Engineer (Projects) will review the hindrance Register whenever he visit site of work.

39. The contractor shall give the Engineer-in-charge on the 7th day of each month, 3 hard copies in colour and one on soft copy (CD) of progress report of the work done upto date and during the previous month. Such progress report will include the project progress summary, work progress (planned v/s actual), CPM chart, milestone status, financial progress status, manpower deployment status, important materials consumed, material at site at the beginning of the month of report, materials consumed during the month and the balance quantities at the end of month and photographs of important activities as well as showing progress of the work. For delay in submission of the progress report, an amount @ Rs.5,000/- (Rupees Five Thousand only) per day of delay will be withhold from the dues of the contractor.

40. The contractor(s) shall give to the Municipality, police and other authorities all necessary notices etc. that may be required by law and obtain all requisite licenses for temporary obstructions, enclosures etc. and pay all fee, taxes and charges which may be leviable on account of these operations in executing the contract. He shall make good any damage to the adjoining

No. of Correction – C NIL
 No. of Omissions – O NIL
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property whether public or private and shall supply and maintain lights either for illumination or for cautioning the public at night. The contractor(s) shall install **colour coated GI Sheet barricading of at least 6 meter, complete with necessary MS support framework as per requirements of local boidies/authoritites/NGT** for enclosing the area as per direction of Engineer-in-charge.

41. The Contractor(s) shall take all precautions to avoid accidents by exhibiting necessary caution boards day and night, speed limit board, red flags, red lights and providing barriers. He shall be responsible for all damages and accidents caused to existing/new work due to negligence on his part. No hindrances shall be caused to traffic during the execution of the work. In case of any accident of labours / contractual staff's the entire responsibility will rest on the part of the contractor and any compensation under such circumstances if becomes payable the same shall be entirely born by the contractor and department shall have no role on this account.
42. The contractor(s) shall take instructions from the Engineer-in-Charge regarding collection and stacking of materials at any place. No excavated earth or building rubbish shall be stacked on areas where other buildings, roads, services and compound walls are to be constructed. The stacking shall take place as per stacking plan however, if any change is required, the same shall be done with the approval of Engineer-in-Charge.
43. Contractor(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 Contractor(s) shall submit at his own cost four prints of "as built" drawings to the Engineer-in-Charge within 15 days of physical completion of work at site. These drawings shall have the following information.

- a. Layout of all piping and their diameters including soil waste pipes and vertical stacks.
- b. Ground and invert levels of all drainage pipes together with locations of all manholes and connections, upto outfall.
- c. Layout of all water supply line with diameters, locations of control valves, access panels etc.

A compensation of Rs. 1.5 lac will be levied and recovered from the contractor for failure to submit the "as built" drawings within 15 days of physical completion of work at site.

44. Water tanks, taps, sanitary, water supply and drainages pipes, fittings and accessories should conform to bye-laws of municipal body/corporation, where CPWD Specifications are not available. The contractor(s) should engage approved, licensed plumbers for the work and get the materials

No. of Correction – C NIL
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(fixtures/fittings) tested, by the municipal Body/Corporation authorities wherever required at his own cost. The Contractor(s) shall submit for the approval of the Engineer-in-Charge the name of the plumbing Agency proposed to be engaged by him, within 60 days of award of work failing which a penalty of Rs. 2,000/- per delay would be levied and recovered from the contractor for each days delay in doing so.

45. The contractor 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 contractor for the test. Failure to conduct the performance test within the time period specified by the Engineer-in-Charge would result in levy and recovery of a penalty of Rs. 5,000/- per day of delay for each such test within 30 days from the date as per directions of Engineer-In-charge.
46. Any cement slurry added over base surface for continuation of concreting for better bond is deemed to have been built in the items and nothing extra shall be payable and no extra cement considered in consumption on this account.
47. The Contractor shall bear all incidental charges for cartage, storage and safe custody of materials issued by department/arranged by the contractor.
48. The following water proofing works shall be executed through agencies meeting the Eligibility criterias. The main contractor shall submit atleast 03 nos. agencies for the water proofing work at the time of submission of bid. The main contractor shall also submit the eligibility document as per the eligibility criteria mentioned against each agency for water proofing work at the time of submission of eligibility bid. The same shall scanned and uploaded along with other documents as specified on page No. 14 with in the period of bid submissions. The eligibility criteria for the agencies is as follows:-

1. **WATER PROOFING TREATMENT OF ALL TYPES OF WORK:** The Contractor(s) shall submit alongwith the bid for the approval of the Engineer-in-Charge, the names of at least three such water proofing agencies, of repute alongwith their technical capability (as per forms A,B,C,D & E given in the bid document) proposed to be engaged by him, who have executed satisfactorily a minimum of **three similar works of value not less than Rs.1.00 Crore each or two works of value not less than Rs.1.40 Crore each or one work of value not less than Rs.1.85 Crore in the last seven years.**
 - a) **Similar works means “Providing water proofing treatment in RCC buildings”. The value of executed works shall be brought to current**

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level by enhancing the actual value of work at simple rate of 7% per annum, calculated from the date of completion of work upto date of receipt of tender.

- b) The agency should have had average annual financial turnover on works at least of Rs. 2.50 crore** during the immediate last three consecutive financial years ending **March 2018 (Scanned copy of Certificate from CA to be uploaded)**
- (c) The agency should not have incurred any loss (Profit after Tax should be positive) in more than two years** during the last five years ending 31st March 2018 **(Scanned copy of Certificate from CA to be uploaded).**
- (d) The agency Should have a solvency of Rs. 1.00 crore (Scanned copy of original solvency certificate from Bank to be uploaded)**
- (e) Willingness certificate as per form 'G'.
- (f) Certificate of registration in the GST.

2. **ALUMINIUM/GLASS WORK:** The Contractor(s) shall submit alongwith the bid for the approval of the Engineer-in-Charge, the names at least three such agencies, of repute alongwith their technical capability (as per forms A,B,C,D & E given in the bid document) proposed to be engaged by him, who have executed satisfactorily a minimum of three aluminium/glass works of value not less than Rs. 6.00 Crore each or two works of value not less than Rs. 9.00 Crore each or one work of value not less than Rs. 12.00 Crore in the last five years.

- a) Similar works means “Providing door/window/exterior facad using aluminium sections including components such as powder coating/colour anodizing of the sections”. The value of executed works shall be brought to current level by enhancing the actual value of work at simple rate of 7% per annum, calculated from the date of completion of work upto date of receipt of tender.**
- b) The agency should have had average annual financial turnover on works at least of Rs. 15.00 crore** during the immediate last three consecutive financial years ending **March 2018 (Scanned copy of Certificate from CA to be uploaded)**
- (c) The agency should not have incurred any loss (Profit after Tax should be positive) in more than two years** during the last five years ending 31st March 2018 **(Scanned copy of Certificate from CA to be uploaded).**
- (d) The agency should have a solvency of Rs. 6 crore (Scanned copy of original solvency certificate from Bank to be uploaded)**
- (e) Willingness certificate as per form 'G'.
- (f) Certificate of registration in the GST.

No. of Correction – C NIL
No. of Omissions – O NIL
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The Department shall approve the name of one eligible agency for each of the works in above. Within 21 days after the award of the work.

49. The work shall be carried out in accordance with the Architectural drawings and structural drawings, to be issued from time to time, by the Engineer-in-Charge. Before commencement of any item of work the contractor shall correlate all the relevant architectural and structural drawings, nomenclature of items and specifications etc. issued for the work and satisfy himself that the information available there from is complete and unambiguous. The figure and written dimension of the drawings shall be superseding the measurement by scale. The discrepancy, if any, shall be brought to the notice of the Engineer-in-charge in writing well before execution of the work. The contractor alone shall be responsible for any loss or damage occurring by the commencement of work on the basis of any erroneous and or incomplete information and no claim whatsoever shall be entertained on this account.
50. Other agencies will also simultaneously execute and install the works of electrification, lifts, fire-fighting etc. of this work and the contractor shall afford necessary facilities for the same. The contractor shall leave such recesses, holes, opening etc. as may be required for the electric and other related works and nothing extra shall be payable on this account.
51. The contractor shall conduct his work, so as not to interfere with or hinder the progress or completion of the work being performed by other contractor(s) or by the Engineer-in-Charge and shall as far as possible arrange his work and shall place and dispose off the materials being used or removed, so as not to interfere with the operations of other contractor 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.
52. **PROGRAMME CHART**
 - (i) The Contractor shall prepare an integrated programme chart in MS Project/Primavera software for the execution of work, showing clearly all activities from the start of work to completion, with details of manpower, equipment and machinery required for the fulfilment of the programme within the stipulated period or earlier and submit the same for approval to the Engineer-in-Charge within ten days of award of the contract. A penalty of Rs. 5,000/- per day shall be levied and recovered on per day basis in case of delay in submission the above programme. The contractor shall provide MS project/Primavera software (4 No.s licence) and workshop for training of technical staff and conduct monthly review of work through MS Project/Primavera for effective utilization of work monitoring tool.
 - (ii) The programme chart should include the following:

No. of Correction – C NIL
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- a) Descriptive note explaining sequence of the various activities.
 - b) Network (PERT/CPM/BAR CHART).
 - c) Programme for procurement of materials by the contractor.
 - d) Programme of procurement of machinery / equipment having adequate capacity, commensurate with the quantum of work to be done within the stipulated period, by the contractor. In addition to above, to achieve the **progress of work as per programme, the contractor must bring at site at least 10,000 sqm of shuttering material required for cement concrete and R.C.C. works etc within one month from the date of start of work till the completion of RCC work as per requirement of work.** The construction agency shall submit shuttering schedule adequate to complete structure work within laid down physical milestone etc.
- (iii) If at any time, it appears to the Engineer-in-Charge that the actual progress of work does not confirm to the approved programme referred above, the contractor shall produce a revised programme showing the modifications to the approved programme to ensure completion of the work. The modified schedule of programme shall be approved by the Engineer-in-Charge.
- (iv) The submission for approval by the Engineer-in-Charge of such programme or the furnishing of such particulars shall not relieve the contractor of any of the duties or responsibilities under the contract. This is without prejudice to the right of Engineer-in-Charge to take action against the contractor as per terms and conditions of the agreement.
53. If the work is carried out in more than one shift or during night, no claim on this account shall be entertained. Normally contractors shall not be allowed to work at night. Work at night shall, however, be allowed if the site conditions/circumstances so demand. However, if the work is carried out in more than one shift or at night, no claim on this account shall be entertained. The contractor has to take permission from the police authorities etc. if required in such situation the contractor shall make available to the department, proper means of communication such as Vehicle etc. at his own cost.
54. Existing drains, pipes, cables, over-head wires, sewer lines, water lines and similar service encountered in the course of the execution of work shall be protected against the damage by the contractor at his own expense. In case the same are to be removed and diverted. The same shall be payable to the contractor. The contractor shall work out the cost and the same shall be approved by Engineer-in-Charge. The contractor shall not store materials or otherwise occupy any part of the site in a manner likely to hinder the operation of such services.
55. The contractor shall be responsible for the watch and ward/ guard of the buildings safety, fittings and fixtures provided by him against pilferage and

No. of Correction – C NIL
 No. of Omissions – O NIL
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breakage during the period of installations and thereafter till the building is physically handed over to the department or one year after actual date of completion whichever is earlier. No extra payment shall be made on this account.

56. SAMPLE OF MATERIALS

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 contractor 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 contractor for incorporation in the work satisfies the provisions of specifications/BIS codes relevant to the material and / or the work done.

BIS marked items (except cement & steel) required on the work shall be got tested. Only important tests, which govern the quality of the product, shall be carried out. The frequency of such tests shall be 25% of the frequency specified in the CPWD Specifications 2009 Vol.I to II with upto date correction slips.

For certain items, if frequency of tests not mentioned in the CPWD Specifications and then relevant IS code shall be followed and tests shall be carried out @ 25% of the frequency specified therein. For testing and frequency of BIS marked cement and steel, refer para 6.1 and 7.1 of Special Condition attached.

57. The contractor 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 contractor on this account. However, cost of photographs, slides, audio-videography etc. shall be borne by the department.
58. The contractor shall be fully responsible for the safe custody of materials brought by him/issued to him even though the materials may be under double lock and key system.
59. The contractor 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 contractor 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. The sealed samples are to be handed over to the testing lab by contractor in the presence of Junior Engineer/Assistant Engineer-in-Charge of work.
60. Malba, rubbish & other waste materials shall be reused at site as directed by Engineer-in-Charge or disposed off to recycling agents. No deduction on this account shall be made from the agency.

No. of Correction – C NIL
No. of Omissions – O NIL
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61. The mobilization advanced shall be released only after obtaining a bank guarantee bonds (not more than 6 in number) from a scheduled bank for the amount of advance to be relapsed and valid for various periods required so as to cover the period till recovery of the advance. These shall be kept renewed from time to time to cover the balance amount and likely period of complete recovery together with interest. The advance should be released in not less than two instalments. The interest on the advance shall be calculated from the date of payment to the date of recovery, both days inclusive.

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 No. of Omissions – O NIL
 No. of Insertions –I NIL

ADDITIONAL CONDITIONS

1. The tenderer shall acquaint himself with the proposed site of work, its approach roads, working space available etc. before quoting his rates and no claim on this account shall be entertained by the department.
2. The contractor(s) shall get himself acquainted with nature and extent of the work and satisfy himself about the availability of materials from kiln or approved quarries for collection and conveyance of materials required for construction.
3. The contractor(s) shall study the Architectural drawings, Structural drawings and soil investigation report for the site, available in the office of the Executive Engineer, EPD-4, PWD, Shaheed Sukhdev College, Sec-16, Rohini, Delhi -110089 on all working days between 11:00 to 16:00 hrs. and satisfy himself about complete characteristics of soil and other parameters at site. However, no claim on the alleged inadequacy or incorrectness of the soil data supplied by the department shall be entertained.
4. The tenderer shall see the approaches to the site. In case any approach from main road is required at site or existing approach is to be improved and maintained for cartage of materials by the contractor, the same shall be provided, improved and maintained by the contractor at his own cost. No payment shall be made on this account.
5. Contractor shall take all precautionary measures to avoid any damage to adjoining property. All necessary arrangement shall be made at his own cost.
6. The contractor 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 of smoke, streams and water-ways. He shall make good at his cost and to the satisfaction of the Engineer-in-Charge, any damage to roads, paths, cross drainage works or public or private property whatsoever caused thereon by the contractor. All waste or superfluous materials shall be carried away by the contractor without any reservation entirely to the satisfaction of the Engineer-in-Charge.
7. Utmost care shall be taken to keep the noise level to the barest minimum so that no disturbance as far as possible is caused to the occupants / users of building/adjacent properties.
8. The contractor shall provide **5 Nos.** vehicle (SUV/Sedan class) one AC and four non AC running upto 2500 KM in calender month. All charges of driver and fuel shall be borne by the contractor. Nothing extra shall be paid on

No. of Correction –C NIL
No. of Omissions – O NIL
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account of providing vehicle. Incase of accident or any damage of vehicle or driver the contractor shall be fully liable. The vehicle shall be made available throughout of calender month even on holidays. Incase of failure to provide vehicle on any day panelty @ of Rs.5000 per day per vehicle will be levied which will be recovered from the contractor's bill.

9. The contractor shall provide **2 nos.** computer operator for office work and checking of bills etc. The salary of computer operator shall be borne by contractor. The computer operator should be available on as and when required basis. Incase of failure to provide operator on any day panelty @ Rs.2000 per day will be levied which will be recovered from the contractor's bill.
10. The contractor shall provide **3 nos.** multi tasking staff for office use. The salary of multi tasking staff shall be borne by contractor. The multi tasking staff should be available on as and when required basis. Incase of failure to multi tasking staff on any day panelty @ Rs.2000 per day will be levied which will be recovered from the contractor's bill.

11. SETTING OUT

- 11.1 The contractor shall establish, maintain and assume responsibility for grades, lines, levels and bench marks. He shall report any errors or inconsistencies regarding grades, lines, levels, dimensions to the Engineer-in-Charge before commencing work. Commencement of work shall be regarded as the contractors acceptance of such grades, lines, levels and dimensions and no claim shall be entertained at a later date for any errors found.
12. If at any time, any error in this respect shall appear during the progress of the work, the contractor shall, at his own expense rectify such error if so required to the satisfaction of the Engineer-in-Charge.
- 12.1 Though the site levels may be indicated in the drawings the contractor shall ascertain himself and confirm the site levels with respect to GTS bench mark from the concerned authorities.
- 12.2 The approval by the Engineer-in-Charge of the setting out by the contractor shall not relieve the contractor of any of his responsibilities.
- 12.3 The contractor shall be entirely and exclusively responsible for the horizontal, vertical and other alignment, the level and correctness of every part of the work and shall rectify effectively any errors or imperfections therein. Such rectifications shall be carried out by the contractor at his own cost to the instructions and satisfaction of the Engineer-in-Charge.
13. The rates quoted by the contractor are deemed to be inclusive of site clearance, setting out work, profile, establishment of reference bench mark, spot levels, construction of all safety and protection devices, barriers, earth

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

embankments, preparatory works, all testing of materials working during monsoon, working at all depths, height and locations etc. unless specified in the schedule of quantities.

14. Royalty at the prevailing rates wherever payable shall have to be paid by the contractor on the boulders, metal, shingle, sand and bajri etc. Or any other material collected by him for the work direct to revenue authorities and nothing extra shall be paid by the department for the same.
15. The contractor shall provide at his own cost suitable weighing, surveying and levelling and measuring arrangements as may be necessary at site for checking. All such equipment shall be got calibrated in advance from laboratory, approved by the Engineer-in-Charge. Nothing extra shall be payable on this account.
16. The contractor shall get the water tested with regard to its suitability and conforming to the relevant IS Code. The contractor shall obtain written approval from the Engineer-in-Charge before he proceeds by using the same for execution of work. The water testing charges shall be borne by the contractor.
17. Other agencies will also simultaneously execute and install the works of sub-station / generating sets, air-conditioning, lifts, etc. for the work and the contractor shall afford necessary facilities for the same. The contractor shall leave such recesses, holes, openings trenches etc. as may be required for such related works (for which inserts, sleeves, brackets, conduits, base plates, clamps etc. shall be supplied free of cost by the department unless otherwise specifically mentioned) and the contractor shall fix the same at time of casting of concrete, stone work and brick work, if required, and nothing extra shall be payable on this account.
18. All materials obtained from Govt. Stores or otherwise shall be got checked by the Engineer-in-Charge or his any authorized supervisory staff on receipt of the same at site before use.
19. All material shall only be brought at site as per programme finalized with the Engineer-in-Charge. Any redelivery of the material not required for immediate consumption shall not be accepted and thus not paid for.
20. The Architectural drawings given in the tender other than those indicated in nomenclature of items are only indicative of the nature of the work and materials/fixings involved unless and otherwise specifically mentioned. However, the work shall be executed in accordance with the drawings duly approved by the Engineer-in-Charge.
21. All materials and fittings brought by the contractor to the site for use shall conform to the samples approved by the Engineer-in-Charge which shall be preserved till the completion of the work. If a particular brand of material is

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No. of Omissions – O NIL
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specified in the item of work in Schedule of Quantity, the same shall be used after getting the same approved from Engineer-in-Charge. Wherever brand / quality of material is not specified in the item of work, the contractor shall submit the samples as per approved list of brand names given in the tender document / particular specifications for approval of technical sanctioning authority. For all other items, materials and fittings of ISI Marked shall be used with the approval of Engineer-in-Charge. Wherever ISI Marked material / fittings are not available, the contractor shall submit samples of materials / fittings manufactured by firms of repute conforming to relevant specifications or IS codes and use the same only after getting the approval. To avoid delay, contractor should submit samples as stated above well in advance so as to give timely orders for procurement. If any material, even though approved by Engineer-in-Charge is found defective or not conforming to specifications shall be replaced / removed by the contractor at his own risk & cost.

22. The contractor shall ensure quality construction in a planned and time bound manner. Any sub-standard material / work beyond set-out tolerance limit shall be summarily rejected by the Engineer-in-Charge & contractor shall be bound to replace / remove such sub-standard / defective work immediately.
23. The day to day receipt and issue accounts of different grade/brand of cement shall be maintained separately in the standard Performa by the Engineer-in-Charge of work and which shall be duly signed by the Jr. Engineer/Assistant Engineer his authorized representative.
24. Cement bags shall be stored in two separate godowns, one for tested cement and the other for fresh cement (under testing) to be constructed by the contractor at his own cost as per sketches given in C.P.W.D Specifications – 2009 Vol. I to II with upto date correction slips having weatherproof roofs and walls. The size of the cement go down is indicated in the sketch for guidance. The actual size of godown shall be as per site requirements and nothing extra shall be paid for the same. The decisions of the Engineer-in-Charge regarding the capacity needed will be final. Each godown shall be provided with a single door with two locks. The keys of one lock shall remain with Engineer-in-Charge of the work and that of other lock with the authorized agent of the contractor at the site of work so that the cement is issued from godown according to the daily requirement with the knowledge of both parties. The account of daily receipt and issue of cement shall be maintained in a register in the prescribed performa and signed daily by the contractor or his authorized agent in token its correctness.
25. For construction works which are likely to generate malba / rubbish the contractor shall dispose of malba, rubbish & other unserviceable materials

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No. of Omissions – O NIL
No. of Insertions – I NIL

and wastes at his own cost to the notified specified Municipal dumping ground only and under no circumstances these shall be stacked / dumped even temporarily, outside the construction premises.

26. The contractor shall arrange at site at least **10,000 sqm.** of centering and shuttering before start of the work. In case the completion schedule requires more quantity of centering and shuttering, the contractor shall do so at no extra cost to the department.
27. In the event of any restrictions being imposed by the Security agency, CPWD, Traffic or any other authority having jurisdiction in the area on the working or movement of labour /material, the contractor shall strictly follow such restrictions and nothing extra shall be payable to the contractor on this account. The loss of time on this account, if any, shall have to be made up by generating additional resources etc.
28. The proposed building work is a prestigious project and quality of work is of paramount importance. Contractor shall have to engage well experienced skilled labour and deploy modern T&P and other equipments to execute the work. Many items like stone masonry & stone cladding work, stone flooring & other specialized flooring work, wood work, precast RCC coffers, polysulphide/ silicone sealant will specifically require engagement of skilled workers having experience particularly in execution of such items.
29. No payment shall be made for any damage caused by rain, snowfall, flood or any other natural calamity, whatsoever during the execution of the work. The contractor shall be fully responsible for any damage to the govt. property and work for which the payment has been advanced to him under the contract and he shall make good the same at his risk and cost.
30. The contractor shall be fully responsible for safety and security of his material, T&P, Machinery brought to the site by him. No claim on the pretext of idle establishment & labour, machinery & equipments, tools & plants and the like, for any reason, delay in decision making by PWD/ Client whatsoever, shall be admissible during the execution of work and after completion.
31. The water proofing works, pile foundation work, all aluminium works & structural glazing etc. shall be carried out through specialized agency. The Contractor shall submit names of three such eligible agencies for each such specialized work alongwith the bid. The specialized agencies shall be approved by the Engineer-in-Charge within 21 days of award of work.
32. Electrical work (Steel conduit & G.I. wires) shall be carried out as per CPWD specifications for Electrical work Part-I Internal 2013 and External 1995 with upto date correction slips.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

33. THIRD PARTY QUALITY CONTROL

- 33.1 Contractor shall cooperate with the third party quality agency engaged by Department in the work.
- 33.2 3rd party quality assurance/control work for this work shall be done by Delhi Technological University Delhi, CBRI Roorkee, IIT Roorkee, IIT Delhi, RITES and any other agency which shall be approved by the competent authority of PWD.
- 33.3 For quality assurance, the contractor has to employ an additional Quality Engineer for producing and maintaining records.
34. The contractor shall make his own arrangement of water for construction and drinking purpose. Water charges shall not be recovered on account of it. Contractor shall get the water tested from any laboratory approved by the Engineer-in-charge at regular intervals as per CPWD specification. All expense towards collection of samples, packing, transportation, testing charges etc. shall be borne by the contractor.

34 Special Conditions on Air Pollution

Guidelines have been issued by SE (TLC), CPWD vide OMs dt. 23.12.2014 and 01.06.2015 on the subject matter in pursuance of orders passed by Hon'ble National Green Tribunal. The Govt. Of NCT of Delhi, Ministry of Environment and Forests, Delhi Pollution Control Committee and other such bodies have also issued directives on Air Pollution from construction and demolition activity. These guidelines are to be strictly followed and adhered to by the contractor. Some of the guidelines are summarized as under:-

1. The contractor shall not store/dump construction material or debris on metalled road.
2. The contractor shall get prior approval from Engineer-in-Charge for the area where the construction material ore debris can be stored beyond the metalled road. These areas shall not cause any obstruction to the free flow of traffic/inconvenience to the pedestrians. It should be ensured by the contractor that no accidents occur on account of such permissible storage.
3. The contractor shall take appropriate protection measures like raising wind breakers of appropriate height on all sides of the plot/area using CGI sheets or plastic and /or other similar material to ensure that no construction material dust fly outside the plot area.
4. The contractor 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 and other allied material are fully covered. He shall take every necessary precautions that the vehicles are properly cleaned and dust free to ensure that enroute their destination, the dust, sand or nay other particles are not released in air/contaminate air.
5. The contractor 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.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

6. The contractor shall provide all medical help, investigation and treatment to the workers involved in the construction of building and carry of construction material and debris relatable to dust emission.
7. The contractor shall ensure that C& D waste is transported to the C & D Waste site only for which due record shall be maintained by the contractor.
8. The contractor shall compulsory use wet jet in grinding and stone cutting.
9. The contractor shall comply with all the preventive and protective environmental steps as stated in the MoEF guidelines, 2010 and those issued by the GNCTD/Hon'ble NGT/DPCC/Hon'ble Delhi High Court/Hon'ble Supreme Court and other such bodies at his own cost.
10. The contractor shall carry out on-Road-Inspection for black smoke generating machinery. The contractor shall use cleaner fuel.
11. The contractor shall ensure that all DG sets comply emission norms notified by MoEF.
12. The contractor 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 cases where speed reduction cannot effectively reduce fugitive dust, the contractor shall divert traffic to nearby paved areas.
13. The contractor shall ensure that the construction material is covered by tarpaulin. The contractor shall take all other precaution to ensure that no dust particles are permitted to pollute air quality as a result of such storage.
14. 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.
15. Nothing extra shall be paid to the contractor for compliance of these conditions.

35 WATER FOR CONSTRUCTION

The contractor shall make his own arrangement of water for construction and drinking purpose. Water charges shall not be recovered on account of it. Contractor shall get the water tested from any laboratory approved by the Engineer-in-charge at regular intervals as per CPWD specification. All expense towards collection of samples, packing, transportation, testing charges etc. shall be borne by the contractor.

36 COMPLIANCE WITH LOCAL BYE-LAWS, RULES AND REGULATIONS

The work shall be carried out in the manner complying in all respects with the requirements of relevant bye-laws of the local body under the jurisdiction of which the work is to be executed or as directed by the engineer-in-charge and nothing extra shall be paid on this account. The contractor shall give due notices to the Municipality, Gram Panchayat, Police and /or other authorities as may be required under the law / rules under force and obtain all requisite licenses / permissions to carry out the work and pay all charges which may be leviable on account of his execution of the work under the agreement. Nothing extra shall be payable on this account.

In the event of any restrictions being imposed by security and traffic agencies or any other authority having jurisdiction in the area on the

No. of Correction – C NIL
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working or movement of labour / material, the contractor shall strictly follow such restrictions and nothing extra shall be payable to the contractor on this account. The loss of time on this account, if any, shall have to be made up by generating additional resources etc.

37 TEMPORARY ELECTRICITY AND TELEPHONE CONNECTION FOR EXECUTION OF WORK

The contractor shall make his own arrangements for temporary electric and telephone connection, if required and make necessary payment including all initial cost, security money and electric / telephone charges for its use direct to the authority concerned. The engineer-in-charge will provide all possible assistance by way of reasonable recommendation for obtaining electricity connection to the concerned authorities but bears no responsibility for the same.

38 ORDER OF PREFERENCE

Should there be any difference or discrepancy between the description of items as given in the schedule of quantities, particular specifications for individual items of work (including special conditions) and I.S. Codes etc., the following order of preference shall be observed.

- (i) Description of items as given in Schedule of quantities
- (ii) Particular specifications
- (iii) Special Conditions, Additional condition and general condition (in order of preference).
- (iv) CPWD Specifications including correction slips issued up to the last date of submission of tender.
- (v) Working drawings
- (vi) Indian Standards Specifications of B.I.S/IRC specifications.
- (vii) ASTM, BS, or other foreign origin code mentioned in tender document.
- (viii) Manufacturer's specifications as decided by the Engineer-in-Charge.
- (ix) Sound Engineering practices or well established local construction practices.

Above provision supersedes para 8.1 of "Conditions of Contract" in PWD 8.

39 ALL HEIGHTS, LIFTS, LEADS AND DEPTHS

Unless otherwise provided in the Schedule of quantities or in CPWD specifications or in tender document, the rates tendered by the contractor shall be all inclusive and shall apply to all heights, lifts, leads and depths of the building and nothing extra shall be payable to him on this account.

40 STACKING OF MATERIALS

The Contractor(s) shall take instructions from the Engineer-in-Charge regarding collection and stacking of materials at any place. No excavated earth or building rubbish shall be stacked on areas where other buildings, roads, services and compound walls are to be constructed. The stacking shall take place as per stacking plan however, if any change is required, the same shall be done with the approval of Engineer-in-Charge. All the building rubbish, malba, dismantle material shall be disposed off by the contractor on his own cost as per directions of the Engineer-in-Charge. Nothing extra shall be paid on this account.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

41 PREVENTION OF NUISANCE AND POLLUTION CONTROL

The contractor 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 from pollutants like smoke, dust, noise. The contractor shall use such methodology and equipment so as to cause minimum environmental pollution of any kind during and minimum hindrance to road users and to occupants of the adjacent properties or other services running adjacent/near vicinity. The contractor shall make good at his cost and to the satisfaction of the Engineer-in-Charge, any damage to roads, paths, cross drainage works or public or private property whatsoever caused due to the execution of the work or by traffic brought thereon by the contractor. All waste or superfluous materials shall be carried away by the contractor, without any reservation, entirely to the satisfaction of the Engineer-in-Charge.

42 DAMAGE CAUSED BY RAIN, SNOWFALL, FLOOD OR ANY OTHER NATURAL CALAMITY

No payment shall be made for any damage caused by rain, snowfall, flood or any other natural calamity, whatsoever during the execution of the work. The contractor shall be fully responsible for any damage to the govt. property and the work for which payment has been advanced to him under the contract and he shall make good the same at his risk and cost. The contractor shall be fully responsible for safety and security of his material, T&P/Machinery brought to the site by him.

43 WATCH AND WARD/ GUARD OF THE BUILDINGS

The contractor shall be responsible for the watch and ward/guard of the buildings, safety of all fittings and fixtures including all equipments, services provided by him against pilferage and breakage during the period of Installations and thereafter till the buildings are physically handed over to the PWD or one year after actual date of physical completion, whichever is earlier. No extra payment shall be made on this account and no claim shall be admissible on this account for this period.

44 PROTECTION OF FLORA

The contractor will take reasonable precautions to prevent his workman and employees from removing and damaging any flora (plant/vegetation) from the project area.

45 CO-OPERATION WITH OTHER CONTRACTORS/ SPECIALIZED AGENCIES/ SUB-CONTRACTORS

- (i) The Contractor shall take all precautions to abide by the environmental related restrictions imposed by any statutory body having jurisdiction in the State as well as prevent any pollution of streams, ravines, river bed and waterways. All waste or superfluous materials shall be transported by the Contractor, entirely to the satisfaction of the Engineer- in-Charge and disposed at designated places only. Utmost care shall be taken to keep the noise level to the barest minimum so that no disturbance as far as possible is caused to the occupants / users of adjoining buildings. No claim what so ever on account of site constraints mentioned above or any

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other site constraints, lack of public transport, inadequate availability of skilled, semi-skilled or unskilled workers in the near vicinity, non-availability of construction machinery spare parts and any other constraints not specifically stated here, shall be entertained from the Contractor. Therefore, the Tenderers are advised to visit site and get first-hand information of site constraints. Accordingly, they should quote their tenders. Nothing extra shall be payable on this account.

- (ii) The Contractor shall cooperate with and provide the facilities to the sub-Contractors and other agencies working at site for smooth execution of the work. The Contractor shall:
 - (a) Allow use of scaffolding, toilets, sheds etc.
 - (b) Properly co-ordinate their work with the work of other Contractors.
 - (c) Provide control lines and benchmarks to his Sub-Contractors and the other Contractors.
 - (d) Provide electricity and water at mutually agreed rates.
 - (e) Provide hoist and crane facilities for lifting material at mutually agreed rates.
 - (f) Co-ordinate with other Contractors for leaving inserts, making chases, alignment of services etc. at site.
 - (g) Adjust work schedule and site activities in consultation with the Engineer-in- Charge and other Contractors to suit the overall schedule completion.
 - (h) Resolve the disputes with other Contractors/ sub-contractors amicably and the Engineer-in-Charge shall not be made intermediary or arbitrator.
- (iv) Other agencies will also simultaneously execute and install the works of sub-station / generating sets, air-conditioning, lifts, etc. for the work and the contractor shall afford necessary facilities for the same.
- (iv) The contractor shall conduct his work, so as not to interfere with or hinder the progress or completion of the work being performed by other contractor(s) or by the Engineer-In-Charge and shall as far as possible arrange his work and shall place and dispose off the materials being used or removed so as not to interfere with the operations of other contractor or he shall arrange his work with that of the others in an acceptable and in a proper co -ordination manner and shall perform it in proper sequence to the complete satisfaction of others.
- (v) For completing the work in time, the Contractor might be required to work in two or more shifts (including night shifts). No claim whatsoever shall be entertained on this account, not with-standing the fact that the contractor may have to pay extra amounts for any reason, to the labourers and other staff engaged directly or indirectly on the work according to the provisions of the labour and other statutory bodies regulations and the agreement entered upon by the Contractor with them.
- (vi) All material shall only be brought at site as per program finalized with

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

46 SAFETY PRACTICES AND SUPERVISION

- (i) Necessary protective and safety equipments shall be provided to the Site Engineer, Supervisory staff, labour and technical staff of the contractor by the Contractor at his own cost and to be used at site.
- (ii) No inflammable materials including P.O.L shall be allowed to be stored in huge quantity at site. Only limited quantity of P.O.L may be allowed to be stored at site subject to the compliance of all rules / instructions issued by the relevant authorities and as per the direction of Engineer - in- Charge in this regard. Also all precautions and safety measures shall be taken by the Contractor for safe handling of the P.O.L products stored at site. All consequences on account of unsafe handling of P.O.L shall be borne by the Contractor.
- (iii) In addition to the supervision of work by PWD engineers, the Consultants deployed by the PWD shall also be carrying out regular and periodic inspection of the ongoing activities in the work and deficiencies, shortcomings, inferior workmanship pointed out by them shall be communicated by PWD engineers to the contractor. Upon receipt of instructions from Engineer in Charge these are also to be made good by necessary improvement, rectification, replacement upto his complete satisfaction.
- (iv) The Contractor shall procure and provide all the materials from the manufacturers / suppliers as per the list attached with the tender documents, as per the item description and particular specifications for the work. The equivalent brand for any item shall be permitted to be used in the work, only when the specified make is not available. This is, however, subject to documentary evidence produced by the contractor for non-availability of the brand specified and also subject to independent verification by the Engineer-in-Charge. In exceptional cases, where such approval is required, the decision of Engineer-in-Charge as regards equivalent make of the material shall be final and binding on the Contractor. No claim, whatsoever, of any kind shall be entertained from the Contractor on this account. Nothing extra shall be payable on this account. Also, the material shall be procured only after written approval of the Engineer-in-Charge.
- (v) All the hidden items such as water supply lines, drainage pipes, conduits, sewers etc. are to be properly tested as per the design conditions before covering and their measurements in computerized measurement book duly test checked shall be deposited with Engineer in charge or his authorized representative, prior to hiding these items.

47 CLEANLINESS OF SITE AND INSPECTIONS

- i) The contractor shall take instructions from the Engineer-In-Charge regarding collection and stacking of materials at any place. No excavated earth or building rubbish shall be stacked on areas where other buildings, roads, services and compound walls are to be constructed.

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- ii) Senior Officers of PWD, Dignitaries from Ministry / Department, DTTE Authorities shall be inspecting the on-going work at site at any time with or without prior intimation. The contractor shall, therefore, keep updated the following requirements and detailing.
 - a) Display Board showing detail of work, weekly progress achieved with respect to targets, reason of shortfall, wages being paid for different categories of workers.
 - b) Entrance and area surrounding to be kept cleaned.
 - c) Display layout plan key plan, Building drawings including plans, elevations and sections.
 - d) Upto date displays of Bar chart.
 - e) Keep details of quantities executed, balance quantities, deviations, possible Extra item, substituted Item etc.
 - f) Keep plastic / cloth mounted one sets of building drawings.
 - g) Set of Helmets and safety shoes for exclusive use for officers/dignitaries visiting at site.
- iii) A penalty of Rs. 15,000/- would be levied and recovered from the contractor for breach or default or non-compliance of any of the provision in para (i) and (ii) above.

48 PRODUCT DELIVERY, STORAGE AND HANDLING OF CHEMICALS

- (i) The contractor shall construct storage space for Chemicals materials to ensure that the storage conditions are as recommended by the manufactures.
- (ii) All the materials shall be procured and delivered in sealed containers with labels legible and intact.
- (iii) All the chemicals {polymers, epoxy, water proofing compound, plasticizer, Polysulphide, SBR based elastomeric, APP (Atactic Polypropylene Polymer), all exterior and interior paints, polish etc.) shall be procured in convenient packs say 20 litres/Kgs.} Capacity packing only or as approved by the Engineer-in-Charge, and not in bigger capacity containers, say 200 litre (Kgs.) drums unless otherwise specifically permitted by the Engineer-in-Charge. One sample from each lot of the chemical procured by the contractor shall be tested in a laboratory as approved by the Engineer-in-charge
- (iv) All material required for the execution of the work shall be got approved, procured and deposited with the Departmental supervisory staff. The materials shall be kept in joint custody of the contractor and the Department. The watch and ward of such material shall, however, remain to be the responsibility of the contractor and no claim, whatsoever, on this account shall be entertained. Different containers of each chemical shall be serially numbered on packing and also consumed in that order. Day-to-Day account of receipt, issue and balance shall be regulated by the Department and proper account shall

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 No. of Omissions – O NIL
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be maintained at site of work in the prescribed form as per the standard practice.

- (v) All the chemicals shall be procured by the contractor directly from the manufacturer. In exceptional circumstances, the contractor may be allowed to procure the materials from the authorized dealers of the manufacturers, if specifically permitted by the Engineer-in-Charge.
- (vi) The original copies of challan/cash memos towards the quantity of various chemicals procured shall be made available by the contractor at the request from the Engineer-in-Charge and a copy of the same shall be kept in record.
- (vii) The Name of manufacturers, manufacturer's product identification, manufacturer's mixing instructions, warning for handling and toxicity and date of manufacturing and shelf life shall be clearly and legibly mentioned on the labels of the each container.
- (viii) The contractor shall submit for the chemicals procured, manufacturer's and / or authorized dealer's certificate regarding supplying and verifying conformance to the material specifications, as specified.
- (ix) All filled containers shall be handled in safe manner and in a way to avoid breaking container seals.
- (x) Empty containers of the chemicals should not be removed from site till the completion of work and shall be removed only with the written approval of the Engineer-in-Charge.
- (xi) All arrangements for measuring, dosing and mixing of material/chemicals at site have to be made by the contractor.
- (xii) Contractor shall suitably advise his site Engineer and all the workers as regards safe handling of chemicals. Necessary protective and safety equipments in form of hand gloves, goggles etc. shall be provided by the contractor and be also used at site.
- (xiii) All incidental charges of any kind including cartage, storage and wastage and safe custody of material etc. shall be borne by the contractor and no claim, whatsoever, shall be entertained on this account.
- (xiv) The chemicals shall be tested in an independent laboratory as approved by the Engineer-in-charge at the frequency as specified. If required, more samples may have to be tested as per the directions of the Engineer-in-Charge. Nothing extra shall be payable on this account. However testing charges shall be borne by the department for the samples satisfying the requirements specified in the tender.

49 Preparation of sample

Contractor will prepare a **Sample Hostel Room both in boys and girls hostel and sample class room/ lecture room in academic block including toilets** completely finished with complete fittings and accessories for approval by the competent authority within **6 months** from the date of start of the work. A penalty of Rs.10,000/- per day per sample room will be imposed on the contractor in case of any delay.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

50 MINIMUM QUALITY ASSURANCE PLAN (CIVIL WORK)

1 FIELD LABORATORY

Contractor shall establish a laboratory at site of work at his own cost within a period of 30 days after the date of issue of letter of commencement of work. The laboratory shall be equipped, inter alia, with the equipment mentioned in Schedule F. In case of non compliance or delay establishing the site laboratory of Rs. 10,000/- (Rs. Ten Thousand only) per day of delay shall be imposed and recovered from the immediate next running account bill of the contractor.

The Contractor shall submit, within 20 days after the date of issue of letter of commencement of work, a detailed and complete method statement for the execution, testing and Quality Assurance, of such items of works, as directed by the Engineer-in-Charge. All the materials to be used in the work, to make the finished work complete in all respects, shall comply with the requirements of the specifications and shall pass all the tests required as per specifications as applicable or such specifications / standards as directed by the Engineer-in- Charge. However, keeping the Quality Assurance in mind, the Contractor shall submit, on request from the Engineer-in- Charge, his own Quality Assurance procedures for basic materials and such items, to be followed during the execution of the work, for approval of the Engineer-in-Charge.

All materials and fittings brought by the contractor to the site for use shall conform to the samples approved by the Engineer-in-charge which shall be preserved till the completion of the work. If a particular brand of material is specified in the item of work in Schedule of Quantity, the same shall be used after getting the same approved from Engineer-In-Charge. Wherever brand / quality of material is not specified in the item of work, the contractor shall submit the samples as per list of acceptable brand names given in the tender document / particular specifications for approval of Engineer-In-Charge. For all other items, materials and fittings of ISI Marked shall be used with the approval of Engineer-In-Charge. Wherever ISI Marked material / fittings are not available, the contractor shall submit samples of materials / fittings manufactured by firms of repute conforming to relevant specifications or IS codes and use the same only after getting the approval of Engineer-In-Charge.

2 OUTSIDE / INDEPENDENT TESTING

Testing of materials shall be done in any Govt. institute/ IITs/ NITs/ Central and State Research Centre / Centrally and State funded laboratories, if testing facility is not available in the field laboratory. Where testing facilities are not available even in aforesaid laboratories, the name of the NABL approved lab shall be got approved by the Chief Engineer (Projects), PWD, GNCTD.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

3 QUALITY CONTROL TESTS

- 3.1 Field / lab tests shall be carried out to check, control and finally assure the quality of work at every level. Material and finished item shall be subjected to test to achieve the desired quality of work. Where ever necessary required number of test shall be carried out in outside laboratory approved by the engineer-in-charge. The mandatory test shall be carried out as per the provision of CPWD Specifications 2009 Volume-I & II and relevant IS codes.
- 3.2 The independent test equal to minimum 25% tests or as desired by Engineer-in-charge of the total number of tests performed in field laboratory shall be carried out in out-side laboratories mentioned in para above.
- 3.3 Any other test in the opinion of the Engineer in Charge required for establishing quality of material or execution of work shall also got carried out by the contractor. Decision of Engineer in Charge shall be final and binding in this respect.

3.4 Ultrasonic Pulse Velocity Method of Test for RCC

- i) The underlying principle of assessing the quality of concrete is that comparatively higher velocities are obtained when the quality of concrete in terms of density, homogeneity and uniformly is good. The consistency of the concrete as regards its general quality gets established. In case of poorer quality lower velocities are obtained. If there are cracks, voids or flaws inside the concrete which come in the way of transmission of pulse, lower velocities are obtained.
- ii) The quality of concrete in terms of uniformity, incidence or absence of internal flaws, cracks and segregation etc. indicative of the level of workmanship employed, can thus be assessed using the guidance given in table below, which have been evolved for characterizing the quality concrete in structure in term of the ultrasonic pulse velocity.

Velocity criterion for Concrete Quality Grading

Sl. No.	Pulse velocity by Cross Probing (km/sec)	Concrete Grading	Quality
1	Above 4.5	Excellent	
2	4.5 to 3.5	Good	
3	3.5 to 3.0	Medium	
4	Below 3.0	Doubtful	

Note: In Case of “doubtful” quality, it may be necessary to carry further tests.

- iii) Pulse velocity method of test of concrete is to be conducted for CPWD works as a routine test. The acceptance criteria as per the above table will be applicable which is as per IS 13311 (part-1): 1992. From the above “Good” and “Excellent” grading are acceptable and below these grading the concrete will not be acceptable.
- iv) 5% of the total number of RCC members in each category i.e. beam, column, slab and footing may be tested by UPV test method for

No. of Correction – C NIL
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establishing quality of concrete. It is suggested that test be conducted on RCC beam near joint with column, on RCC column near joint with beam, on RCC footings and rafts. On RCC rafts a suitable grid can be worked out for determining number of tests. In addition doubtful areas such as honeycombed locations, locations, where continuous seepage is observed, construction joints and visible loose pockets will also be tested.

- v) The test results are to be examined in view of the above acceptance criteria “Good” and “Excellent” and wherever concrete is found with less than required quality as per acceptance criteria, repairs to concrete will be made. Honeycombed areas and loose pockets will be repaired by grouting using Portland Cement Mortar/Polymer Modified Cement Mortar /Epoxy Mortar ,etc. after chipping loose concrete in appropriate manner. In areas where concrete is found below acceptance criteria and defects are not apparently visible on surface ,injecting approved grout in appropriate proportion using epoxy grout /acrylic Polymer modified cements slurry made with shrinkage compensating cement / plain cement slurry etc will be resorted to for repairs.(refer relevant chapters from CPWD Hand Book on Repairs and Rehabilitation of RCC Buildings).Repair to concrete will be done till satisfactory results are obtained as per the acceptance criteria by retesting of the repaired area. If satisfactory results are not obtained dismantling and relaying of concrete will be done. The cost of repairs to concrete such as the above shall be solely borne by the contractor. No claim on this account shall be entertained by the Department.

- 3.5 The contractor shall supply free of charge the materials required for testing including its transportation cost to testing laboratories. The cost of tests carried out shall be borne by the contractor / Department in the manner indicated below:
- By the contractor, if the results show that the material does not conform to relevant codes / particular specification / manufacturer’s specification.
 - By the Department, if the results show that the material conforms to relevant codes / particular specification / manufacturer’s specification.
- 3.6 The contractor shall ensure quality construction in a planned and time bound manner. Any sub-standard material / work beyond set out tolerance limit shall be summarily rejected by the Engineer-in-charge & contractor shall be bound to replace / remove such sub-standard / defective work immediately. If any material, even though approved by Engineer-In-Charge is found defective or not conforming to specifications shall be replaced / removed by the contractor at his own risk & cost.

3.7 REMOVAL OF REJECTED/SUB-STANDARD MATERIALS

The following procedure shall be followed for the removal of rejected/sub-standard materials from the site of work:

- Whenever any material brought by the contractor to the site of work is rejected, entry thereof should invariably be made in the Site Order Book under the signature of the Assistant Engineer, giving the approximate quantity of such materials.

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- b As soon as the material is removed, a certificate to that effect shall be recorded by the Assistant Engineer against the original entry, giving the date of removal and mode of *removal*, i.e., whether by truck, carts, or by manual labour. If the removal is by truck, the registration number of the truck should be recorded.
- c When it is not possible for the Assistant Engineer to be present at the site of work at the time of actual removal of the rejected/sub-standard materials from the site, the required certificate should be recorded by the Junior Engineer, and the Assistant Engineer should countersign the certificate recorded by the Junior Engineer.

4.0 Custody & Reporting of Records

All the records shall be maintained jointly by laboratory in-charge and the authorized representative of engineer-in-charge. Records shall be maintained in the shape of registers and shall be kept in the safe custody of Assistant Engineer in-charge of work. Status of mandatory test shall be reported at the time of presentation of each running account bill or monthly progress reports.

Maintenance of register of test

- i. The register of tests carried out at construction site or in outside laboratories shall be maintained by the contractor which shall be issued to the contractor by engineer-in-charge. The contractor shall make a written request for issue of test register clearly stating the name of register.
- ii. All samples of materials including cement concrete cubes shall be taken jointly with contractor by JE/TPQAA, and out of this at least 50% samples shall be taken in presence of AE in charge. If there is no JE, all samples of materials including cement concrete AE cubes shall be taken by AE jointly with contractor. All the necessary assistance shall be provided by the contractor. Cost of sample materials is to be borne by the contractor and he shall be responsible for safe custody of samples to be tested at site.
- iii. All the tests in field lab setup at construction site shall be carried out by the engineering staff deployed by the contractor which shall be 100% witnessed by AE and TPQAA. At least 10% of the tests are to be witnessed by the Executive Engineer.
- iv. All the entries in the register will be made by the designated engineering staff of the contractor and same should be regularly reviewed by JE/AE/EE.

Submission of copy of test register, material at site register and hindrance register along with each alternate running account bill and final bill shall be mandatory. These registers shall be duly checked by AE(P) in division office and receipts of registers should be acknowledged by accounts officer by signing the copies and register to confirm receipt in division office.

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If the test register and hindrance register is not submitted along with each alternate R/A bill & final bill, it will be responsibility of EE & AAO not to release any payment to the contractor.

Maintenance of material at site (MAS) register-

- i. All the MAS registers including cement and steel registers shall be maintained by contractor which shall be issued to the contractor by engineer-in-charge in the same manner as being issued to PWD field staff.
- ii. Each of the entry of receipt of material at site shall be 100% test checked by JE or by AE if there is no JE.

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

SPECIAL CONDITIONS FOR FURNITURE

1. The contractors are advised to get acquainted with the proposed work and its site and also study the Architectural Drawings, specifications and special conditions carefully before tendering. No claim of any sort shall be entertained on account of any site conditions and ignorance of specifications and special conditions.
2. The work shall be carried out as specified in the nomenclature of individual item, specifications and conditions mentioned in bid documents and procurement shall be made from only leading and reputed manufacturer as approved by Engineer-In-Charge and DTU authorities.
3. The payment for Deviated quantities beyond the limit specified under clause 12 in Schedule F shall be paid as per clause 12.
4. The rates quoted by the contractor shall be taken as net and nothing extra shall be paid on any account i.e. royalty, cartage, GST and stacking at required places etc.
5. The rates for different items of work shall apply for all heights and depths, leads and lifts unless otherwise specified in the agreement or specifications applicable to the agreement. The rates would also include all arrangements for fixing of furniture on the floor including use of appropriate fasteners, fixtures, mortars, grouts etc as per direction of Engineer-in-Charge.
6. Any damage done by the contractor to any existing work during the course of execution of the work shall be made good by him at his own cost.
7. Articles manufactured by the reputed firms and approved by Engineer-in-Charge shall only be used. Only articles classified, as 'first quality' by the approved manufacturer shall be used unless otherwise specified. In case articles bearing ISI certification are not available in the market, quality of samples brought by the contractor shall be judged by standards laid down in the relevant CPWD specifications. For the items not covered by CPWD specifications relevant BIS standards shall apply. The sample of materials to be brought to site for use in work shall be got approved from the Engineer-in-Charge before actual execution of work.
8. The contractor shall submit a detailed programme of work within 2 months of the date of issue of letter of award. Detailed programme should include all the mile stones, cash flow, material procurement, manpower deployment etc for successful completion of work within the stipulated time of completion. Program must show clearly the critical path to complete the project in time. The Engineer-in-Charge can modify the programme and the contractor shall have to work accordingly. During review of work progress, Engineer in Charge can ask to modify the programme. Contractor shall resubmit the modified programme within 2 days.
9. The quantities of each item shall not be exceeded beyond the agreement quantities without prior permission of Engineer-in-Charge.
10. Statutory deductions on account of GST, income tax and surcharge as applicable shall be made from the gross amount of the bill.

No. of Correction – C NIL
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11. The contractor shall make his own arrangements for obtaining electric connection, if required and make necessary payments directly to the department concerned.
12. The contractor shall make his own arrangement for getting the permission to ply the trucks from the traffic police.
13. No payment shall be made to the contractor for any damage caused by rain, snow fall, floods or any other natural causes whatsoever during the execution of work. The damage caused to work shall have to be made good by the contractor at his own cost and no claim on this account shall be entertained.
14. Other agencies may also simultaneously be executing the work of electrification, Horticulture or external services and other building works for the same building along with this work. The contractor shall afford necessary facilities for the same and no claim in the matter shall be entertained. The contractor shall especially co-ordinate with the other agency carrying out his work.
15. Some restrictions may be imposed by the security staff etc. on the working and or movement of labour and materials, etc, the contractor shall be bound to follow all such restrictions / instructions and nothing shall be payable on this account.
16. The contractor shall take all precautions to avoid accidents by exhibiting necessary caution boards. He shall be responsible for all damages and accidents caused due to negligence on his part. No hindrance shall be caused to traffic during the execution of the work by storing materials on the road.
17. The contractor shall be fully responsible for the safe custody of the material issued or brought by him to site for doing the work.
18. The rate for all items of work, shall unless otherwise clearly specified include cost of all labour, material and other inputs involved in the execution of the items.
19. The order of preference in case of any discrepancy as indicated in condition no. 8.1 under "Conditions of Contract" given in the General Conditions of Contract for Central P.W.D work 2014 read along with correction slips/amendments issued upto last date of submission of Tender i/c extension if any form may be read as the following.
 - a. Description of Schedule of quantities.
 - b. Special conditions,
 - c. Contract clauses of General Conditions of Contract for Central P.W.D works 2014 (read along with correction slips/amendments issued upto last date of submission of Tender i/c extension if any) form.
 - d. CPWD Specifications.
 - e. Relevant BIS Codes
 - f. Architectural drawings.
 - g. Manufacturers specification

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h. Sound engineering practice.

20. Any reference made to any Indian Standard Specifications in these documents, shall imply to the latest version of that standard, including such revisions / amendments as issued by the Bureau of Indian Standards up to last date of receipt of tenders. The contractor shall keep at his own cost all such publications of relevant Indian Standards applicable to the work at site.
21. The contractor shall make his own arrangement of water for construction and drinking purpose as well for electricity and its distribution at his own cost. The department will render only assistance to the contractor for making application to DJB/ authorized Electric supply agency, if required. All the fees and charges including consumption charges shall be borne by the contractor.
22. The contractor shall clean the site thoroughly of scaffolding materials, rubbish, equipments left out of his work and dress the site around the building to the complete satisfaction of the Engineer-in-charge before the work is treated as completed.
23. Maintenance of Register of Tests- All the registers of tests carried out at Construction Site or in outside laboratories shall be maintained by the contractor which shall be issued to the contractor by Engineer-in-Charge. All testing charges of the materials/ products as per direction of the Engineer-in-charge shall be borne by the contractor.
24. No labour hutment/ jhuggis shall be allowed at site. Contractor should make all arrangement of transportation of labourers to & from the site. Nothing extra shall be paid to contractor on this account.
25. No extra payments shall be made for supplying and fixing of furniture at any height and lead.
26. The contractor shall execute /make good or any minor civil/ electrical /mechanical or other related allied works to complete the work as per the direction of engineer-in-charge.

27. EXTENDED DEFECT LIABILITY PERIOD SECURITY:

The extended period of defect liability shall be five years reckoned from the date of completion recorded by PWD for the completed work. Apart from Security Deposit deducted from the bill as per Schedule-'E' an additional 7.5% amount shall be withheld on Account of above as extended defect liability period security from each gross R/A bill and final bill till the sum deducted will amount to an additional security of 7.5% of tender value of the work. While the 2.5% security deposit shall be refunded after the completion of the defect liability period of 12 months after completion of work as per Clause 17 of the GCC, the remaining 7.5% amount withheld as security for the extended defect liability period for an additional four years shall be refunded only after five years from the date of completion of the work. Sufficient staff and materials/Equipments etc. will be arranged by the contractor to enable to

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carry out the repairs/ rectifications immediately whenever pointed out by DTU (Delhi Technological University)/PWD free of cost. Extended defect liability period will start from 12 months after the date of final completion. During the extended defect liability period the contractor shall be liable to remove all the defects. All defects noticed during the currency of the Contract and also during the defect liability period and the extended defect liability Period (as per list below) shall be completely and satisfactorily rectified and repaired by the Contractor without any extra payment for the same. In case the Contractor fails to rectify these defects within 7 (Seven)days of lodging of written complaint with the Agency satisfactorily and completely, DTU/PWD reserves the right to get the rectification work done at the risk and cost of the Contractor. The decision of DTU/PWD in this regard shall be final and binding on the Contractor and shall be beyond the purview of the dispute settlement under clause 25 of General Conditions of Contract.

If the contractor fails to rectify the defects pointed out within 7 (SEVEN) days of lodging of written complaint during the extended defect liability period, then the rectification work shall be got done through any other agency/agencies at the risk and cost of the contractor during the extended defect liability period to the satisfaction of the DTU/PWD. The following defects are to be rectified/repairs are to be done during the entire defect liability period of 5 years from date of completion i/c the extended defect liability period.

- (i) Termite in Ply board or any other board installed.
- (ii) Defects in castors.
- (iii) Peeling off of PVC lipping from edges.
- (iv) Cracks in lamination.
- (v) Fading/peeling off of powder coating or paint or anodic coating or any other coat/veneer.
- (vi) Malfunctioning of Top-up mechanism in Chair.
- (vii) Fading/tearing of fabric on chair.
- (viii) Breaking/Cracking of Ply wood or any other board installed.
- (ix) Rusting of any metallic part.
- (x) Loosening of any screws/slides/fasteners/guide fixtures/gaskets/washers/bolts/nuts/clamps/ brackets/rollers/castors/hardware etc. (xi) Bulging/bending/splitting of wooden parts/boards/ Laminates etc. (xii) Loosing of/Malfunctioning of joints (xiii) Any other defect as notified by the Engineer-in-Charge. (xiv) If any defects are noticed in any of the furniture supplied by the agencies during the entire defect liability period including the extended defect liability period of five years, it shall be rectified/replaced by the contractor within three days of issuing of notice by the Engineer-in-Charge / DTU and, if not attended to, the same shall be got done by Engineer-in-Charge / DTU through other agency at the risk and cost of the contractor and recovery shall be effected from the amount retained towards guarantee. The extended defect liability security can be released in full, if bank guarantee of equivalent amount, valid for the duration of extended defect liability period, is produced and deposited with the Department. This

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- extended defect liability period security amount withheld will be refunded to the contractor on satisfactory completion of the entire defect liability period of 5 years including the extended defect liability period on recommendations of the Engineer-in-Charge.
28. On satisfactory completion of all the works as per the provision of the Contract, the Contractor shall hand over the works to the College authorities through PWD. The Contractor shall maintain sufficient staff and materials till the handing over of the works to the College authorities to protect the works and its installation from theft/damage from outside agencies. All installations shall be neatly cleaned and of approved brand and make; set of keys along with key ring shall be handed over to the client. Nothing extra shall be payable on this account.
 29. All hardware items shall be first quality from reputed approved manufacturers and shall be got approved from Engineer-in-charge before actual execution.
 30. Open plan office arrangement (OPEA) shall comprise of basic elements/modules/units the partition, work surfaces, storage units, accessories, fixtures and fittings etc. arranged in desired configurations for office purpose.. The system shall offer flexibility to make subsequent changes/modifications and shall have in-built wire management system separately for electrical, computer data networking and telephone cables.
 31. The complete system shall have facility to remove element/module/unit individually without affecting adjoining element / module/ unit for maintenance/ replacement purpose for subsequent changes.
 32. The complete partitions and all the individual basic elements/ modules/ units shall meet structural stability/ rigidity requirements and be provided without any extra cost to the department.
 33. All hardware components like clamps/ nut / bolts/ washers, screws, gaskets, fitting and fixture, brackets, roller/ guide/ slide, casters, hardware etc. as may be required or are forming integral part of the system/ basic elements / modules/ units for construction/ installation shall meet the relevant structural specifications and other requirements and shall be provided without any extra cost to the department.
 34. All wood / wood based material shall be given appropriate anti-termite and fire retardant treatment. All the exposed surfaces of all the Aluminum/ MS sections / covers etc. shall be powder coated with 50 micron thick in desired shade.
 35. All the materials used for the works shall meet relevant BIS or other applicable standards (latest revision). All ply board shall be of Grade-1 having lamination of approved colour on exposed face and balancing lamination on the unexposed face.
 36. All basic elements / modules / units shall be machine made in factory and only assembly/ erection/ installation shall be done at site. The manufacturing factory shall be fully equipped with adequate machinery for achieving desired quality of workmanship as well as timely supplied.

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- Engineer-in-charge shall, if required, inspect the factory during the manufacturing process and the contractors shall make all necessary arrangements for inspection of the team of Engineer-in-charge.
37. All the materials brought to site shall be protected suitably, duly wrapped / packed and stored so as to avoid any damage during loading/ transportation/ unloading/ handling / installation/ erection or due to weather conditions etc. at any stage.
 38. The contractor shall provide necessary cut out for computer, telephone and power outlets as per the approved sample/ shop drawing without any extra cost to the department.
 39. All the edges of the Ply boards except those which are post formed shall be sealed with PVC edge banding tape of 2mm thickness and have primer at the back. The edge banding tape shall be rounded to a radius of 2mm to 3mm at hot edges and must not melt, and to be glued on edge banding machine.
 40. All the post formed tops, work surfaces etc. shall have balancing lamination on the unexposed surface.
 41. The Resins used in the furniture shall be of Phenol Formaldehyde only and not of Urea Formaldehyde.
 42. The bidder has to give an undertaking that all items supplied by him are strictly as per schedule of quantity of the agreement.
 43. The contractor shall produce all the materials well in advance so that there is sufficient time for testing of the materials and clearance of the same before incorporation in the work.
 44. The contractor shall produce on demand from Engineer-in-charge, the approved manufacturers' certificates certifying that the materials conform to the technical specifications. For other materials which are ISI/ BIS marked, approved manufacturer's certificate shall be considered as fulfilling the mandatory test requirement. However in case Engineer-in-charge feels that the material supplied is not of required specifications even if it is ISI/BIS approved and have approved manufacturers certificate, he can send the sample to the approved lab for testing.
 45. For any tests as directed by the Engineer-in-charge, that have to be carried out at an outside laboratory, the cost of materials, transport etc., shall be borne by the contractor.
 46. The necessary tests shall be carried out on the items supplied and testing charges i/c transportation i/c packing etc. to Lab. shall be borne by the Agency The samples shall be provided by the Agency free of cost. The testing shall be carried out in any Govt. Lab./Public Undertaking Lab./IIT or NIT Lab./Government Engineering College or any other lab as approved by Engineer-in-charge.
 47. The contractor shall arrange for conducting the tests in the presence of an officer, authorized by the Engineer-in-Charge. Full records of all the tests conducted shall be maintained by the contractor in the format given by

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- Engineer-in-Charge which will be made available to the Engineer-in-Charge or to any officer authorized by him whenever required.
48. The Engineer-in-Charge or his representative shall be free to visit the approved manufacturer's works at all reasonable times to witness and inspect the testing of furniture. It is the duty of contractor to see that all the furnitures supplied are tested as per relevant IS specifications. The contractor shall furnish approved manufacturer test certificate for the routine and type test conducted on the furniture offered. If necessary the contractor shall arrange to conduct the entire routine test at the approved manufacturer premises in presence of Engineer-incharge or his authorized representative on receipt of material/equipment at site. The contractor shall offer equipment/material for inspection and get the same approved before installations.
 49. The Agency shall have to make his own arrangement for housing facilities for labour away from construction site and shall have to transport the labour to and fro between site and labour camp at his own cost.
 50. Minor variations (up to +5%) in the dimensions of items manufactured by approved brands, may be accepted. However, the decision of the Engineer-inCharge/Furniture Committee of the DTU in this regard will be final and binding on the bidder.
 51. While installation of modular furniture, existing flooring including any carpeting, tiling, sheets etc shall be protected by using PVC sheet/ card board/ foam sheet to avoid scratches/ damages for which nothing extra shall be paid.
 52. Nothing extra shall be paid for fixing of any furniture item like student benches, auditorium chairs or any other furniture item. The item rate is inclusive of all such civil and associated works required for proper fixing.
 53. The contractor has to hand over the furniture to the representative of college. Proper receipt/taken over note is required from college authorities before making payment. Furniture supplied at site shall remain in the custody of the contractor before such receipt of college authorities. Therefore, until the furniture item is handed over the college authorities, the responsibility of its safety, any damage shall lie with the contractor. No claim thereto shall be entertained.
 54. Any loss/damage during transportation, storage and installation at site is the sole liability of the contractor and nothing extra will be paid on such account.
 55. The contractor shall have to submit the samples of items of furniture within 3 months of the award of the work as per the nomenclature and specifications given in bid documents and the same have to be displayed at the Project site as per directions of Engineer-In-Charge for approval of the Project Monitoring Committee/Competent authority of DTU as constituted by VC, DTU.
- No supply of furniture shall be made without approval of the samples as above.

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56. The samples of the furniture submitted by the bidder shall be under the safe custody of the representative of Engineer-in-Charge at site, till the time the work is completed in all respects.
57. The Engineer-in-Charge reserves the right, without being liable for any damages or obligation to reject any or all the samples without assigning any reason.
58. The following furniture works shall be executed through agencies meeting the Eligibility criterias. The main contractor shall submit atleast 03 nos. agencies for the furniture work at the time of submission of bid. The main contractor shall also submit the eligibility document as per the eligibility criteria mentioned against each agency for furniture work at the time of submission of eligibility bid. The same shall scanned and uploaded along with other documents as specified on page No. 14 with in the period of bid submissions. The eligibility criteria for agencies of furniture work is as follows:-

1. **FURNITURE WORK:** The Contractor(s) shall submit alongwith the bid for the approval of the Engineer-in-Charge, the names of at least three such agencies for furniture work, of repute alongwith their technical capability (as per forms A,B,C,D & E given in the bid document) proposed to be engaged by him, who have executed satisfactorily a minimum of **three similar works of value not less than Rs.7.00 Crore each or two works of value not less than Rs.11 Crore each or one work of value not less than Rs.14 Crore in the last seven years.**
 - a) **Similar works means “Providing and fixing customized furniture of all types”. The value of executed works shall be brought to current level by enhancing the actual value of work at simple rate of 7% per annum, calculated from the date of completion of work upto date of receipt of tender.**
 - b) **The agency should have had average annual financial turnover on works at least of Rs. 18 crore during the immediate last three consecutive financial years ending March 2018 (Scanned copy of Certificate from CA to be uploaded)**
 - (c) The agency should not have incurred any loss (**Profit after Tax should be positive**) in more than **two years** during the last five years ending 31st March 2018 (**Scanned copy of Certificate from CA to be uploaded**).
 - (g) The agency Should have a solvency of **Rs. 7 crore (Scanned copy of original solvency certificate from Bank to be uploaded)**
 - (h) Willingness certificate as per form ‘G’.
 - (i) Certificate of registration in the GST.

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The Department shall approve the name of one eligible agency for each of the works in above. Within 21 days after approval is accorded by Project Monitoring Committee/Competent authority of DTU or as per direction of Engineer-in-charge.

**Executive Engineer
EPD-4, PWD,
Shaheed Sukhdev College,
Sec-16, Rohini, Delhi-89**

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No. of Omissions – O NIL
No. of Insertions –I NIL

AE-I
(EPD-4)

EE
(EPD-4)

AE (P)
(CPM (Housing))

EE(P)
(CPM (Housing))

SPECIAL CONDITIONS FOR CEMENT & STEEL

1. The contractor shall, at his own expense procure and provide all materials including cement and steel required for the work.
2. The contractor shall procure all the materials in advance so that there is sufficient time to testing and approving of the materials and clearance of the same before use in work.
3. All materials brought by the contractor for use in the work shall be got checked from the Engineer-in-Charge or his authorized representative of the work on receipt of the same at site before use.
4. The contractor shall also employ necessary watch and ward establishment for the safe custody of materials at his own cost.
5. Contractor has to produce manufacturers test certificate for each lot of cement & steel procured at site.

6. CONDITIONS FOR CEMENT

- 6.1 The contractor shall procure Port Land Pozzolana cement confirming to IS : 1489 (Part-I) as required in the work from reputed manufacturers of cement such as ACC, Ultratech, Vikram, Shree Cement, Ambuja, Jaypee Cement, Lafarge, CCI and J.K.Cement or from any other reputed cement manufacturers having a production capacity not less than one million tonners per annum as approved by ADG for that sub-region. The tenderer may also submit a list of name of cement manufacturers which they propose to use in the work. The tender accepting authority reserves right to accept or reject name(s) of cement manufacture(s) which the tenderer proposes to use in the work. No change in the tendered rates will be accepted if the tender accepting authority does not accept the list of cement manufacturers, given by the tenderer, fully or partially, Supply of cement as approved by Ministry of Industry, Government of India and holding licence to use ISI certification mark for their product whose name shall be got approved from Engineer-in-Charge. Supply of cement shall be taken in 50 kg. bags bearing manufacturer's name and ISI marking, alongwith manufacturers test certificate for each lot. Samples of cement arranged by the contractor shall be taken by the Engineer-in-Charge and got tested in accordance with provisions of relevant BIS Codes. In case test results indicate that the cement arranged by the contractor does not conform to the relevant BIS Codes, the same shall stand rejected and shall be removed from the site by the contractor at his own cost within a week's time of written order from the Engineer-in-Charge to do so.
- 6.2 The cement shall be brought at site in bulk supply of approximately 100 tonnes or as decided by the Engineer-in-Charge.

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6.3 The cement godown of the capacity to store a minimum of 5000 bags of cement shall be constructed by the contractor at site for which no extra payment shall be made. Double lock provision shall be made to the door of the cement godown. The keys of one lock shall remain with the Engineer-in-Charge or his authorized representative and the key of the other lock shall remain with the Contractor. The contractor shall be responsible for the watch and ward and safety of the cement godown. The contractor shall facilitate the inspection of the cement godown by the Engineer-in-Charge at any time.

6.4 The cement shall be got tested by Engineer-in-Charge and shall be used on work only, after test result have been received. The contractor shall supply free of charge the cement required for testing. The cost of tests shall be borne by the contractor/ Department in the manner indicated below:-

By the contractor, if the results show that the cement does not confirm to relevant BIS codes.

By the Department, if the results show that the cement confirms to relevant BIS codes.

6.5 The actual issue and consumption of cement on work shall be regulated and proper accounts maintained as provided in Clause -10 of the contract. The theoretical consumption of cement shall be worked out as per procedure prescribed in Clause-42 of the contract and shall be governed by the conditions laid therein.

6.6 If the quantity of cement actually used in the work is found to be more than the theoretical quantity of cement including authorised variation, nothing extra shall be payable to the contractor on this account . In the event of it being discovered that after the completion of the work, the quantity of cement used is less than the quantity ascertained as herein before provided (allowing variation on the minus side as stipulated in Clause - 42), the cost of quantity of cement not so used shall be recovered from the contractor @ given in schedule 'F'. Decision of the Engineer-in-Charge in regard to theoretical quantity of cement which should have been actually used as per the schedule and recovered at the rate specified, shall be final and binding on the contractor.

For non-scheduled items, the decision of the Chief Engineer (Projects) regarding theoretical quantity of the cement which should have been actually used, shall be final and binding on the contractor.

6.7 Cement brought to site and cement remaining unused after completion of work shall not be removed from site without written permission of the Engineer-in-Charge.

6.8 Damaged cement shall be removed from site immediately by the contractor on receipt of a notice in writing from the Engineer-in-Charge. If he does not

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do so within three days of the receipt of such notice, the Engineer-in-Charge shall get it removed at the cost of the contractor.

- 6.9 In case the contractor brings surplus quantity of cement the same shall be removed from the site after completion of work by the contractor at his own cost after approval of the Engineer-in-Charge.
- 6.10 The cement in bags shall be stacked by the contractor in two godowns one for fresh arrival to be tested for quality and another already tested in use having weather proof roof and walls and on a proper floor consisting of two layers of dry bricks laid on well consolidated earth at a level at least 30 cm above the ground level. These stacks shall be in rows of two bags deep and 10 bags high with a minimum of 60 cm. clear space all round. The bags should be placed horizontally continuous in each line as shown in the accompanying sketch given in CPWD Specification - 2009 Vol.I to Vol. II with upto date correction slips. The sketch is only for guidance. Actual size / shape of godowns shall be as per site requirement and nothing extra shall be paid on this account.
- 6.11 Cement register for the cement shall be maintained at site. The account of daily receipts and issue of cement shall be maintained in the register by the contractor or his authorized agent & sign by authorized representative of Engineer-in-Charge.
- 6.12 Cement which is not used within 90 days from its date of manufacture shall be tested at laboratory approved by the Engineer-in-Charge until the results of such tests are found satisfactory; it shall not be used in any work.
7. The contractor shall procure TMT bars of Fe500 D grade of primary producers such as SAIL, Tata Steel Ltd, RINL, Jindal Steel & Power Ltd. and JSW Steel Ltd.
 - (a) The grade of the steel such as Fe500 D to be procured is to be specified as per BIS 1786-2008.
 - (b) The TMT bars procured from primary producers shall conform to manufacture's specifications.
8. 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.
9. Samples 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 contractor does not confirm to the specifications as defined under para (1a) above, the same shall stand rejected, and it shall be removed from the site of work by the contractor at his own cost within a week time or written orders from the Engineer-in-Charge to do so.

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10. The steel reinforcement bars shall be brought to the site in bulk supply of 20 tonnes or more, or as decided by the Engineer-in-Charge.
11. The steel reinforcement bars shall be stored by the contractor 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 sizes and lengths shall be stored separately to facilitate easy counting and checking.
12. For checking nominal mass, tensile strength, bend test, re-bend test, 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 thereof	One sample for each 40 tonnes or part thereof
10 mm to 16 mm One dia bars	sample for each 35 tonnes or part thereof	One sample for each 45 tonnes or part thereof
Over 16 mm dia bars	One sample for each 45 tonnes or part thereof	One sample for each 50 tonnes or part thereof

13. The contractor shall supply free of cost the required steel bars for testing including its transportation to testing laboratories. The cost of tests shall be borne by the contractor/departments in the manner indicated below:
 - (i) By the contractor, if the result shows that the steel does not confirm to relevant BIS codes.
 - (ii) By the department, if the results shows that the steel confirms to relevant BIS codes.

The actual issue and consumption of steel on work shall be regulated and proper accounts maintained as provided in clause 10 of the contract. The theoretical consumption of steel shall be worked out as per procedure prescribed in clause-42 of the contract and shall be governed by conditions laid therein. In case the consumption is less than theoretical consumption including permissible variations recovery at the rate so prescribed shall be made. In case of excess consumption no adjustment need to be made.

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.

No. of Correction – C NIL
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PARTICULAR SPECIFICATIONS

CIVIL & SANITARY INSTALLATION / WATER SUPPLY / DRAINAGE WORK

1.0 EARTH WORK:-

- 1.1 The work shall be done in accordance with CPWD Specifications – 2009: Vol. I & Vol. II with upto date correction slips.
- 1.2 Excavation shall be undertaken to the width of the Basement / Retaining wall footing including necessary margins for construction operation as per drawing or directed otherwise. Where the nature of soil or the depth of the trench and season of the year, do not permit vertical sides, the contractor at his own expense shall put up the necessary shoring, strutting and planking or cut slopes with or without steps, to a safer angle or both with due regard to the safety of personnel and works and to the satisfaction of the Engineer, Measurement of plan area of excavation for payment shall be permitted only. Nothing extra shall be paid for making steps and slopes etc. as required.
- 1.3 The agency shall clearly demarcate the building layout on the ground after clearing the building site from all vegetation/ shrubs/ Jungle and general dressing of the building site, before commencement of excavation work to the satisfaction of the Engineer-in-Charge. Nothing shall be paid for jungle clearing and dressing within the footprint of the buildings, pathways, footpath and roads.
- 1.4 The contractor shall make at his own cost all necessary arrangements for maintaining water level, in the area where works are under execution low enough so as not to cause any harm to the works or problems in carrying out with the execution and the rates for all items of work shall be considered as inclusive of pumping out or bailing out water, if required, for which no extra payment shall be made. This will include water coming from any source, such as rains, accumulated rain water, floods, leakages from sewer and water mains, subsoil water table being high or due to any other cause whatsoever. The contractor shall make necessary provision of pumping, dredging, and bailing out water coming from all above sources and excavation and other works shall be kept free of water by providing suitable system approved by the Engineer-in-charge.
- 1.5 Sub-soil water table at work site is reported to be about 6.7m to 7.9m below general ground level. The water level may vary due to rainy season or due to dewatering etc. in order to avoid possibility of basement floor of main building being getting uplifted/damaged due to water pressure, the contractor shall make arrangement for lowering 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 laying of P.C.C., water proofing treatment, laying of basement raft and beams

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including filling of earth/sand under the basement floor. 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 up to ground level and until the structure attains such height to counter balance the uplift pressure. However, the contractor should inspect the site and make his own assessment about sub-soil water level likely to be encountered at the time of execution and quote his rates accordingly. 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 by the Engineer-in-charge.

- 1.6 All the major excavation shall be carried out by mechanical excavator. No extra payment shall be made for that.
- 1.7 The rates are inclusive for all depths & nothing extra shall be paid for additional lift etc.

2.0 CONCRETE WORK:-

The work shall be done in accordance with CPWD Specifications – 2009: Vol. I & Vol. II with upto date correction slips.

3.0 R.C.C./ C.C WORK (DESIGN MIX CONCRETE):-

- 3.1 The RCC work shall be done with Design Mix Concrete. Wherever letter M has been indicated, the same shall imply for the Design Mix Concrete. The Design Mix Concrete will be designated based on the principles given in IS: 456, 10262 & SP 23. The condition and specifications stated herein shall have precedence overall conditions and specifications stated in relevant I.S codes/CPWD specifications. The concrete mix shall be designed for specified target mean compressive strength in order to ensure that the work test results do not fall below the acceptance criteria specified for the concrete mix. The Contractor shall design mixes for each class of concrete indicating that the concrete ingredients and proportions will result in concrete mix meeting requirements specified. The mix shall be designed with quantities of admixture / plasticizer proposed to achieve required workability & strength. The specifications mentioned here in below shall be followed for Design Mix Concrete.
- 3.2 The sources of coarse aggregate, fine aggregate & water to be used in concrete work shall be identified by the contractor & he will satisfy himself regarding their conforming to the relevant specification & their availability before getting the same approved by the Engineer-in-Charge.
- 3.3 **Coarse Aggregate:** - As per CPWD Specifications - 2009 - Vol.I & Vol. II with upto date correction slips.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- 3.4 **Fine Aggregate:** -As per CPWD Specifications - 2009 - Vol.I & Vol. II with upto date correction slips.
- 3.5 **Water:** - It shall confirm to requirements laid down in IS:456-2000 / CPWD Specifications - 2009 - Vol.I & Vol. II with upto date correction slips.
- 3.6 **Cement:** - PPC shall be used for design mix concrete and shall conform to IS-1489 (part-I). However, if higher grade of cement is used by the contractor nothing extra shall be paid on this account.
- 3.7 **Admixtures/ Plasticizers:** - The admixture shall confirm to IS: 9103, wherein required, the admixture of approved quality and approved make only shall be used to attain the required workability. Nothing extra shall be paid for use of admixtures.
- 3.8 **Grade of Concrete:** - The compressive strength of various grades of concrete shall be given as below:-

GRADE DESIGNATION	COMPRESSIVE STRENGTH ON 15 cm CUBES min. 7 DAYS (N/mm ²)	SPECIFIED CHARACTERISTIC COMPRESSIVE STRENGTH AT 28 DAYS AT (N/mm ²)	MAXIMUM WATER CEMENT RATIO
(i) M-20	As Per Design	20	0.50
(ii) M-25	As Per Design	25	0.50
(iii) M-30	As Per Design	30	0.45
(iv) M-35	As Per Design	35	0.45
(iv) M-40	As Per Design	40	0.45

Water cement ratio and slump shall be as per IS: 456-2000

NOTE:-

- In the designation of a Concrete mix letter M refers to the mix and the number of the specified characteristic compressive strength of 15 cm - Cube at 28 days expressed in N/mm².
 - It is specifically highlighted that in addition to the above requirements, the maximum cement content for any grade shall be limited to 380 kg. / Cubic meter.
 - The maximum cement content for design mix concrete shall be maintained as per the quantity mentioned above. In case where the quantity of cement required as per Design Mix is lower than the quantity specified in the respective item in the "schedule of quantity", necessary deduction for less quantity of cement used shall be made from the contractor.
- 3.9 The contractor shall engage one of the following approved laboratories/ test house at his own expenses for designing the concrete mix in accordance with relevant IS Codes and to conduct laboratory test to ensure the target strength and workability criteria for a given grade of concrete.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- i) I.I.T, Delhi
- ii) National Council for Cement & Building Materials, Ballabhagarh.
- iii) Delhi College of Engineering, Delhi.

The various ingredients for mix design / laboratory tests shall be sent to the lab/test houses through the Engineer-in-Charge and the samples of such aggregates sent shall be preserved at site by the department.

- 3.10 In the event if all the three laboratories are unable to carry out the requisite design/ testing, the contractor may have it done from any other laboratory with prior approval of the Chief Engineer (Projects), PWD (GNCTD).
- 3.11 The contractor shall submit the report on design mix from any of above approved laboratories for approval of Engineer-in-Charge within 40 days from the date of issue of letter of acceptance of the tender, failing which a penalty of Rs. 5,000/- per day shall be levied and recovered from the contractor for each day's delay in submitting the said report. No concreting shall be done until the design mix is approved. In case of white portland cement and the likely use of admixtures in concrete with ordinary portland/ white portland cement, the contractor shall design and test the concrete mix by using trial mixes with white cement and / or admixtures also, for which nothing extra shall be payable.
- 3.12 In case of change of source or characteristic properties of the ingredients used in the concrete mix during the work, a revised laboratory mix design report conducted at laboratory established at site shall be submitted by the contractor as per the direction of the Engineer-in-Charge, failing which no further construction work will be allowed.

3.13 Trial Batches

- 3.13.1 The designed mix proportion shall be checked for target mean compressive strength by means of trial batches.
- 3.13.2 The quantities of materials for each trial mix shall be sufficient for atleast six specimens (cubes) and the concrete required for carrying out workability tests.
- 3.13.3 The workability of trial mix No. 1 shall be measured and mix shall be carefully observed for freedom from segregation, bleeding and its finishing characteristics. The water content, if required, shall be adjusted corresponding to the required changes in the workability.
- 3.13.4 With the modified water content, the mix proportions shall be recalculated by keeping with water cement ratio unchanged. The mix proportions, as modified, shall form the Trial Mix No. 2 and tested for the specified strength and workability.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

3.13.5 In addition, trial mix No. 3 and 4 shall be designed by keeping water contents same as that determined for trial mix 2 but varying the water cement ratio + 10 percent of the specified value and tested for their design characteristics.

3.14 All cost of mix designing and testing connected therewith including charges payable to the laboratory shall be borne by the Contractor including redesigning of the concrete mix wherever required and directed by Engineer-in-Charge.

3.15 APPROVAL OF DESIGN MIX:-

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

$$T_{ck} = F_{ck} + 1.65s$$

Where F_{ck} = Characteristic compressive strength at 28 days.

s = Standard deviation which depends on degree of quality control.

The degree of quality control for this work is “good” for which the standard deviation (s) obtained for different grades of concrete shall be as follows:-

GRADE OF CONCRETE	STANDARD DEVIATION(S)
M-10	3.5
M-15	3.5
M-20	4.0
M-25	4.0
M-30	5.0
M-35	5.0
M-40	5.0

Minimum three sets of separate preliminary test shall be carried out for each trial batch of concrete mix. Each test shall comprise six specimens and only one test set of six specimens shall be made on any particular day. Out of the six specimen of each set, three shall be tested at seven days and remaining three at 28 days. The preliminary tests at seven days are intended only to indicate the strength to be attained at 28 days. While the design mix shall be approved only on the basis of test strength of 28 days. The design mix shall be considered satisfactory and approval if atleast three preliminary test- sets individually satisfy the following strength and workability criteria.

- The average strength of each test sets is not less than the specified target mean compressive strength (TCK).
- The strength of any specimen cube is not less than 0.85 T_{ck} .
- The concrete mix is required degree of workability and acceptance concrete finish.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- 3.16 All cost of mix designing and testing connected therewith including charges payable to the laboratory shall be borne by the Contractor.

3.17 WORK STRENGTH TEST:-

TEST SPECIMEN:-

Work strength test shall be conducted in accordance with IS:516 on random sampling. Each test shall be conducted on six specimen, three of which shall be tested at 7 days and remaining three at 28 days.

TEST RESULTS OF SAMPLES:-

The test results of the sample shall be the average of the strength of three specimen. The individual variation shall not be more than + 15% percent of the average. If variation is more, the test results shall be treated as invalid. 90% of the total tests shall be done at the laboratory established at site by the contractor and remaining 10% in the laboratory of Central Designs Organisation, CPWD or in any other laboratory as directed by the Engineer-in-Charge.

LOT SIZE:-

The minimum frequency of sampling of concrete of each grade shall be in accordance with the following:-

QUANTITY OF CONCRETE IN THE WORK (CUBIC METRE PER DAY).	NUMBER OF SAMPLES
1-5	1
6-15	2
16-30	3
31-50	4
51 & above	4 Plus one additional sample for each additional 50 cubic metre of part thereof

NOTE: - At least one sample shall be taken from each shift.

3.18 STANDARD OF ACCEPTANCE:-

- i) In case the test results of all the samples are above the characteristic compressive strength, the concrete shall be accepted.
- ii) In case the test result of one or more samples fails to meet the requirement (i) above, it shall be accepted if both the following conditions are met:-
 - a) Any individual test result is not less than $(F_{ck} - 4) \text{ N/mm}^2$.
 - b) The mean of test results from any group of four consecutive samples is more than $(F_{ck} + 4) \text{ N/mm}^2$.
- iii) Concrete of each grade shall be assessed separately.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- iv) Concrete is liable to be rejected, if it is porous or honeycombed, its placing has been interrupted without providing a proper construction joint, the reinforcement has been displaced beyond the tolerances specified, or construction tolerances have not been met.
- 3.19 The contractor has to arrange at site centering and shuttering for 1200 sqm. before start of work. Only M.S. centering / shuttering and scaffolding material unless & otherwise specified shall be used for all R.C.C. work to give an even finish of concrete surface. However, marine-ply shuttering in exceptional cases as per site requirement may be used on specific request from contractor as approved by the Engineer-in-Charge.
- 3.20 Nothing extra shall be paid for the centering and shuttering, circular in shape whenever the form work is having a mean radius exceeding 6m in plan.
- 3.21 In order to keep the floor finish as per architectural drawings and to provide required thickness of the flooring as per specifications, the level of top surface of R.C.C. shall be accordingly adjusted at the time of its centering, shuttering and casting for which nothing extra shall be paid to the Contractor.
- 3.22 As per general engineering practice, level of floors in toilet / bath, balconies, shall be kept 12 to 20mm as required lower than general floors shuttering should be adjusted accordingly. Nothing extra is payable on this account.

3.23 Production of Concrete

All concrete shall be produced at site through fully automatic computerised weigh-batching plant of suitable capacity conforming to IS: 4925 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. Fully automatic batching and mixing plant having capacity not less than **30 cum/ hour** shall be installed at the arranged site by the contractor within **30 days** of award of work, failing which a penalty of Rs. 5,000/- per day shall be levied and recovered from the contractor for delay. The batching and mixing plants shall be dedicated plants 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 by the Engineer-in-charge at his own cost. In such a situation nothing extra shall be paid to the contractor. 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 after approval by the Engineer-in-Charge and contractor shall be wholly responsible for ensuring the property of concrete as required at site, nothing extra shall be paid to the contractor.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

When the work is nearing completion and daily requirement of concrete is very less, if agreed by the Engineer-in-Charge, the contractor may be permitted to procure the concrete from approved Ready Mix Concrete (RMC) supplier and nothing extra shall be paid to the contractor on this account.

Land for Temporary Use

The land for labour camps and batching plant shall be arranged by the contractor. The lease/rent charges shall be borne by the contractor. The Engineer-in-Charge shall extend necessary help and issue necessary recommendations etc. to the concerned department for temporary allotment of land during construction period. If the land belongs to PWD and the same is made available to the contractor, the rent of such land shall be recovered @ Rs.1, 00,000/- per acre per month. The contractor shall vacate the land after completion of work in same condition as was at the time of allotment.

The batching and mixing plant shall be fully automatic of suitable capacity not less than 30cum/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:

- Separate storage bins for different sizes of aggregates, silo for cement and fly ash; water storage tank.
- Batching equipment
- Mixers
- Control Panels with provision of generation of computerized output reports of a batch.
- Mechanical material feeding and elevating arrangements

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.

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.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

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 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.

3.24 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 and/or steel closed bottom buckets capable of carrying minimum 0.6 cum concrete. 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 revolution 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.

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. Special precaution shall be taken that surrounding temperature during concreting shall not exceed 30 degree centigrade.

Except where otherwise agreed to by the Engineer-in-Charge, concrete shall be deposited in horizontal layers to a compacted depth of not more than 450 mm. Unless agreed to by the Engineer-in-Charge, concrete shall not be

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

dropped into place from a height exceeding 1.5m. In order to avoid such situations chutes, tremie pipe or closed bottom buckets shall be used. These shall be kept clean and used in such a way as to avoid segregation. Slope of the chute shall be so adjusted that concrete flows without the use of excessive quantity of water. The delivery end of chute shall be as close as possible to the point of deposit. The chute shall be thoroughly flushed with water before and after each working period and the water used for this purpose shall be discharged outside the formwork. The concrete shall be compacted by using immersion type vibrators. When the concrete is being continuously deposited to a uniform depth along a member, vibrator shall not be operated within one meter of free end of the advancing concrete. Every effort shall be made to keep the surface of the previously placed layer of concrete alive so that the succeeding layer can be amalgamated with it by the vibration process. In case the concrete in underlying layer has hardened to such an extent that it cannot be penetrated by the vibrator but is still fresh (that is, just after initial set), un-imposed bond shall be achieved between the top and underlying layer by first scarifying the lower layer before the new concrete is placed by systematically and thoroughly vibrating the new concrete. The points of insertion of vibrator in the concrete shall be so spaced that the range of action overlap to some extent and the freshly filled concrete is sufficiently consolidated at all locations. The spacing between the dipping positions of vibrator shall be maintained uniformly throughout the surface of concrete so that concrete is uniformly vibrated. The vibrating head shall be regularly and uniformly inserted in the concrete so that it penetrates of its own accord and shall be withdrawn slowly whilst running so as to allow redistribution of concrete in its way and allow the concrete to flow back into the hole behind the vibrator. The vibrator head shall be kept in one position till the concrete within its influence is completely consolidated. Vibration shall be continued until the coarse aggregate particle have blended into the surface but have not disappeared. The contractor shall keep at least one additional vibrator in serviceable condition to be used in the event of breakdowns and maintenance problems.

The vibrator head shall not be brought more than 200 mm near to the formwork as this may cause formation of water stagnations. The formwork shall be strong and great care shall be exercised in its assembly. It shall be designed to take up increased pressure of concrete and pressure variations caused in the neighbourhood of vibrating head, which may result in excessive local stress on the formwork. The joints of the formwork shall be made and maintained tight and close enough to prevent the squeezing out slurry or sucking in of air during vibration. The formwork to receive concrete shall be cleaned and made free from standing water, dust, etc. The contractor shall keep provision for screed and shutter vibrators at site.

No concrete shall be placed in any part of the structure until the approval of Engineer-in-Charge has been obtained. If concreting is not started within 24

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

hours of the approval being given, it shall have to be obtained again from the Engineer-in-Charge. Concreting shall be done continuously over the area between construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept, clean, thoroughly wetted and covered with a 13 mm thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. The 13 mm layer of mortar shall be freshly mixed and placed immediately before placing of new concrete.

Where concrete is not fully hardened, all latency shall be removed by scrubbing the wet surface with wire or bristle brushes. Care shall be taken to avoid dislodgement of particles of coarse aggregate. The surface shall then be thoroughly wetted, all free water removed and then coated with neat cement grout. Particular attention shall be given to corners and close spots.

3.25 **Measurement** - As per CPWD Specifications - 2009 - Vol. I & Vol. II with upto date correction slips.

3.26 **Tolerances** - As per CPWD Specifications - 2009 - Vol. I & Vol. II with upto date correction slips.

3.27 **Rates:-**

3.27.1 The rate includes the cost of materials/ plasticizers / admixtures, labour and T&P, including mixing, placing, transportation involved in all the operations described above except for the cost of centering, shuttering & reinforcement which will be paid for separately.

3.27.2 In case of actual average compressive strength being less than specified strength which shall be governed by para "Standard of Acceptance" as above the rate payable shall be worked out accordingly as per C.P.W.D. specifications - 2009 - Vol.I & Vol. II with upto date correction slips.

3.27.3 In case of rejection of concrete on account of unacceptable compressive strength, governed by para "Standard of Acceptance" as above, the work for which samples have failed shall be redone at the cost of contractor. However, the Engineer-in-Charge may order for additional tests (like cutting cores, ultrasonic pulse velocity test, load test on structure on part of structure, etc) to be carried out at the cost of contractor to ascertain if the portion of structure wherein concrete represented by the sample has been used, can be retained on the basis of results of individual or combination of these tests. The Contractor shall take remedial measures necessary to retain the structure as approved by the Engineer-in-Charge without any extra cost. However, for payment, the basis of rate payable to contractor shall be governed by the 28 days cube test results and reduced rates shall be regulated in accordance with para 3.24.2.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- 3.28 In respect of all projected slabs at all levels including cantilever, canopy, the payment for the RCC work shall be made under the item RCC slabs. The payment for shuttering at the edges shall be made under item of centering and shuttering for RCC slabs. Nothing extra shall be paid for the side shuttering at the edge of these projected balconies and projected varandah slabs.

4.0 **SHUTTERING / Form Work:-**

- 4.1 The work shall be done in accordance with CPWD Specifications - 2009 - Vol. I & Vol. II with upto date correction slips.
- 4.2 Steel shuttering or water proof ply shuttering as approved by the Engineer-in-Charge shall be used by the contractor. Minimum size of shuttering plates shall be 600mm x 900mm except for the case when closing pieces required to complete the shuttering panels. Dented, broken, cracked, twisted or rusted shuttering plates shall not be allowed to be used on the work.
- 4.3 The shuttering plates shall be cleaned properly with electrically driven sanders to remove any cement slurry or cement mortar or rust. Proper shuttering oil or debonding compound shall be applied on the surface of the shutter plates in the requisite quantity before assembly of steel reinforcement.
- 4.4 The joint filler shall be resilient closed cell expanded polyethene and non-tainting as manufactured by Supreme Industries Ltd.
- 4.5 Providing joint filler of required thickness in position to substrate using either double sided foam adhesive tape or neoprene synthetic rubber adhesive. When forming expansion joint with the Board in in-situ concrete, joint sealing slots can be readily formed in the following matter-
- a) Before installing, simply cut off a strip of the required depth. Then install the filler flush with the finished surface.
 - b) Prior to sealing, the top strip can then be pulled easily from the joint to provide an uncontaminated sealing slot ready for preparation and sealing.
- 4.6 Rates shall be inclusive of all including labour, material, T&P, scaffolding etc. complete. Nothing extra shall be payable on any account.
- 4.7 The rates of shuttering are for all staging height & nothing extra shall be payable on this account.

5.0 **REINFORCEMENT:-**

- 5.1 The reinforcement shall be done as per CPWD Specifications - 2009 - Vol.I & Vol. II with upto date correction slips.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

5.2 The rate of item of reinforcement of RCC work includes all operations including straightening, cutting, bending, welding, binding with annealed steel or welding and placing in position at all the floors with all leads and lift complete as per CPWD Specification - 2009 - Vol.I & Vol. II with upto date correction slips.

5.3 To avoid displacement of bars in any direction and to ensure proper cover, only factory made round type/rectangular cover blocks shall be used by the contractor. Nothing extra shall be payable on this account.

6.0 BRICK WORK:-

Unless otherwise specified FPS Bricks shall be used in all items of brick work. The classification of bricks brought by the contractor shall strictly confirm to CPWD Specifications – 2009 Vol-1 & II with upto date correction slips or as specified. The rate shall also include for leaving chases / notches for dowels / cramps for all kinds of cladding to come over brick work.

7.0 STONE / MARBLE WORK:-

General:-

7.1 The execution of stones work shall be in general as per CPWD Specifications - 2009 - Vol.I & Vol. II with upto date correction slips.

7.2 All holes, rebates, recesses etc. for providing fixing and inserts shall be predrilled and precut and worked using precision machine tools. Nothing extra on this account shall be payable.

SAMPLES FOR STONE WORK:-

7.3 Samples of each item of stone work either individually or in combination shall be prepared for approval of Engineer-in-Charge before commencement of work.

7.4 Sequence of execution for cladding work shall be suggested by the contractor for approval of Engineer-in-Charge.

8.0 SCAFFOLDING:-

Double steel scaffolding having two sets of vertical supports shall be provided. The supports shall be sound and strong, tied together with horizontal pieces over which scaffolding planks shall be fixed.

9.0 WOOD WORK:-

9.1 The wood work in general shall be carried out as per CPWD Specifications - 2009 Vol.I & II with upto date correction slips.

9.2 All fittings and fixtures shall be got approved from the Engineer-in Charge before procurement well in advance and the approved samples shall be kept at site till completion of the work.

9.3 Glazing for toilets shall be of translucent type.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- 9.4 The shape and size of beading shall be as per drawings. The joints of beading shall be mitred.

10.0 STEEL WORK:-

Work shall be carried out as per CPWD Specifications - 2009 - Vol.I & Vol. II with upto date correction slips.

11.0 FLOORING

- 11.1 All work in general shall be carried out as per CPWD Specifications- 2009 - Vol.I & Vol. II with upto date correction slips.
- 11.2 Whenever flooring is to be done in patterns tiles/ stone, the contractor shall get samples of each pattern laid and approved by the Engineer-in-Charge before final laying of such flooring for which nothing extra shall be paid.
- 11.3 Different stones/ tiles used in pattern flooring shall be measured separately as defined in the nomenclature of the item and nothing extra for laying pattern flooring shall be paid over and above the quoted rate. No additional wastage if any shall be accounted for any extra payment.
- 11.4 The proper gradient shall be given to flooring for toilets, varrandah, kitchen, court yard, etc. as per the directions of Engineer-in-Charge.

11.5 Ceramic Tiles/Vitrified Tiles Work/ Granite stone flooring

- 11.5.1 Work shall be carried out as per CPWD Specifications- 2009 Vol I & II with up to date correction slips and as per manufactures specifications.
- 11.5.2 Rates shall be inclusive of all operations including labour, material, T&P, scaffolding etc. complete. Nothing extra shall be payable on any account.
- 11.5.3 Size of ceramic/vitrified tiles shall not be less than 300 mm x 450 mm. unless or otherwise as per nomenclature of the item. Nothing extra shall be paid on this account.
- 11.5.4 One piece Granite stone for treads / risers in staircase shall be used and nothing extra shall be paid on this account.

12.0 ROOFING, WATER PROOFING & INSULATION

Work shall be executed as per CPWD Specifications, 2009 Vol I & II with upto date correction slips.

12.1 Water Proofing of terrace/ Sunken Portion Area/UG tank.

12.1.1 Brick Bat Terracing/ Water Proofing

The water proofing compound used in integral water proofing treatment shall satisfy all the performance requirements indicated in IS :m 2645 and shall be got tested before its use. The compound shall be used @ 2% by weight of cement used or as recommended by the manufacturer.

- 12.1.2 Total quantity of the water proofing compound required shall be arranged only after obtaining the prior approved of the Engineer-in-Charge in writing. Materials shall be kept under double lock and key and proper account of the

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

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.

- 12.1.3 The finished surface after water proofing treatment for roof slab shall have smooth slope.
- 12.1.4 Before commencement of treatment on roof surface, it shall be ensured that the outlet drain pipes/ spouts have been fixed and the spout opening have been eased and rounded off properly for easy flow of water.

12.2 Water proofing of Sunken Portion Area

Application of cementitious- organic chemical based coating as per manufacturer's specifications of Kryton/Pedilite (water proofing compound confirming to IS:2645) or equivalent applied on vertical and horizontal surface after laying of all pipes and smooth plugging of holes.

Concrete surface on which water proofing is desired shall be kept wet for 48 hrs. after cleaning of all dirt, oil grease, bitumen, laitance or other contaminants.

Surface water shall be removed prior to application of waterproofing, but surface shall remain wet during the application to enhance deep penetration & formation of crystals at greater depth to block voids.

The area shall be protected from sun and rain for 48 hrs. and continues flooding for 7 days.

Flooding shall be done for 72 hrs. to test the area for any leakage/ seepage etc. In case of failure, the process shall be repeated and tested again by the contractor at his own risk and cost.

Rates shall be inclusive of all operations including labour, material, T&P, scaffolding and testing etc. complete. Nothing extra shall be payable on any account.

Guarantee Bond

Ten years guarantee bond in prescribed proforma attached at annexure-II herewith shall be submitted by the contractor which shall also be signed by both the specialised agency and the contractor to meet their liability/ liabilities under the guarantee bond. However, the sole responsibility about efficiency of water proofing treatment shall rest with the main contractor.

(Five percent) of the cost of water proofing work shall be retained as 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 satisfactory. If any defect is noticed during the guarantee period, it shall be rectified by the contractor within seven days of receipt of intimation of defects in the work. If the defects

No. of Correction – C NIL
No. of Omissions – O NIL
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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 contractor.

However, the security deposit deducted may be released in full against bank guarantee of equivalent amount in favour of Engineer-in-Charge, if so decided by the Engineer-in-Charge.

The security deposit against this item of work shall be in addition to the security deposit mentioned elsewhere in contract form.

13.0 FINISHING

13.1 The work shall be carried out as per CPWD Specifications- 2009 Vol.-I & Vol. II with upto date correction slips.

13.2 All painting material shall brought to the site of work in the original sealed containers. The material brought to the site of work shall be sufficient for at least 30 days of work. The material shall be kept under the joint custody of contractor and representative of the Engineer-in-Charge. The empty contains shall not be removed from the site till the completion of the work without permission of the Engineer-in-Charge.

14.0 SPECIFICATIONS FOR ALUMINIUM DOOR, WINDOW, VENTILATOR WORKS ETC.

14.1 Extent and intent

The work shall be carried out through an approved specialised agency, who shall furnish all materials, labour, accessories, equipment, tool and plant and incidentals required for providing and installing anodised aluminium doors, windows, claddings, louvers and other items as called for on the drawings. The drawings and specifications cover the major requirement only. The supplying of additional fastenings, accessory features and other items not mentioned specifically herein, but which are necessary to make a complete installation shall be a part of this contract.

14.2 General

Aluminium doors, windows etc. shall be of sizes, section details as shown on the drawings. The details shown on the drawings indicate generally the sizes of the components parts and general standards. These may be varied slightly to suit the standard adopted by the manufacturer. Before proceeding with any manufacturing, the contractor shall prepare and submit complete manufacturing and installation drawings for approval of the Engineer-in-Charge and no work shall be performed until the approval of these drawings is obtained.

14.3 Shop Drawings

The contractor shall submit the shop drawings of doors. Windows, louvers, cladding and other aluminium work, based on architectural drawings, to the

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Engineer-in-Charge for his approval. The drawings shall show full size sections of doors, windows etc. thickness of metal (i.e wall thickness), details of construction, sub frame/ rough ground profile, anchoring details, hardware as well as connection of windows, doors and other metal work to adjacent work. Samples of all joints and methods of fastening and joining shall be submitted to the Engineer-in-Charge for approval well in advance of commencing the work.

14.4 **Samples**

Samples of doors, windows, louvers etc. shall be fabricated, assembled and submitted to the Engineer-in-Charge for his approval. They shall be of sizes types etc. as decided by Engineer-in-Charge. All samples shall be provided at the cost of the contractor.

14.5 **Sections**

Minimum doors and windows shall be fabricated from extruded section of profile of detailed on drawings. The sections shall be extruded by the manufacturers approved by the Engineer-in-Charge. The aluminium extruded sections shall conform IS designation 63400-WP (HV9WP Old designation) with chemical Composition and technical properties as per IS 733 and IS : 1285. The permissible dimensional tolerance of the extruded sections shall be such as not to impair the proper and smooth function/ operation and appearance of doors and windows.

14.6 **Fabrication**

Doors, windows, etc. shall be fabricated to sizes as shown, at factory and shall be of section, sizes combinations and details as shown in the Architectural Drawings. All doors, windows etc. shall have mechanical joints. All members shall be accurately machined and fitted to form hairline joints prior to assembly. The joint and accessories such as cleats, brackets, etc. shall be of such materials as not to cause any bimetallic action. The fabrication of doors, windows, etc. shall be done in suitable sections to facilitate easy transportation, handling and installation. Adequate provision shall be made in the door and window members for anchoring to support and fixing of hardware and other fixtures as approved by the Engineer-in-Charge.

14.7 **Powder Coating**

All aluminium sections shall be powder coated 50 micron to required color as specified in the item and as per direction of Engineer-in-Charge. Polythene tape protection shall be applied on the powder coated section before they are brought to site. All care shall be taken to ensure surface protection during transportation, storage at site and installation. The tape protection shall be removed on installation. The samples will be tested in the approved laboratory and cost of samples, cost of testing, shall be borne by the contractor.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

14.8 **Protection of Finish**

All aluminium members shall be wrapped with approved self adhesive non-staining PVC tapes.

14.9 **Handling and stacking**

14.9.1 Fabricated materials shall be stacking in an approved manner to protect the material against any damage during transportation. The loading and unloading shall be carried out with utmost care, on receipt of materials at site, they shall be carefully examined to detect any damaged pieces. Arrangements shall be made for expeditious replacement of damaged piece/parts. Materials found to be acceptable on inspections shall be repacked in crates and stored safely.

14.9.2 In the case of Composite windows and doors, the different units are to be assembled first. The assembled Composite units should be checked for line, level and plumb before final fixing is done. Units may be serial numbered and identified as how to be assembled in their final location of situation so warrants.

14.9.3 Where aluminium comes into contact with masonry brickwork, concrete, planter or dissimilar metals, it shall be coated with approved insulation lacquer, paint or plastic tape to ensure that electro- chemical corrosion is avoided. Insulation material shall be trimmed off to a clean flush line on completion.

14.9.4 The contractor shall be responsible for assembling Composite, bedding and filling the groove with backup roads polysulphide sealant inside and outside, placing the doors, windows etc. in their respective opening. After the doors/windows have been fixed in their correct assigned position, the open hollow sections abutting masonry concrete shall be fitted with approved polysulphide sealant densely packed and neatly finished.

14.9.5 The contractor shall be responsible for doors, windows, etc. being set straight plumb, level and for their satisfactory operation after fixing is complete.

14.10 **Installation**

14.10.1 Just prior to installation the doors, windows etc. shall be uncreated and stacked on edge on level bearers and supported evenly. The frame shall be fixed into position true to line and level using adequate number of expansion machine bolts, anchor fasteners of approved size and manufacturer and in an approved manner. The holes in concrete/masonry members for housing anchor bolts shall be drilled with an electric drill.

14.10.2 The doors, windows assembled as shown on drawings shall be placed in correct final position in this opening and marks made on concrete members at jambs, sills and heads against the holes provided in

No. of Correction – C NIL
No. of Omissions – O NIL
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frames for anchoring. The frame shall then be removed from the opening and laid aside. Neat hole with parallel sides of appropriate size shall then be drilled in the concrete members with an electric drill at the marking to house the expansion bolts. The expansion bolts shall then be inserted in the holes, struck with a light hammer till the nuts is forced into the anchor shell. The frame shall then be placed in final position in the opening and anchored to the support through cadmium plated machine screws of required size threaded to expansion bolts. The frame shall be set in the opening by using wooden wedges at supported and bar plumbed in position. The wedges shall invariably be placed at meeting points of glazing bars and frames.

14.11 **Neoprene Gaskets**

The contractor shall provide and install Neoprene gaskets of approved size and profile at all locations as shown and as called for to render the doors, windows etc. absolutely air tight and weather tight. The contractors shall produce samples of the gaskets for approval and procure after approval only.

14.12 **Fittings**

Hinges, stays, handles, tower bolts, locks and other fittings shall be of excellent quality and manufacturers shall be approved by the Engineer-in-Charge.

14.13 **Manufacturer's Attendance**

The manufacturer immediately prior to the commencement of glazing shall adjust and set all windows and doors and accept responsibility for the satisfactory working of the opening frames.

14.14 **Mastic Cement**

The gaps between frames and supports and also any gaps in the windows section shall be raked out as directed and filled with mastic cement of approved colour and make to ensure complete water tightness. The mastic cement shall be of such colour and Composition that it would not stain the masonry/ concrete work, shall receive paint without bleeding, will not sag and shall not set hard or dry out under any conditions of weather. The samples of mastic cement to be used for this purpose shall be got approved by the Engineer-in-Charge before its actual use.

14.15 **Sealant**

Use modified silicone for joint subject to movement and in glazing.

Surfaces to receive sealant shall be properly prepared, cleaned, primed and excess sealant removed from finished surfaces.

Sealed joints shall be neatly tooled and surfaces smoothed.

No. of Correction – C NIL
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Follow the instruction of the sealant manufacturers.

Colour of the sealant shall be approved by the Engineer-in-Charge.

14.15.1 **Glazing**

Glazing shall generally be accomplished from the inside of building.

The glazing system shall be designed to this end use a continuous E.P.D.M compression gaskets on both sides (Present Gasket on one side of glazing pocket and roll in gasket on another side). A continuous wet seal shall be employed to ensure a complete water tightness.

Maintain a minimum glazing bite, edge clearance and surface clearance depending on the glass as recommended by the glass manufacturer.

14.15.2 **Sealant and Gasket Application**

Sealant and gasket shall be provided wherever shown in the drawings or required for a permanently weather tight installation. The sealing mechanism is necessary but is not indicated, it shall be of type recommended by the sub-contractor and approved by the Engineer-in-Charge.

All adjoining surfaces shall be protected to receive sealant against staining by masking and/ or other methods.

Joints and joint surfaces shall be clean, dry, and free of any material that may have an adverse effect on the bonding and/ or seal of the sealant and gasket materials.

Apply sealant and gasket under the conditions recommended by the manufacturer(s). Prime all surface to receive sealant and gasket unless recommended otherwise, use no sealant that has started to set in its container or a sealant that has exceeded the self life published by the manufacturer.

Fill all joints continuously and completely with sealant, forming a neat, uniform, concave bead. Finish the material flush with adjoining surfaces unless shown on the drawings. All sealant surfaces shall be tooled smooth.

Tensile or shear stress in structural silicone sealant joint shall not exceed 1.4 kg./sqm.

14.16 **Protection & Cleaning**

The contractor shall adequately protect all components and accessories from damage during shipments, storage at job site, erection and after completion of the work. At such time as may be directed, the sub contractor shall remove all protective tapes or coating, thoroughly clean all anodised aluminium and glass surfaces with suitable cleaning agent, make final adjustments to all ventilators, etc. and hardware leaving all in first class working order.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

14.17 Details of Tests

14.17.1 The various tests on aluminium sections shall be conducted in accordance with the relevant IS codes.

14.17.2 The minimum number of tests for powder coating and corrosion resistance shall be as given below:

S.No.	Details	No. of Tests
(i)	Doors, Windows & Ventilators	5% of Nos. manufactured.

14.17.3 The samples of major member of each unit of doors/ windows shall be selected at random by Engineer-in-Charge as such that all the aluminium section be got tested.

14.17.4 The cost of samples, carriage or the samples and testing charges, if any, shall be borne by the contractor.

14.18 Acceptance Criteria

The aluminium sections shall conform to the provisions of the relevant item of BOQ. For payment purposes only actual weight of sections shall be taken into account. If, however, the sectional weight of any aluminium section is higher than the permissible variation then the weight payable shall be restricted to the weight of the section including permissible variation.

Measurement: Payment by weight shall be made for aluminium sections including beading only and all fixing angles, fittings/ features such as handles and hinges etc. shall not be included in the weight to be paid.

14.18.1 **Guarantee Bond:-** All aluminium work shall carry two years guarantee after completion of the work against water leakage, unsound material and workmanship and defective anodising as per guarantee bond at annexure-III.

Two years guarantee in prescribed proforma attached at Annexure-III must be given by the specialised firm, which shall be counter signed by the contractor, in token of his overall responsibility in addition 10% (Ten percent) of the cost of these items would be retained as guarantee to which the performance of the work done. The cost guarantee against this item of work shall be in addition to the security deposit mentioned elsewhere in the contract form. If any defect is noticed during the guarantee period, it should be rectified by the contractor within seven days, and if not attended to the same will be got done from another agency at the risk and cost of the contractor. However, this security deposit can be released in full, if bank guarantee of equivalent amount for two years is produced and deposited with the department.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

14.19 Work shall be carried out as per CPWD Specifications- 2009 Vol.-I & Vol.-II with upto date correction slips.

14.20 **Rates**

14.20.1 The rate of the item shall include the cost of materials, T&P, Double Scaffolding and labour required in all the above operations.

15.0 **SANITARY INSTALLATIONS/ WATER SUPPLY/ DRAINAGE**

15.1 The work in general shall be carried out as per CPWD Specifications- 2009 Volume-I to II with upto date correction slips. Rate include all materials, labour and all the operations mentioned in the respective item unless and otherwise specifically mentioned.

15.2 The tendered rates shall include the cost of cutting holes in walls, floors, RCC slabs etc. wherever required and making good the same for which nothing extra shall be paid.

15.3 The CI/SCI/CPVC/PPR pipe wherever necessary shall be fixed to RCC columns, beams etc. with rawl plugs of approved quality and nothing extra shall be paid for on this account.

15.4 The contractor shall give a satisfactory performance test of the entire installation(s) before the work is finally accepted and nothing extra shall be payable to the contractor on this account.

15.5 P/S floor traps shall be of deep seal type of approved make, P/S traps shall have a minimum water seal of 75 mm while for floor traps shall have a minimum water seal of 50mm.

16.0 **Interlocking Paver Blocks**

16.1 The Interlocking Paver Blocks shall confirm to IS-15658.

16.2 Test shall be conducted to satisfy the quality of material for every 25,000 Paver Blocks (of Each grade) or part thereof:-

17. **TREMIX FLOORING**

17.1 The work in general shall be carried out as per the CPWD specifications for CC pavements. The work shall be got executed through specialized applicators having similar experience in executing tremix flooring using vacuum dewatering system. Before taking up the work, the Contractor shall, therefore, submit the credentials of the applicators along with the details of the similar works executed by them for the approval of Engineer-in-Charge.

17.2 The contractor or their applicators shall adequate machinery for laying and vibrating concrete including vacuum dewatering system etc.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- 17.3 The concrete shall be of specified grade ready mix cement concrete with specified cement content per cubic metre of concrete with slump 70 to 80 mm. The concrete shall not have air-entrainment more than 2%. The concrete shall be levelled to required slope using bull float. The excess water shall be removed using vacuum dewatering process. After the concrete has stiffened to the point of supporting floating operation the surface shall be power floated using IRONITE no. 3.
- 17.4 The flooring shall be done in panels of sizes not more than 20x4 metre. The construction joints shall, therefore, be formed with square edges using the steel formwork. Each panel shall then be divided into smaller panels of size not more than 3x2 metre by providing contraction joints by cutting grooves of size 3 mm x 20 mm deep using mechanical saw. The cutting of the grooves shall be done as soon as the concrete is set.
- 17.5 The top surface of the flooring shall be sprinkled with IRONITE no. 3 (non coloured) @ 3 kg. Per sqm. It shall be sprinkled when the concrete is green, before trowelling. Two-third quantity of the dryshake (metallic floor hardener) shall be sprinkled in the first pass and floated with power trowel and one third of the dry shakes shall be sprinkled in the 2nd pass and floated with power trowel to smooth finish. The first shake shall be allowed to remain unworked until it has absorbed moisture and then power floated. Similar operation shall be done for the 2nd shake. The surface then shall be textured to brush finish in a workman like manner with uniform grains generally in one direction.
- 17.6 The surface shall then be cured for minimum 10 days.
- 17.7 All precautions shall be taken to avoid any marks, impressions, scratches, stains etc. to the finished surface.
- 17.8 One test for wear resistance (abrasion test) as per IS 1237 shall be carried out on the sample (3 specimen) core cuts from the pavement. One core sample shall be tested for every 10,000 sqm or part thereof. The average wear shall not exceed 2mm and 2.5mm for individual specimen. Besides other tests for concrete shall be carried out as per the CPWD specifications. All arrangements for taking out core samples and other samples shall be made by the contractor. The core holes shall then be filled properly with the concrete of the same mix in a workman like manner and cured properly. Nothing extra shall be paid on this account.
- 17.9 The joints (expansion and contraction)/grooves then be filled with joints sealing compound conforming to grade B of IS 1834 or equivalent in workman like manner. It shall not be measured separately for payment.
- 17.10 The item includes cost of all inputs of material, labour, T&P, all accidental charges, wastages and testing etc involved in the work.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

- 18.1 **ACCOUSTICAL TREATMENT** –Acoustical treatment to ceiling and walls shall be carried out using very low, medium, and high frequency absorption materials as specified in the schedule of quantities .The work shall be carried out generally as per CPWD specifications 2009 vol I&II with upto dates correction slips with additional recommendations/ directions of specialist manufacturers.
- 18.2 The work of acoustical treatment shall be got executed through authorised applicator of approved manufacturer only.

19. **EXPANSION JOINT**

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 centering 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 locations in load application areas that accommodates multi directional seismic movement without stress to it's 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-centering arrangement that freely rotates / moves in all directions. The Self - centering arrangement shall exhibit circular sphere ends that lock and slide inside the corresponding aluminum 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 conform to ASTM 6063).

Floor Joint of 125 mm gap

Providing and fixing of expansion joint system of approved make and manufacture for various roof locations as per approved drawings and direction of Engineer-In-Charge. The joints shall be of extruded aluminum base members with, self aligning and self centering arrangement support plates as per ASTM B221-02. The system shall be such that it provides water tight roof to roof /roof to corner joint cover expansion control system that is capable of accommodating multidirectional seismic movement without stress to its components. System shall consist of metal profile that incorporates a universal aluminum base member designed to accommodate various project conditions and roof treatments. The cover plate shall be designed of width and thickness required to satisfy movement and loading requirements and secured to base members by utilizing manufacturer's pre-engineered self-centering arrangement that freely rotates / moves in all directions. The Self centering arrangement shall exhibit circular sphere ends that lock and slide

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

inside the corresponding aluminum extrusion cavity to allow freedom of movement and flexure in all directions including vertical displacement. The Joint System shall resist damage or deterioration from the impact of falling ice, exposure to UV, airborne contaminants and occasional foot traffic from maintenance personnel. Provision of Moisture Barrier membrane in the Joint System to have water tight joint is mandatory requirement. (Material shall confirm to ASTM 6063.)

Roof Joint of 125 mm gap

Application Procedure

Expansion joint shall be provided as shown in the drawing and as per direction of Engineer-in-Charge. All joints should be cleaned and free from loose aggregates, the edges should be in proper line. The joint should be of the appropriate width as per the drawings.

Provide continuous frame on each side of the joint, designed to support gasket and centre plate where required. After installing the frames at both sides, place the centre plate in between the two frames and finally flush the gasket on the top of the frames.

Fixing of the joint after proper assembly of the components should be through the proper stainless steel counter skunked screws, which should be drilled to the base concrete slab beams with a bonding agent.

Measurement

The measurement shall be taken in running meter correct to the two places of decimal. The rates shall include providing and fixing of complete Expansion Joint cover.

Rate

The rates for the item shall include the cost of all the material screws, nut bolts tools, and labour involved in all the operations described above including cartage, lifts and all taxes like GST, Octroi etc. as applicable.

20. ACRYLIC FIRE STOP SEALANT

Providing and applying acrylic firestop sealant, with minimum 2 hours fire rating when tested in accordance with UL 1479 standards, shall be used along the periphery of ducts & Metal pipes without insulation. The products shall be age tested as per standards. The products shall carry test certificate for mold resistance rating of 0 as determined by ASTM G21-96. and shall have a VOC content of approx. <1 g/l as per LEED 2009. The products shall be UL listed & classified and shall bear the UL approval logo on the packing. (considering 5 mm joint width & 13 mm thick depth of sealant)

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Typical Application

- i) Movement / Expansion Joint
- ii) Top of Wall Joint
- iii) Dry Wall Joint
- iv) Door Frame Joint
- v) Metal Pipe Penetration
- vi) Metal Conduit Penetration
- vii) HVAC Duct penetration

Measurement for payment

Payment for Acrylic Fire stop sealant shall be made on the basis of Running Metre with 5mm joint width and 13mm depth.

Rate

The rate shall include for all materials, labour charges, transportation, all taxes, lead, lift etc. complete for the Application and finished work.

21. INTUMESCENT FIRE STOP SEALANT

Providing and applying intumescent firestop sealant, with minimum 2 hours fire rating when tested in accordance with UL 1479 standards, shall be used along the periphery of plastic & PVC Pipes. The products shall be age tested as standards. The products shall carry test certificate for mold resistance rating of 0 as determined by ASTM G21-96. and shall have a VOC content of approx. <1 g/l as per LEED 2009. The products shall be UL listed & classified and shall bear the UL approval logo on the packing. (considering 5 mm annular gap and 50 mm thk sealant)

Typical Application

- i) Plastic pipe Penetration/PVC pipes
- ii) Insulated pipe Penetration
- iii) Cable Bundle Penetration

Measurement for payment

Payment for Intumescent Fire stop sealant shall be made on the basis of Running Metre with 5mm joint width and 50mm depth.

Rate

The rate shall include for all materials, labour charges, transportation, all taxes, lead, lift etc. complete for the Application and finished work.

22. EXPANDING FIRESTOP FOAM

Providing and Applying expanding firestop foam , with minimum 2 hours fire rating when tested in accordance with UL 1479 standards, shall be used to

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

seal areas around cables that are highly dense or are not accessible and cannot be sealed with fire stop mortar properly. The expanding foam shall expand minimum seven times its volume to fill the cavity at the time of dispensing the material and shall fully cure within two minutes after dispensing. The expanding foam shall also be repenetratable. The products shall be age tested as per standards. The products shall carry test certificate for mold resistance rating of 0 as determined by ASTM G21-96 and shall have a VOC content of approx. <1 g/l as per LEED 2009. The products shall be UL listed & classified and shall bear the UL approval logo on the packing. (Rates are considering 90% occupancy and 50 mm thickness of foam). Note: Only 10% of the shaft opening area shall be considered for the Payment.

Typical Application

- i) Multiple Penetration
- ii) Cables
- iii) Complex Penetration

Measurement for payment

Payment for Expanding firestop foam shall be made in square meter correct to two places of decimal. Only 10% of the shaft opening area shall be considered for the Payment.

Rate

The rate shall include for all materials, labour charges, transportation, all taxes, lead, lift etc. complete for the Application and finished work.

23. STAINLESS STEEL HARDWARES FOR DOOR/ WINDOW/ VENTILATORS.

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

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

Irrespective of the stipulations contained above, the contractor shall produce samples for all the fitting in advance and a written approval for the chosen sample shall be obtained from the Engineer -in- Charge. The decision of the Engineer -in- Charge in respect of the specification, quality and make of fitting to be used at site shall be final and binding on the contractor. 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

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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 by the Engineer-in-Charge 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 should clearly indicate the lot numbers of the supplied fittings.

24. MS FIRE CHECK DOOR OF 120 MINUTES FIRE RATING

Providing and fixing in position single / double, leaf fire check doors and frames at all levels of approved make, design, finish, tested and certified at CBRI, Roorkee etc. complete in all respect as per specifications and direction of Engineer-In-Charge and consisting of: -

Door frame shall be Single rebate Grooved profile of size 150 x 58 mm made out of 1.60mm (16gauge) minimum thick galvanized steel sheet confirming to IS 2260 & 4351 with grooved seal. Frames shall be Mitered and field assembled with self-tabs. All provision should be mortised, drilled and tapped for receiving appropriate hardware. Rubber door silencers should be provided on the striking jamb. 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 grouted with cement & sand slurry necessary for fire doors on the clear masonry opening.

Door leaf shall be 46mm thick fully flush double skin door with or without vision lite. Door leaf shall be manufactured from 1.2mm (18guage) 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 resin bonded honeycomb core with fire rated proprietary insulation filler bonded to both faces of sheet with lock seam joints at style edges. All doors shall be factory prepped for receiving appropriate hardware and provided with necessary reinforcement for hinges, locks, and door closers. The edges should be interlocked with a bending radius of 1.4mm. For pair of doors astragals has to be provided on the meeting stile for both active and inactive leaf. Vision lite wherever applicable should be provided as per manufacturers recommendation with a beading and screws from inside.

The door frames and door shutters shall be primed with 'H' primer and finished with PU/Powder coated. The shutter would be mounted with SS Ball

No. of Correction – C NIL
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Bearing Hinges of size 100mm x 75mm x 3.0mm of Becker Fire Solutions (4 Nos per leaf), appropriate openings for vision panel glass. Prototype Test certificate for a test carried out earlier at CBRI Roorkee for fire rating of doors, shall be attached along with manufacturers test certificate.

All door shall be factory made and rate to include installation, Fire rated hardware like hinges, panic bar, door closer, Vision Panel 300x 200, Glass, lock, handles, coordinator etc. as desired with necessary reinforcement and direction of Engineer in charge.

Scope:

This specification covers the design, supply of materials, Manufacture and installation of factory made metal fire doors of approved make and ISO 9001-2000 Certified Company and the manufacturer must be approved manufacturer of supply and fixing of CE/UL certified metal steel fire doors at all levels with all accessories and including supply and installation of hardware.

Applicable Codes and Standards:

All standards, specifications, acts, and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions.

List of certain important Indian Standards, Acts and Codes applicable to this work is given below. However, the applicable standards and codes shall be as per but not limited to the list given below:

IS: 277 Galvanised steel sheet (plain and corrugated) of GPL Grade with Z 120 Coating.

IS: 3614 Metallic and non-metallic fire check doors–Resistance test and Part-2 performance criteria.

Material: -

a) Door frame shall be Single Rebate Grooved profile of size 150 x 58 mm made out of 1.60mm (16gauge) minimum thick galvanized steel sheet confirming to IS 2260 & 4351 with grooved seal. Frames shall be Mitered and field assembled with self-tabs. All provision should be mortised, drilled and tapped for receiving appropriate hardware. Rubber door silencers should be provided on the striking jamb. 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 grouted with cement & sand slurry necessary for fire doors on the clear masonry opening.

b) Door leaf shall be 46mm thick fully flush double skin door with or without vision lite. Door leaf shall be manufactured from 1.2mm (18guage) minimum

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

thick galvanised steel sheet. The internal construction of the door should be rigid reinforcement pads for receiving appropriate hardware. The infill material shall be resin bonded honeycomb core with fire rated proprietary insulation filler bonded to both faces of sheet with lock seam joints at style edges. All doors shall be factory prepped for receiving appropriate hardware and provided with necessary reinforcement for hinges, locks, and door closers. The edges should be interlocked with a bending radius of 1.4mm. For pair of doors astragals has to be provided on the meeting stile for both active and inactive leaf. Vision lite wherever applicable should be provided as per manufacturer's recommendation with a beading and screws from inside.

c) The door frames and door shutters shall be primed with 'H' primer and finished with PU/Powder coated. The shutter would be mounted with SS Ball Bearing Hinges of size 100mm x 75mm x 3.0mm of Becker Fire Solutions (4Nos per leaf), appropriate openings for vision panel glass. Prototype Test certificate for a test carried out earlier at CBRI Roorkee for fire rating of doors, shall be attached along with manufacturers test certificate.

All door shall be factory made and rate to include installation, hardware's like hinges, panic bar, door closer, Vision Panel 300x 200, Glass, lock, handles, coordinator etc. as desired with necessary reinforcement and direction of Engineer in charge.

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

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.
Shop Drawings	:	Detailed plans and elevations, details of framing members, anchoring methods, clearances, hardware, and accessories clearly shown.
Manufacturer's Certificates	:	Certifying that products meet or exceed specified requirements.
Operation and Maintenance Data	:	Submit lubrication requirements and frequency, and periodic adjustments required.
Name of installer	:	Approved by the manufacturer, specializing in performing work of this section with minimum three years' experience.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Manufacturer's warranty	:	For all parts and components of the fire rated door set system except counterbalance spring and finish for 5 years
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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.

Installation: -

The Contractor 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 Contractor shall submit the details of manufacturers from the list of approved makes from which he intends to procure the doors. The contractor 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 Contractor 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 Contractor of his responsibility and obligation regarding adequacy, correctness, completeness, safety, strength, quality, workmanship,

Door closer confirming to CE & EN 1154 and B.S. – 476, Part-22, two hours' fire door.

Panic Exit Device – Single / Double leaf confirming to CE & EN 1154 and B.S. – 476, Part-22, two hours' fire rated.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Mortice Lock with lever handle confirming to CE & EN 122090 / DIN 18251 and B.S.- 476, Part-22, two hours' fire rated.

Stainless steel ball bearing hinges 4 nos. on each side of shutters size 100 mm x 100 mm x 3 mm with screws etc. complete.

Vision panel: 6 mm thick borosilicate toughened glass 120 min fire rated glass on each leaf of size 300 x 200 mm.

Testing: -

The fire doors shall be tested by CBRI/ International Test House or any Test Lab approved by the competent authority in accordance with BS 476 part 22. Galvanized steel to be used conforming to IS 277. Testing charges shall be paid by the department.

Mock- up: -

Before proceeding for mass production of all units, the contractor should 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 contractor should proceed for mass production only after approval of Mock-ups by Engineer-in-Charge or his authorized representative.

Measurement: -

Fire rated door set measurements shall be in square meter correct to two places of decimal. Length shall be measured to the nearest cm from wall face to wall face and height from finished floor level to finished soffit of door opening.

Rate: -

The rate shall include the cost of all materials, hardware's i.e. hinges, panic bar, door closer, lock, handles etc. & Vision Glass 300x200mm and labour involved in all the operations described above.

25. EXTRUDED POLYSTYRENE RIGID INSULATION

Material

Extruded Polystyrene boards to be manufactured from General Purpose polystyrene granules through an automated extrusion process free of CFC blowing agents: preferably with a blend of CO₂ & ethanol: low Global warming index: the boards are 100 % closed cell structure with a unique properties of high compressive strength & a stable thermal conductivity properties over the life cycle of building etc. The insulation boards complying with ISO 4898:2008 & ASTM C 578-08b/15b - type VI, having thermal conductivity of

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

0.0289 W/m K as per ASTM C 578 (measured as per IS 3346), compressive strength of > 350 kPa listed as per ASTM D 1621, density of 34-36 kg/m³ as per ASTM D 1622, water absorption < 1% by volume as per ASTM D 2842, oxygen index of 24.1 to 28.1 listed as per ASTM D 2863, cell size 0.4 mm of dia (max) as per ASTM D 3576. Fire retardant property as per DIN 4102, Part 1 of class B2 and as per ASTM E84 class A.

Approved system

The boards of size 600mm width x 1250 mm length & 75 mm thickness with square edge to be laid in brick patterns with the help of suitable bituminous vapour barrier & mechanical fasteners of appropriate length with fixtures like rock wool sleeves, Fire stop, foam filler at the perimeter joints & wherever any opening etc. are provided as per the instructions of Engineer in charge complete with all respects.

Finish

Board to be finished with Fibre glass mesh as per manufacturer specifications.

Thermal Performance

The extruded polystyrene insulation system improves the thermal efficiency of the building by reducing the U value as per the prescribed norms in the ECBC codes depending on the type of building in terms of hours of operations & geographical location. The thermal performance is very stable throughout the life cycle of the building. It improves the thermal comfort & also helps in optimizing the loads thereby reducing the capex & operating cost of HVAC systems.

Fire Performance

XPS boards must be fully tested in accordance with DIN 4102 Part 1 of class B2 and as per ASTM E84 class A, with regard to fire properties, Flame spread, & surface burning characteristics. Also, suitable Fire stops, sleeves, PU spray wherever there are electrical cut outs & opening. The boards must be of self-extinguishing characteristic etc.

Quality Assurance

The suspended ceiling system is to be manufactured within a recognized quality management system as per ISO 4898 & ASTM C 576 requirements. Each batch should also have the raw material GPPS test certificates.

Measurement: -

Length and breadth shall be measured correct to a centimetres.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Rate: -

The rate shall include the cost of all materials, Adhesive, fasteners and labour involved in all the fixing of the boards including transportation and taxes etc. complete.

26. STONE CLADDING WORK

Providing and fixing dry cladding upto 10 metre heights with 30mm thick gang saw cut stone with (machine cut edges) of uniform colour and size upto 1mx1m, fixed to structural steel frame work and/ or with the help of cramps, pins etc. and sealing the joints with approved weather sealant as per Architectural drawing and direction of Engineer-in-charge. (The steel frame work, stainless steel cramps and pins etc. shall be paid for separately).

The work shall be carried out as per CPWD specification 2009

Shop Drawings and Sequence of execution for cladding work shall be submitted by the contractor for approval of PWD. The work shall be executed after the approval of PWD.

27. VITRIFIED FLOOR TILE

Providing and laying Double Charged vitrified floor tiles (Polish / satin/ antiskid/ matt Finish) in different sizes (thickness to be specified by the manufacturer) with water absorption less than 0.08% and conforming to IS: 15622, of approved make, in all colours and shades, laid on 20mm thick cement mortar 1:4 (1 cement: 4 coarse sand), jointing with grey cement slurry @ 3.3kg/sqm including grouting the joints with white cement and matching pigments etc., complete.

Size of Tile 600x600 mm / 300x600 mm

Material:

The tiles shall be of approved make and generally confirm to standard as per specifications. They shall be flat, and true to shape and free from blisters, crazing, welts, crawling or other imperfection detracting from their appearance. The tiles shall be tested as per standard acceptance criteria mentioned.

The tiles shall be square of nominal size such as 600 x 600mm (± 5 mm) as directed and approved by the engineer-in-Charge. The thickness shall be minimum 9.8mm as specified.

The tiles shall be vitrified, homogenous throughout its body structure and surface shall be mirror finish as specified. The underside of the tiles shall not have any finish in order that the tiles may adhere properly to the base. The edges of the tiles shall be preferably free from shine or polish. However, any

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

finish, if unavoidable shall be permissible on only upto to 50 percent of the surface area of the edges.

Preparation of Surface and Laying:

Base concrete or the RCC slab on which the tiles are to be laid shall be cleaned, wetted and mopped. The bedding for the tiles shall be with cement mortar 1:4 (1 cement: 4 coarse sand) or as specified. The average thickness of bedding shall be 20mm. Mortar shall be spread, tamped and corrected to proper levels and allowed to harden sufficiently to offer a fairly rigid cushion for the tiles to be set and to enable the mason to place wooden plank across and squat on it.

Over this mortar bedding neat grey cement slurry of honey like consistency shall be spread at the rate of 3.3 kg of cement per square meter over such an area as would accommodate about 5-6 tiles. Tiles shall be soaked in water washed clean and shall be fixed in this grout one after another, each tile gently being tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints shall be kept as thin as possible and in straight lines or to suit the required pattern.

The surface of the flooring during laying shall be frequently checked with a straight edge about 2m long, so as to obtain a true surface with the required slope. Where full size tiles cannot be fixed, these shall be cut (sawn) to the required size, and their edge rubbed smooth to ensure straight and true joints. Tiles, which are fixed in the floor adjoining the wall, shall enter not less than 10mm under the plaster, skirting or dado. After tiles have been laid surplus cement slurry shall be cleaned off.

Pointing and Finishing

The joint shall be cleaned off the grey cement slurry with wire/coir brush or trowel and all dust and loose mortar removed. Joints shall then be grouted with epoxy grout of desired contrast colour (of any approved make). The floor shall then be kept wet for 7 days. After curing the surface shall be washed and finished clean. The finished floor shall not sound hollow when tapped.

Acceptance Criteria For Tiles: -

S. No.	Property	Standard Laid Down
1.	Deviation in Thickness	± 5.0%
2.	Straightness of side	± 0.5%
3.	Rectangularity	± 0.6%

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

4.	Surface Flatness	±0.5%
5.	Water absorption	<0.08%
6.	MOHS Hardness	6
7	Flexural Strength (minimum)	30 N/MM ²
8.	Abrasion Resistance	144 MM ³
9.	Skid Resistance	0.6
10.	Breaking Strength	1113 N
11.	Density (G/CC)	2
12.	Frost Resistance	Frost proof
13.	Chemical Resistance	No Damage
14.	Thermal Shock Resistance	No Damage
15.	Colour Resistance	No Damage
16.	Thermal Expansion	9 x 10 ⁻⁶

Measurement:

Length and breadth shall be measured correct to a centimetres before laying skirting, dado or wall plaster and the area calculated in square meter correct to two places of decimal. Where covers are used at the junctions, the length and breadth shall be measured between the lower edges of the covers.

No deduction in measurement shall be made for opening up to 0.20 sqm and nothing extra shall be allowed for forming such openings. For any opening exceeding 0.20 sqm in area, deduction in measurements for the full opening shall be made in such cases.

Rate :

The rate for flooring shall include the cost of all materials and labours involved in all the operations described above including cartage, lifts and all taxes like, Sales Tax/VAT, Excise duty, Octroi etc. as applicable. Nothing extra shall be paid for the use of cut (sawn) tiles in the work.

28. VITRIFIED WALL TILE (Dado/Skirting)

Providing and laying Double charge vitrified tiles (Polish Finish) in different size (thickness to be specified by manufacturer), with water absorption less than 0.08% and conforming to IS: 15622, of approved brand & manufacturer

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

in colours & shades in skirting, rises of steps and dados over 12mm thick bed of cement mortar 1:3 (1 cement : 3 coarse sand) and jointing with grey cement slurry @ 3.3 kg. per sqm. Including pointing with white cement mixed with pigment of matching shade complete.

Size of Tile 600x600 mm / 300x600 mm

Material:

The tiles shall be of approved make and generally conform to standard as per specifications. They shall be flat, and true to shape and free from blisters, crazing, welts, crawling or other imperfection detracting from their appearance.

The tiles shall be square of nominal size such as 600 x 600mm (\pm 5mm) as directed and approved by the Engineer-in-Charge. The thickness shall be minimum 9.8mm as specified.

The tiles shall be vitrified, homogenous throughout its body structure and surface shall be mirror finish as specified. The underside of the tiles shall not have any finish in order that the tiles may adhere properly to the base. The edges of the tiles shall be preferably free from shine or polish. However, any finish, if unavoidable shall be permissible on only upto to 50 percent of the surface area of the edges.

Preparation of Surface and Laying:

RCC column/ wall on which the tiles are to be laid shall be cleaned, wetted and mopped. The bedding for the tiles shall be with cement mortar 1:3 (1 cement: 3 coarse sand) or as specified. The average thickness of bedding plaster shall be 12mm thick plaster of cement mortar 1:3 shall be applied and allowed to harden. The plaster shall be roughened with wire brushes or by scratching diagonal at closed intervals.

Over this mortar plaster bedding neat grey cement slurry of honey like consistency shall be spread at the rate of 3.3 kg of cement per square meter at the back off tiles and set in the bedding mortar. The tiles shall be tamped and corrected to proper plane & lines. The tiles shall be set in a required pattern and jointed. The joints shall be as fine as possible. Top of skirting or dado shall be truly horizontal and joints truly vertical except where otherwise indicated. Odd size/ cut size of tile shall be adjusted at bottom to take care of slope of the flooring. Skirting and dado shall rest on the top of the flooring. Where full size tiles cannot be fixed, these shall be cut (sawn) to the required size & their edges rubbed smooth. Skirting/ dado shall not project from the finished "surface" or "wall" by more than the tile thickness, undulations if any shall be adjusted in wall.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Pointing and Finishing:

The joint shall be cleaned off the grey cement slurry with wire/coir brush or trowel and all dust and loose mortar removed. Joints shall then be grouted with epoxy grout of desired contrast colour (of any approved make). The wall shall then be kept wet for 7 days. After curing the surface shall be washed and finished clean. The finished wall shall not sound hollow when tapped.

Acceptance Criteria For Tiles :

S. No.	Property	Standard Laid Down
1.	Deviation in Thickness	± 5.0%
2.	Straightness of side	± 0.5%
3.	Rectangularity	± 0.6%
4.	Surface Flatness	±0.5%
5.	Water absorption	<0.08%
6.	MOHS Hardness	6
7.	Flexural Strength (minimum)	30 N/MM ²
8.	Abrasion Resistance	144 MM ³
9.	Skid Resistance	0.6
10.	Breaking Strength	1113 N
11.	Density (G/CC)	2
12.	Frost Resistance	Frost proof
13.	Chemical Resistance	No Damage
14.	Thermal Shock Resistance	No Damage
15.	Colour Resistance	No Damage
16.	Thermal Expansion	9 x 10 ⁻⁶

Measurement

Length shall be measured correct to a cm. Height shall be measured correct to a cm in the case of dado and 5mm in case of riser and skirting. The area shall be calculated in square metre, correct to two places of decimal. Length and height shall be measured along the finished face of the skirting or dado including curves where specials such as coves, internal and external angles and beads are used. Where cornices are used the area of dado shall be measured excluding the cornices. Nothing extra will be paid cutting (sawn) the tiles to sizes.

Rate

The rate for skirting/ dado shall include the cost of all materials and labours involved in all the operations described above including cartage, lifts and all taxes like, Sales Tax/VAT, Excise duty, Octroi etc. as applicable. Nothing extra shall be paid for the use of cut (sawn) tiles in the work.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

29. PVC VINYL FLOORING

Providing and laying of 3.8mm thick PVC Vinyl flooring with foam backing, vinyl floor covering of size 2 Mtrs. width x 25 Mtrs. length of weight 2975 g/m² with wear layer thickness of 0.65mm. Wear layer should be treated with Protocol (UV cured Polyurethane surface treatment) which facilitates ease of maintenance and eliminates the use of acrylic emulsions. The product should have antistatic properties (AS Class 1) and incorporates Sanosol (antibacterial and fungicidal treatment). The product should have excellent sound insulation with impact sound insulation of 19db and excellent shock absorbent behavior. The laid flooring shall confirm the fire rating Bfl-s1 class as per EN: 13501-1. The floor should have extreme durability (Group 'T') rating. The work shall be carried out as per manufacture specification confirms to US Green Building Council norms.

Installation:-

Installation should be made in accordance with installation guidelines supplied and regularly updated by the manufacturer Technical Department. Installation should be carried out in accordance with local standards. Subfloor to be smooth, hard, clean and dry prior to laying. Where applicable the subfloor must be moisture free. The material must be allowed to acclimatize 24 hours prior to installation in a room temperature of between 18-24°C. All seams must be heat welded using hot weld rod.

Maintenance:-

Maintenance should be carried out regularly to retain the appearance and durability of the floor. The floor covering should be maintained with regular sweeping and damp proofing using a neutral cleaner, or auto scrubber machine with an appropriate pad.

Rubber leaves indelible stains on vinyl flooring; do not use mats with rubber backing and replace tubular furniture feet with those made of PVC or polyamide. Place mats of sufficient length at entrances to reduce outside sources of dirt.

Measurement:

Measurements shall be taken in square meter correct to two places of decimal.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Rate:

The rate shall include the cost of providing material and complete installation materials required as per the manufacturer and cleaning of the installed floor for once as per the direction of the Engineer-in-charge.

30. SELF LEVELLING COMPOUND FOR VINYL FLOORING

Providing of Self Levelling Compound containing high quality synthetic resins, special cements and selected fillers, when mixed with water, a fluid easily towelled mortar with free flooring properties, it should be applied normally upto 2-3mm. Primer should be applied on the sub-floor to seal the pores, to prevent air bubbles from rising through the applied mortar to maintain flow life and also to promote excellent uniform adhesion to the substrate.

References:

ASTM C 109 : Compressive Strength of Hydraulic Mortars

ASTM C 191 : Setting time of Hydraulic Cement

ASTM C 1059 : Standard specification for latex agents for bonding fresh to hardened concrete.

Delivery, Storage and Handling:

- i) Store products in a dry area and should be protected from direct sunlight.
- ii) Handle products in accordance with manufacturer's recommendations.
- iii) Packed products shall be in original packaging, labelled with product information.

Execution:

As per Manufacturer Specifications.

Measurement:

Measurements shall be taken in square meter correct to two places of decimal.

Rate:

The rate shall include the cost of providing material and complete application required as per the manufacturer and cleaning of the floor for once as per the direction of the Engineer-in-charge.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

31. TEXTURE PAINT

(Work to be carried out as per Manufacturer Specification)

Providing and applying External Texture finish of approved makes as per approved design and pattern. Acrylic Texture finish shall be applied over the plastered surface with required thickness shall 2 to 2.5mm thickness to form the necessary approved design by using trowel / putty blade and it should be allowed for drying for minimum 12 hrs over a coat of alkali resistant primer, a coat or more of Latex based elastomeric fibre reinforced, waterproof coating shall be applied over this and a top 2-3 coats of ultra premium, high performance dual layer cross linking technology, dirt resistant, Anti fungal/Algae, Moisture resistant sun reflective paint over the texture, including surface preparation like through cleaning, prewetting & removal of loose mortars, etc. The quoted rate shall include the cost for all the above items including labours, tools & tackles, required scaffolding, platforms, etc. for all heights, all taxes, etc.

The contractor shall supply all materials, labour, tools. ladders. scaffolding and other equipment necessary for the completion and protection of all texture work as herein specified shall be applied to all surfaces requiring texturing throughout the exterior of the building as given in the schedule of finishes or elsewhere. The texturing shall be carried out by a specialist sub-contractor, approved by the Engineer-in-Charge. Care is to be taken that all surfaces to be textured are thoroughly cleaned and dry.

Storage:

Storage of materials to be used on the job shall be only in a single place approved by the Engineer-in-Charge. Such storage place, shall not be located within any of the buildings included in the contract.

The paint shall be continuously stirred in the container so that its consistency is kept uniform throughout

The painted surfaces shall present uniform appearance and semi-gloss finish free from streaks, blisters etc.

Application:

For new work, the surface shall be thoroughly cleaned off all mortar dropping, dirt dust, algae, fungus or moth, grease and other foreign matter of brushing and washing, pitting in plaster shall make good, surface imperfections such as cracks, holes etc. should be repaired using white cement. The prepared surface shall have received the approval of the Engineer -in- charge after inspection before painting is commenced.

Before pouring into smaller containers for use, the texture shall be stirred thoroughly in its container, when applying also the texture shall be

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

continuously stirred in the smaller containers so that its consistency is kept uniform. Dilution ratio of texture with potable water can be altered taking into consideration the nature of surface climate and as per recommended dilution given by manufacturer. In all cases, the manufacturer's instructions and directions of the Engineer-in-charge shall be followed meticulously. The lids of texture drums shall be kept tightly closed when not in use as by exposure to atmosphere the texture may thicken and also be kept safe from dust.

Measurement:

The length and breadth shall be measured correctly in sqm. correct to two places of decimal.

Rate:

The rate shall include the cost of all type of the materials, machinery and the manpower for all heights involved in all the operations described above. Any incidental additional requirements for execution of this item to the satisfaction of Engineer-in-Charge shall also be treated as included in the item and nothing extra will be paid for such extra work.

32. ROOF INSULATION

Providing and laying roof insulation with 50 mm thick impervious sprayed, closed cell free Rigid Polyurethane foam over deck insulation conforming to IS - 12432 Pt. III (density of foam being 40-45 kg/ cum), over a coat of polyurethane primer applied @ 6-8 sqm per litre, laying 400 G polythene sheet over PUF spray and providing a wearing course of 40 mm thick cement screed 1:2:4 (1 cement : 2 coarse sand : 4 stone aggregate 20 mm nominal size) in chequered rough finish, in panels of 2.5 m x 2.5 m and embedding with 24 G wire netting and sealing the joints with polymerized mastic, all complete as per direction of Engineer-in-Charge.

Reference Code: IS: 12432

General

Rigid Polyurethane foam is a generic; name given to polyurethane (PUR) or polyisocyanurate (PIR) rigid foam. These are high efficiency thermal insulation material suitable for use on surfaces operating within the temperature range of -180 to 110°C for PUR and -180 to 140°C for PIR. When applied by spray application processes, the service temperature range is restricted to -30 to +120°C for both the materials.

In all cases of overdeck insulation where there is a parapet wall or an up stand around the roof, effectiveness of junction between roof and vertical portion would be ensured by continuing the treatment to a vertical extension of 0.5m, Min around the roof perimeter. Such extra area is to be measured.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

For treatments on vertical areas of overdeck insulation, a multiplication factor of 1.2 shall be applied to the actual area to account for rebound losses over thickness.

To account for excess rebound losses in underdeck PUR/PIR Spray insitu application, measured area shall be subject to a multiplication factor of 1.4.

Spray treatment is applied as a continuous treatment and hence no deductions shall be made in measurements for cutouts having area of one square metre or less.

Application:

- 1) Manufacturer's application instructions should be followed at all times. Only qualified applicators with prior experience of spraying the specified foam system should be deployed. Prior to application of the spray foam, the contractor shall apply a test area on the surface to be insulated. This area shall be checked for:
 - a) Local surface roughness
 - b) General foam surface appearance; c) Specified foam thickness
 - c) Foam quality, such as striations, voids, uniform cells
 - d) Foam adhesion
- 2) The panel with the accepted/approved foam shall be treated as the standard for the subsequent implementation of the foaming work.
- 3) The foam shall be applied to roof substrate at a surface temperatures in the range of 15°C to 50°C in 12 mm thick (minimum) passes to reach the desired over all thickness with -3 to +10 mm tolerance. The substrate temperatures stated above may vary depending upon the foam system selected. In areas where obstacles do not permit normal spray techniques and the application tolerances specified above cannot be met, the contractor may apply the specified minimum thickness of foam required by a suitable method that he shall select. However, the completed application of foam shall be rendered monolithic with adjacent areas where normal spray application is applied. All foam over roofs of buildings or tanks shall be applied in such a manner as to provide easy drainage of water and prevent ponding.
- 4) Extreme caution shall be taken to prevent spraying in the presence of water/moisture (rain, fog, condensation) as well as when wind velocities are greater than 25 km/h. Shielded scaffolds may be used to allow spraying in high wind velocities with client's approval.
- 5) The equipment shall be operated with the temperature settings within the range specified by the foam manufacturer.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

- 6) Compressed air sources shall have moisture traps. Before spray application begins, all hoses and guns shall be solvent-flushed and inspected to ensure that no moisture is present.
- 7) All flames, sparks, welding and smoking shall be prohibited in the application area.
- 8) All affected items, in the surrounding area, shall be protected from over spray. Spray guns must be held near perpendicular to the surface being insulated and pressures adjusted so that over spray is minimized.
- 9) The applicator shall keep with him on the scaffolding or on the roof, or in both locations, sufficient buckets, plastic film, etc, to enable him to discharge any test foam without causing unwanted deposition on the application area.
- 10) Care is required when spraying on roof surfaces through which chimneys/ducts/pipes penetrate when their temperature exceeds the maximum service temperature limit of foam. An appropriate hot face insulating material 25 to 50 mm in thickness shall be installed prior to foam application in the area. approximately 600 mm x 600 mm on the surface surrounding all such hot chimney inlet or outlet lines, or any area where hot spots are likely.

Coating:

When foam is exposed to the weather/ultra-violet rays, or used in areas where water will accumulate, or in a corrosive atmosphere, a protective coating is necessary. Since coating performance is highly dependent on the applied film thickness, appropriate minimum film coatings should be ensured.

Coatings shall be polyurethane based for best compatibility with the sprayed foam and shall be applied within 24 h of completion of spraying application. Brush applied high solid build coatings of 0.5 mm to 1 mm, DFT (Typical) preferably single component moisture cure type are best suited to provide protection to the sprayed foam. Most of these coatings can be spray applied using airless guns as well.

Coatings which are suitable include chlorosulphonated polyethylene based solvent bearing products and high solid acrylic latex coatings. When non-urethane based coatings are used, there may be need for a primer. In each case, it must be ensured that:

- a) Coating is elastomeric
- b) Dry film thickness of coating is not less than 0.75 mm.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Measurement:

Measurements shall be taken in square meter correct to two places of decimal, Surface area of the insulation shall be measured for Payment.

Rate:

The rate shall include the cost of all materials and labour, tools & Plants involved in all the operations described above.

33. 60mm thick C&D Waste Factory made CC Interlocking Paver Block

Providing and laying 60mm thick factory made cement concrete interlocking paver block of M-30 grade made by block making machine with strong vibratory compaction, of approved size, design & shape, laid in required colour and pattern over and including 50mm thick compacted bed of coarse sand, filling the joints with line sand etc. all complete as per the direction of Engineer-in-charge.

Base:

Interlocking paver block to be fixed on the bed 50 mm or specified otherwise thick of coarse sand of approved specification and filling the joints with the sand of approved type and quality or as specified and as directed by Engineer-in-charge.

Material:

Factory made precast paver block of M-30 or otherwise specified grade to be used. Paver blocks to be of approved brand and manufacturer and of approved quality. Minimum strength as prescribed by manufacturer and as per direction of Engineer-in-Charge for the grade specified to be tested as per method mentioned in specification of subhead cement concrete of CPWD Specification 2009 Vol. I.

Measurement & Rates:

Area provided with paver block to be measured in sqm. correct upto two places of decimal. The rate include the cost of the material, labour, tools etc. required in all the operations described above.

34. HDPE pipes & Fittings

Providing and fixing HDPE (PE) Pipes (PE-80) 8kgf/cm² confirming to IS 4984 : 1995 complete with all fittings e.g. plain or door bends, junctions, cowl, offsets, access pieces etc. jointing with rubber rings and solvent cement including fixing the pipes on wall face with MS galvanized holder bat clamps or suspended below ceiling with MS galvanized hangers/supports

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

and fasteners all as approved by the engineer in charge including Cutting holes in walls, floors excavation, refilling and disposal of surplus earth wherever required and making good . The rates shall be inclusive of painting of all supports and clamps with a coat of red oxide primer and two or more coats of synthetic enamel paint of approved colour and Quality to give an even shade including surface preparation.

General:

High Density Polyethylene (HDPE) pipes/fittings shall be allowed for use as water, wastewater and reclaimed water pressure pipe where compatible with the specific conditions of the project. The use of material other than HDPE pipe may be required by ASPA if it is determined that HDPE pipe is unsuitable for the particular application. All material used in the production of water main piping shall be approved by the National Sanitation Foundation (NSF).

All HDPE pipe and fittings shall be from a single manufacturer, who is fully experienced, reputable and qualified in the manufacture of the HDPE pipe to be furnished. The pipe shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these Specifications.

Material :

i) **Material of pipe sizes 100 mm dia. and larger**

- a) Materials used for the manufacture of polyethylene pipe and fittings shall be made from a PE 3408 high density polyethylene resin compound meeting cell classification 345434C per ASTM D3350; and meeting Type III, Class C, Category 5, Grade P34 per ASTM D1238.
- b) High Density Polyethylene (HDPE) pipe shall comply with AWWA Specifications C906.
- c) Dimensions and workmanship shall be as specified by ASTM F714. HDPE fittings and transitions shall meet ASTM D3261. HDPE pipe shall have a minimum density of 0.955 grams per cubic centimeter. All HDPE pipe and fittings shall have a Hydrostatic Design Basis (HDB) of 1,600 psi.
- d) HDPE pipe and accessories 4-inch diameter and larger, shall be 160 psi at 73.4°F meeting the requirements of Standard Dimension Ratio (SDR) 17 as minimum strength.
- e) The pipe Manufacturer must certify compliance with the above requirements.

ii) **Material of pipe sizes 100 mm dia. and less.**

- a) Materials used for the manufacture of polyethylene pipe and fittings shall be made from a PE 3408 high density polyethylene resin compound meeting cell classification 345434C per ASTM D3350; and meeting Type III, Class C, Category 5, Grade P34 per ASTM D1238.
- b) Dimensions and workmanship shall be as specified by ASTM D3035. HDPE fittings and transitions shall meet ASTM D3261. HDPE pipe shall have a

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

minimum density of 0.955 grams per cubic centimeter. All HDPE pipe and fittings shall have a Hydrostatic Design Basis (HDB) of 1,600 psi.

- c) HDPE pipe and accessories 50 mm diameter and larger, shall be 160 psi at 73.4°F meeting the requirements of Standard Dimension Ratio (SDR) 9 as minimum strength.
- d) The pipe Manufacturer must certify compliance with the above requirements.

iii) **Fittings :**

- a) All molded fittings and fabricated fittings shall be fully pressure rated to match the pipe SDR pressure rating to which they are made. All fittings shall be molded or fabricated by the manufacturer. No Contractor fabricated fittings shall be used unless approved by the Engineer.
- b) The manufacturer of the HDPE pipe shall supply all HDPE fittings and accessories as well as any adapters and/or specials required to perform the work as shown on the Drawings and specified herein.
- c) All fittings shall be installed using butt-fused fittings, thermo-fused fittings/couplings, or flanged adapters and must be approved by the Engineer. No size on size wet taps shall be permitted.

iv) **Joining Method :**

- a) The pipe shall be joined with butt, heat fusion joints as outlined in ASTM D2657 and conform to the Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe, Technical Report TR-33/2005, published by the Plastic Pipe Institute (PPI). All joints shall be made in strict compliance with the manufacturer's recommendations.
- b) Lengths of pipe shall be assembled into suitable installation lengths by the butt fusion process. All pipes so joined shall be made from the same class and type of raw material made by the same raw material supplier. Pipe shall be furnished in standard laying lengths not to exceed 50 feet and no shorter than 20 feet.

v) **Installation :**

- a) High Density Polyethylene (HDPE) Pipe shall be installed in accordance with the instruction of the manufacturer, as shown on the Drawings and as specified herein. A factory qualified joining technician as designated by the pipe manufacturer shall perform all heat fusion joints.
- b) HDPE shall be installed either by Open Trench Construction or Directional Bore Method.
- c) Care shall be taken in loading, transporting and unloading to prevent damage to the pipe. Pipe or fitting shall not be dropped. All pipe or fitting shall be examined before installation, and no piece shall be installed which is found to be defective. Any damage to the pipe shall be repaired as directed by the Engineer. If any defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner by the contractor, at his own expense.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- d) Ropes, fabric or rubber protected slings and straps shall be used when handling pipes. Chains, cables or hooks inserted into the pipe ends shall not be used. Two slings spread apart shall be used for lifting each length of pipe.
- e) Pipes shall be stored on level ground, preferably turf or sand, free of sharp objects, which could damage the pipe. Stacking of the polyethylene pipe shall be limited to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated
- f) Temperature conditions. Where necessary due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitably and of such width as not to allow deformation of the pipe at the point of contact with the sleeper or between supports.
- g) Sections of pipe with cuts, scratches or gouges exceeding 5 percent of the pipe wall thickness shall be removed completely and the ends of the pipeline rejoined.
- h) All HDPE pipe must be at the temperature of the surrounding soil at the time of backfilling and compaction.
- i) If a defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional cost to the Owner. All pipe and fittings shall be thoroughly cleaned before installation, shall be kept clean until they are used in the work and when laid, shall conform to the lines and grades required. kinked or otherwise damaged.

vi) Cleaning:

At the conclusion of the work, thoroughly clean all of the new pipe lines to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period by forcing a cleaning swab through all mains 4" or greater. Flushing velocities shall be a minimum of 2.5 feet per second. All flushing shall be coordinated with ASPA Inspector and Water Resources Department. Debris cleaned from the lines shall be removed from the job site.

vii) Testing:

- a) Pressure testing shall be conducted per Manufacturer's recommendations and as approved by the ASPA Engineer.
- b) All HDPE water mains shall be disinfected prior to pressure testing as per ASPA specification.
- c) All HDPE mains shall be field-tested. Contractor shall supply all labor, equipment, material, gages, pumps, meters and incidentals required for testing. Each main shall be pressure tested upon completion of the pipe laying and backfilling operations, including placement of any required temporary roadway surfacing.
- d) All mains shall be tested at 150 percent of the operating design pressure of the pipe unless otherwise approved by the Engineer.
- e) Pressure testing procedure shall be per Manufacturer's recommendations or as follows:

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

- i. Fill line slowly with water. Maintain flow velocity less than 2 feet per second.
 - ii. Expel air completely from the line during filling and again before applying test pressure. Air shall be expelled by means of taps at points of highest elevation.
 - iii. Apply initial test pressure and allow to stand without makeup pressure for two to three hours, to allow for diametric expansion or pipe stretching to stabilize.
 - iv. After this equilibrium period, apply the specified test pressure and turn the pump off. The final test pressure shall be held for one to three hours.
 - v. Upon completion of the test, the pressure shall be bled off from a location other than the point where the pressure is monitored. The pressure drop shall be witnessed by the resident project representative and ASPA representative at the point where the pressure is being monitored and shall show on the recorded pressure read-out submitted to the Engineer for Record.
- f) Allowable amount of makeup water for expansion during the pressure test shall conform to Chart 6, Allowance for Expansion Under Test Pressure, Technical Report TR 31/9-79, published by the Plastic Pipe Institute (PPI). If there are no visual leaks or significant pressure drops during the final test period, the installed pipe passes the test.
 - g) If any test of pipe laid disclosed leakage significant pressure drop greater than the manufacturer's recommended loss, the Contractor shall, at his/her own expense, locate and repair the cause of leakage and retest the line. The amount of leakage, which will be permitted, shall be in accordance with AWWA C600 Standards.
 - h) All visible leaks are to be repaired regardless of the amount of leakage.
 - i) The Contractor must submit his plan for testing to the Engineer for review at least 10 days before starting the test and shall notify ASPA Inspector a minimum of 48 hours prior to test.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

LIST OF PREFERRED MAKES/ MANUFACTURERS FOR DIFFERENT MATERIALS - CIVIL WORKS

Acceptable makes of materials to be used in the work are as detailed below.

	DETAILS OF MATERIALS	MANUFACTURERS NAME
1.	RIENFORCEMENT STEEL (TMT FE - 500D)	TATA STEEL LTD, RINL,JINDAL STEEL AND SAIL.
2.	STRUCTURAL STEEL SECTIONS	TATA, JINDAL,RINL & SAIL
3.	CEMENT [ORDINARY PORTLAND CEMENT AND CEMENT (P.P.C) 43 GRADE)]	ACC, AMBUJA, JSW , CCI, SHREE CEMENT, JK CEMENT, ULTRA TECH
4.	PRECAST DRAIN COVER / KERB CHANNEL	KK, NITCO, HINDUSTAN TILES, DALAL
5.	READY MIXED CEMENT CONCRETE	ACC, ULTRA TECH, AFCON
6.	WHITE CEMENT	BIRLA WHITE , J.K WHITE, LAFARGE
7.	CC PAVERS	NITCO, UNISTONE, ULTRA TILES
8.	GRASS PAVER	UNISTONE , ULTRA TILES, NITCO
9.	VITRIFIED DOUBLE CHARGED (GLAZED / MAIT / ANTISKID) TILES	KAJARIA, JOHNSON, ORIENT BELL, AGL, ASIAN
10.	GLASS MOSAIC TILES	BISAZZA, ITALIA,
11.	GLAZED CERAMIC TILES	SOMANY, KAJARIA, JOHNSON, ORIENT BELL,AGL, ASIAN
12.	PVC VINYL FLOORING	UNITEX, ARMSTRONG, LG, RESPONSIVE, WONDER FLOOR
13.	SELF- LEVELING COMPUND	BASF , FOSROC, SIKA , RESPONSIVE, TIKI DAN
14.	SYNTHETIC ENAMEL PAINT	BERGER ,NEROLAC, ASIAN ,ICI, DULUX
15.	PLASTIC EMULSION PAINT	ASIAN, BERGER,NEROLAC,DULUX
16.	STEEL PRIMER	NEROLAC, BERGER, ASIAN PAINTS, DULUX, ICI
17.	EXTERIOR WATERPROOFING PAINT	ASIAN, BERGER, ,NEROLAC
18.	FLUSH DOOR SHUTTER	MERINO, CENTURI, DURO, GREENLAM, KITPLY
19.	PLY BOARDS, VENEERS	MERINO, GREENLAM, DURO, CENTURI, KITPLY
20.	LAMINATE	MERINO, GREENLAM , KITPLY AND CENTURI
21.	HYDRAULIC DOOR CLOSER, FLOOR SPRING, SENSORS, PATCH FITTINGS, MORTICE LATCH & LOCKS	HARDWYN, GODREJ, DORSET, AUTOINGRESS, HETTICH
22.	S.S HARDWARE AND FITTINGS	DORMA, OZONE, DORSET

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

23.	FRICTION STAY HINGES	KICH , EARL BEHARI, NULITE, DORSET, AUTOINGRESS
24.	WIRE MESH	STERLING ENTERPRISES, TRIMURTY WELDED MESH
25.	WOOD ADHESIVE	JIVANJOR, FEVICOL, 3M SIKA , THERMOSHIELD
26.	ADHESIVE TAPE	NORTON, 3M OR EQUIVALENT
27.	TILE ADHESIVE	ARDEX ENDURA , PIDLITE , STP Ltd., TIKIDAN, ASIAN PAINTS, FERROUS CRETE
28.	STONE ADHESIVE	FERROUSCRETE, FAVIMATE, ARDEX ENDURE, TIKIDAN, ASIAN PAINTS
29.	EPOXY GROUTING COMPOUND	ARDEX ENDURA , PIDLITE , TIKIDAN, FOSROC, ASIAN PAINTS, STP Ltd.
30.	EPOXY MORTAR	STP Ltd., SIKA, TIKIDAN, PIDILITE, ASIAN PAINTS, FOSROC
31.	NUTS, BOLTS & SCREWS	KUNDAN, BOUN OR EQUIVALENT
32.	ALUMINIUM SECTIONS FOR DOORS & WINDOWS ETC.	JINDAL, HINDALCO , BHORUKA, NALCO, CLASSIC CROWN, EVERLITE, JYOTI, SHAKTI
33.	SILICON SEALANT	GE , DOW CORNING , PIDLITE , FAIRMATE
34.	TEXTURE PAINT	ASIAN BURGER, DULUX, NEROLAC
35.	S.S STAIRCASE RAILING	JINDAL, DORMA, KICH HARDWYN
36.	GYPSUM BOARD/ PERFORATED GYPSUM BOARD/ TILES	INDIA GYPSUM, LAFARGE, BORAL, GYPTECH
37.	WALL PUTTY	JK, BIRLA WHITE, ASIAN PAINTS, FERROUS CRETE
38.	FLOOR HARDNER	PIDITOP, SUNANDA CHEMICALS, STP Ltd., FOSROC , SIKA FAIRMATE, TIKIDAN
39.	POLYSULPHIDE SEALANT	PIDILITE, STP Ltd., SUNANDA CHEMICALS , ASIAN PAINTS, TIKIDAN.
40.	POLYSULPHIDE SEALANT FOR PAVEMENTS	DR. FIXIT, PIDILITE , ASIAN PAINTS, TIKIDAN, SUNANDA CHEMICALS, STP Ltd.
41.	WATERP PROOFING COMPOUND, MEMBRANCE	DR, FIXI, CICO, STP Ltd., ASIAN PAINTS, TIKIDAN, SUNANDA CHEMICALS
42.	ADMIXTURES	DR. FIXIT , TIKIDAN, SUNANDA CHEMICALS, STP, ASIAN PAINTS
43.	ADMIXTURES & PLASTICIZER, OTHER CONSTRUCTION CHEMICALS	LATICRETE, STP Ltd., ARDEX ENDURA, TIKIDAN, ASIAN PAINTS
44.	VITREOUS CHINA SANITARYWARE	HINDWARE, JAQUAR, PARRYWARE
45.	SATINLESS STEEL SINK	NILKANTH, NIRALI, PARRYWARE, JAYNA

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

46.	C.P. BRASS FITTING	JAQUAR, GROHE, KHOLER, CERA, HINDWARE
47.	SOIL ,WASTE & VENT PIPES & FITTING (A) CENTRIFUGAL CASTIRON	RIF, NECO, SKF, HIF, BENGAL IRON CORPORATION (BIC)
48.	CENTRIFUGALLY CAST (SPUM) IRON PIPES (CLASS LA)	RIF, NECO, SKF, HIF, BENGAL IRON CORPORATION (BIC)
49.	HDPE PIPES	SUPREME, FINOLEX, ASTRAL, SFMC
50.	CPVC PIPES	ASTRAL, PRINCE, SFMC, FINOLEX, SUPREME
51.	G.I PIPES	TATA , JINDAL HISAR, SURYA, (AS PER CLASS SPECIFIED IN THE BOQ)
52.	G.I FITTINGS	UNIK, ZOLOTO, AVR
53.	UPVC PIPES	SUPREME, PRINCE, FINOLEX, SURYA, AKG
54.	GUNMETAL VALVES	LEADER, SANT, ZOLOTO
55.	BALL VALVES	ZOLOTO , IBP , ARCO, SANT
56.	BUTTERFLY VALVS	AUDCO, ZOLOTO, SANT
57.	C.I DOUBLE FLANGED SLUICE VALVES	KIRLOSKAR, IVC OR EQUIVALENT
58.	C.I DOUBLE FLANGED NON - RETURN VALVES	KIRLOSKAR, IVC OR EQUIVALENT
59.	MS PIPES	JINDAL , HISAR ,TATA, SURYA
60.	C.I MANHOLES COVERS	BIC, RIF, NECO, SKF, HIF, BENGAL IRON CORPORATION
61.	C.P. BATHROOM ACCESSORIES LIKE ROBE HOOK, TOWEL RING, TOWEL RAIL, SOAP DISH, TUMBLER HOLDER, TOILET PAPER HOLDER, TOWEL RACK ETC.	JAQUAR, KOHLER, HINDWARE, CERA
62.	SPREADER , WASTE COUPLING	GEM , ESS, CAMRY, JAQUAR, HINDWARE
63.	PVC WATER STORAGE TANKS	SINTEX , SHEETAL , POLYCON
64.	WATER METERS	CAPSTAN METERS INDIA LTD. , KRANTI or equivalent
65.	ROOF TILES (HEAT RESISTANCE)	THERMATEK , NITCO, NATIONAL
66.	MIRROR	ATUL, MODIGUARD, GOLDEN FISH, ASAHI (INDIA)
67.	FLOAT GLASS	MODI GLASS, SAINT GOBAIN GLASS, SCHOTT
68.	REFLECTIVE GLASS / 8T GLASS	SAINT GOBAIN, ASAHI (INDIA),. PILKINGTON.
69.	LOOKING GLASS / MIRROR	ATUL, MODI GUARD , GOLDEN FISH

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

70.	FIRE CHECK DOOR	ABACUS , PROMAT , SEHGAL & SEHGAL INDUSTRIES, NAVAIR, SUKRI, FIBER CRETE
71.	FIRE RESISTANT GLASS	SAINT GOBAIN, SCHOTT, MODI GUARD, PILKINGTON
72.	DOOR FITTINGS HARDWARE FOR FIRE CHECK DOORS DOOR CLOSER, PANIC BAR, PANIC TRIM, HINGES, MORTICE DEAD LOCK, DOOR COORDINATER	DORMA , INGERSOLL RAND, MARSHALL, BECKER, GODREJ
73.	PAINT AND PRIMER FOR FIRE CHECK DOOR	VIPER FRS 880 / FRS 881 , BURGER, NULLIFIRE, BECKER FIRE SOLUTION
74.	INTUMESCENT FIRE / SMOKESEAL	ASTRO FLAME , PROMAT , LORIENT
75.	CALCIUM SILICATE BOARD FOR FIRE DOOR	HILUX , PROMOTECH, DURO
76.	HIGH PERFORMANCE SOLAR TOUGHENED GLASS	SAINT GOBAIN, ASAHI, MODI GUARD
77.	G.R.G CEILING TILES FALSE CEILING	AEROLITE , ULTRALITE , CREDENCE, DIAMOND
78.	METAL CEILING	HUNTER DOUGLAS, ARMSTRONG, GRID SQUARE, CREDENCE
79.	ACOUSTIC WALL PANEL / CEILINGS	CREDENCE , ARMSTRONG, ANUTONE, GYPTECH
80.	PRECOATED GALVANIZED SHEET	LLOYDS, TATA, JINDAL
81.	AAC BLOCK	JK SMARTBLOX,BIL-TECH , AEROCON , MAGICRETE,
82.	AAC BLOCK ADHESIVE	ARDEX ENDURE(WHITE STAR), FERROUSCRETE(FERRO-1188) ,ULTRA TECH(FIXO BLOCK),
83.	PVC WATER STOPS	SIKA, PIDLITE, STP Ltd., FORSROC , TIKIDAN
84.	APP WATERPROFFING MEMBRANE	SIKA, PIDLITE , STP Ltd., TIKIDAN
85.	SHUTTRING PLY	ARCHID PLY , DURO, VIRGO, EURO, KITPLY
86.	REBARING CHEMICAL	HILTI, FISCHER, SUNANDA CHEMICALS
87.	FIRE SEALANT	HILTI, 3M, FISCHER , WURTH
88.	SS FASTENERS /ANCHORS/ CRAMPS	HILTI , FISCHER, EJOT, WURTH
89.	MECHANICAL EXPANSION JOINT	HERCULES, SANFIELD , KOHINOOR, Z-TECH
90.	UPVC WINDOWS AND FRAMES	FENESTA, ALUPLAST, REAHU, KOMMERLING

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

91.	GRC	SHREE GRC, UNISTONE, ERICRAFT, DALAL TILES
92.	ROLLER BLIND	DECK, VISTA , MAC
93.	POLY CARBONATE SHEET	LEXAN, MG POLYPLAST, PDM, POLYGEL, TUFLITE
94.	SENSOR BASED URINEL	JAQUAR, KEROVIT , HINDWARE
95.	FRAMELESS URINAL PARTITION	LLT, JAQUAR, GREENLAM STURDO
96.	SW GULLEY TRAP	PERFECT / ISI MARK
97.	GI CHAIN LINK FENCING	JAI DURGA HITECH, RAJAN WIRE, ACCURATE WIRE
98.	CONC HARDNER	FOSROC, SIKKA, PIDLITE, SUNANDA CHEMICALS, STP
99.	C & D WASTE	IL & FS and agencies approved by MCD
100.	PU FOAM	RP FOAM / MH POLYMERIS / FLEXIPOL, LLYOD INSULATION
101.	NP2 RCC PIPE	LAKSHMI, SOOD & SOOD , JAIN & CO / ISI MARKED
102.	SFRC MANHOLE COVERS	KK MANHOLES, INDO, BALAJI PIPES INDUSTRIES
103.	FOOT REST	KK MANHOLE , KGM
104.	ACP	AW DECOR , WONDER ALU BOARD, ALUSTAR
105.	PANIC BAR EXIST DEVICE	INGERSOLL RAND / MONARCH
106.	DASH FASTNERS AND STONE CLADDING CLAMP/CRAMP	HILTI , FISHER, CANON, BOSCH, TRIXEL (AXEL INDIA)
107.	RAISED / FALSE ACCESS FLOORING	UNIFLOOR , TATE, KINGSPAN
108.	FLYASH CEMENT BRICKS	KSP INDUSTRIES, PRAKASH INTERNATIONAL LTD, WUBRIC, PERFECT BRICKS
109.	GYPSUM PLASTER	FERROUS CRETE, ULTRA TECH, GYPROC (ELITE-90)
110.	FURNITURE	ONLY FROM REPUTED MANUFACTURER AS APPROVED BY ENGINEER-IN-CHARGE AND DTU AUTHORITIES

The Agency is required to get prior approval of Engineer-in-charge for the make of the material to be used in the work. In case of non-availability of material from these manufacturers, the Chief Engineer (Projects) may allow use of alternative BIS approved manufacturer makes.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

PART-C

ELECTRICAL WORKS

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

AE-I
(EPD-4)

EE
(EPD-4)

AE (P)
(CPM (Housing))

EE(P)
(CPM (Housing))

ELIGIBILITY CONDITION

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

AE-I
(EPD-4)

EE
(EPD-4)

AE (P)
(CPM (Housing))

EE(P)
(CPM (Housing))

ELIGIBILITY CRITERIA FOR MAIN AGENCY WITH RESPECT TO ASSOCIATED ELECTRICAL AGENCY TO BE ENGAGED BY MAIN CONTRACTOR FOR EXECUTING THE ELECTRICAL SUBHEADS

1. For the electrical work of Internal electric installation, external lighting and water supply pump sets the composite category contractor of appropriate class and category will only be eligible for doing the work. The eligible main contractor if not registered in CPWD composite category of appropriate class, can associate CPWD registered contractor of appropriate class and category for doing the work mentioned above. The sub-contractor should have valid electrical License.
2. For the E and M sub-heads of Sub-station , DG sets, Firefighting, fire alarm, lifts, HVAC, UPS, BMS, EPBAX, LAN networking, CCTV and Access control works, High mast lighting, Solar Water Heating Work, shall be executed by the main contractor through association of specialized agencies/firms duly approved by the Engineer-in-Charge for electrical component as per the eligibility criteria as below for the different sub-heads, by executing tripartite agreement between the main contractor, department and specialized agency.
3. The Composite category contractor shall also be eligible to carry out himself any or all of these specialized works mentioned in the NIT without associating any specialized agency provided:

- (a) He fulfills the prescribed eligibility criteria respectively for these work(s) in the NIT.

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.
4. Tender accepting Authority may approve change of Agency in case it is required during the currency of the contract.
5. Executive Engineer (E) shall be the Engineer-in-charge as far as electrical works are concerned.
6. The main contractor within 30 days after the award of work shall submit all the eligibility document of at least 2 sub-contractors as per the eligibility criteria mentioned against each sub head for the sub-contractors (at least 2 nos. for each sub-head including those in Para 1 above). Penalty of Rs 25000/- per day will be levied and recovered from the contractor for each day delay in submitting the name of the two sub-contractors on a case to case basis.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

7. The department will intimate the name of eligible sub-contractor to the main eligible contractor within 15 days after the **details have been submitted by the main contractor..**
8. The main firm should submit the willingness from eligible electrical contractors to get associated with them for execution of the electrical component of works in complete and wholesome manner. (Proforma for willingness certificate attached in Form-A)
9. The eligibility criteria for the E and M works under sub-head wise is as follows: -

a) ELIGIBILITY CRITERIA FOR INTERNAL EI, SUB-HEAD:-

The CPWD registered contractor of appropriate class and category.
The contractor should have valid electrical license.
Willingness certificate as per the Form-A.

b) PART - A - ELIGIBILITY CRITERIA -SUB-STATION AND EXTERNAL LIGHTING SUB-HEAD: -

The agency/firm should have satisfactorily completed similar works, as stated below, during the last 7 years Ending previous day of last date of submission of tenders.

- (i). Three similar works each work costing not less than Rs. 150.77 Lakhs with capacity of individual transformer in each work not less than 1280KVA.
(OR)
- (ii). Two similar works each work costing not less than Rs. 226.15 Lakhs with capacity of individual transformer in each work not less than 1280KVA.
(OR)
- (iii). One similar work costing not less than Rs. 301.53 Lakhs with capacity of individual transformer in each work not less than 1280KVA.

Similar works means **“Supply, installation, testing and commissioning of sub-station equipment’s with capacity of individual transformer should not be less than 1280 KVA.”**

The value of executed works shall be brought to current level by enhancing the actual value of work at simple rate of 7% per annum, calculated from the date of completion of work to the date of receipt of tender.

- (iv) Should have had average annual financial turnover of Rs. 188.46 Lakhs on works during the last three year ending 31st March 2018. (Copy of Certificate from CA is required)
- (v) Should not have incurred any loss in more than two years during the last five years ending 31st March 2018. (Copy of Certificate from CA is required)
- (vi) Should have a solvency of Rs. 150.77 Lakhs (Copy of the solvency certificate issued from the bank).

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- (vii) Should have Valid Electrical License.
- (viii) Notarized Affidavit that “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 tendering in CPWD in future forever. Also, if such a violation comes to the notice of Department before date of start of work, the Engineer-in-Charge shall be free to forfeit the entire amount of Earnest Money Deposit/Performance Guarantee”.
- (ix) Willingness certificate as per the Form-A.
- (x) Certificate of registration in the GST or proof for apply in the GST IN.

PART -B - ELIGIBILITY CRITETIA FOR - DG SET SUB-HEAD: -

The agency/firm should have satisfactorily completed similar works, as stated below, during the last 7 years Ending previous day of last date of submission of tenders.

- (i). Three similar works each work costing not less than Rs. 40.56 lakhs with capacity of DG set in each work not less than 400KVA.
(OR)
- (ii). Two similar works each work costing not less than Rs. 60.84 Lakhs with capacity of DG set in each work not less than 400KVA.
(OR)
- (iii). One similar work costing not less than Rs. 81.12 Lakhs with capacity of DG set in each work not less than 400KVA.

Similar works means **“Supply, installation, testing and commissioning of silent type DG set with capacity of individual DG set should not be less than 400 KVA.”**

The value of executed works shall be brought to current level by enhancing the actual value of work at simple rate of 7% per annum, calculated from the date of completion of work to the date of receipt of tender.

- (iv) Should have had average annual financial turnover of Rs. 50.70 lakhs on works during the last three year ending 31st March 2018. (Copy of Certificate from CA is required)
- (v) Should not have incurred any loss in more than two years during the last five years ending 31st March 2018. (Copy of Certificate from CA is required)
- (vi) Should have a solvency of Rs. 40.56 lakhs (Copy of the solvency certificate issued from the bank).
- (vii) Should have Valid Electrical License.
- (viii) Notarized Affidavit that “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 tendering in CPWD in future forever. Also, if such a violation comes to the notice of Department before

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

date of start of work, the Engineer-in-Charge shall be free to forfeit the entire amount of Earnest Money Deposit/Performance Guarantee”.

- (ix) Willingness certificate as per the Form-A.
- (x) Certificate of registration in the GST or proof for apply in the GST IN.

c) ELIGIBILITY CRITERIA FOR FIRE-FIGHTING SUB-HEAD: -

The agency/firm should have satisfactorily completed similar works, as stated below, during the last 7 years Ending previous day of last date of submission of tenders.

- (i). Three similar works each work costing not less than Rs. 106.54 Lakhs
(OR)
- (ii). Two similar works each work costing not less than Rs. 159.81 Lakhs
(OR)
- (iii). One similar work costing not less than Rs. 213.08 Lakhs

Similar works means **“Providing firefighting (wet riser) system.”**

The value of executed works shall be brought to current level by enhancing the actual value of work at simple rate of 7% per annum, calculated from the date of completion of work to the date of receipt of tender.

- (iv) Should have had average annual financial turnover of Rs. 133.18 Lakhs on works during the last three year ending 31st March 2018. (Copy of Certificate from CA is required)
- (v) Should not have incurred any loss in more than two years during the last five years ending 31st March 2018. (Copy of Certificate from CA is required)
- (vi) Should have a solvency of Rs. 106.54 Lakhs (Copy of the solvency certificate issued from the bank).
- (vii) Should have Valid Electrical License.
- (viii) Notarized Affidavit that “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 tendering in CPWD in future forever. Also, if such a violation comes to the notice of Department before date of start of work, the Engineer-in-Charge shall be free to forfeit the entire amount of Earnest Money Deposit/Performance Guarantee”.
- (ix) Willingness certificate as per the Form-A.
- (x) Certificate of registration in the GST or proof for apply in the GST IN.

d) ELIGIBILITY CRITERIA FOR FIRE ALARM & PA SYSTEM SUB-HEAD: -

The agency/firm should have satisfactorily completed similar works, as stated below, during the last 7 years Ending previous day of last date of submission of tenders.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- (i). Three similar works each work costing not less than Rs. 92.59 Lakhs
(OR)
- (ii). Two similar works each work costing not less than Rs. 138.89 Lakhs
(OR)
- (iii). One similar work costing not less than Rs. 185.18 Lakhs

Similar works means **“Providing addressable fire alarm system.”**

The value of executed works shall be brought to current level by enhancing the actual value of work at simple rate of 7% per annum, calculated from the date of completion of work to the date of receipt of tender.

- (iv) Should have had average annual financial turnover of Rs. 115.74 Lakhs on works during the last three year sending 31st March 2018. (Copy of Certificate from CA is required)
- (v) Should not have incurred any loss in more than two years during the last five years ending 31st March 2018 . (Copy of Certificate from CA is required)
- (vi) Should have a solvency of Rs. 92.59 Lakhs (Copy of the solvency certificate issued from the bank).
- (vii) Should have Valid Electrical License.
- (viii) Notarized Affidavit that “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 tendering in CPWD in future forever. Also, if such a violation comes to the notice of Department before date of start of work, the Engineer-in-Charge shall be free to forfeit the entire amount of Earnest Money Deposit/Performance Guarantee”.
- (ix) Willingness certificate as per the Form-A.
- (x) Certificate of registration in the GST or proof for apply in the GST IN.

e) ELIGIBILITY CRITERIA FOR LIFT SUB-HEAD: -

- (i) The agency/firm should be manufacturer of lift as per the acceptable make for lift.
- (ii) Certificate of registration in the GST or proof for apply in the GST IN.
- (iii) Willingness certificate as per the Form-A.

f) ELIGIBILITY CRITERIA FOR HVAC AND VENTILATION SUB-HEAD: -

The agency/firm should have satisfactorily completed similar works, as stated below, during the last 7 years Ending previous day of last date of submission of tenders.

- (i). Three similar works each work costing not less than Rs. 445.53 Lakhs with capacity of individual chiller in each work not less than 312TR.
(OR)
- (ii). Two similar works each work costing not less than Rs. 668.29 Lakhs with capacity of individual chiller in each work not less than 312TR.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

(OR)

- (iii). One similar work costing not less than Rs. 891.06 Lakhs with capacity of individual chiller in each work not less than 312TR.

Similar works means **“Supply, installation, testing and commissioning of water cooled centralized air-conditioning system with capacity of individual chiller should not be less than 312 TR.”**

The value of executed works shall be brought to current level by enhancing the actual value of work at simple rate of 7% per annum, calculated from the date of completion of work to the date of receipt of tender.

- (iv) Should have had average annual financial turnover of Rs. 555.91 Lakhs on works during the last three year ending 31st March 2018. (Copy of Certificate from CA is required)
- (v) Should not have incurred any loss in more than two years during the last five years ending 31st March 2018. (Copy of Certificate from CA is required)
- (vi) Should have a solvency of Rs. 445.53 Lakhs (Copy of the solvency certificate issued from the bank).
- (vii) Should have Valid Electrical License.
- (viii) Notarized Affidavit that “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 tendering in CPWD in future forever. Also, if such a violation comes to the notice of Department before date of start of work, the Engineer-in-Charge shall be free to forfeit the entire amount of Earnest Money Deposit/Performance Guarantee”.
- (ix) Willingness certificate as per the Form-A.
- (x) Certificate of registration in the GST or proof for apply in the GST IN.

g) ELIGIBILITY CRITERIA FOR UPS SYSTEM SUB-HEAD: -

The agency/firm should have satisfactorily completed similar works, as stated below, during the last 7 years Ending previous day of last date of submission of tenders.

- (i). Three similar works each work costing not less than Rs. 14.92 lakhs.
(OR)
- (ii). Two similar works each work costing not less than Rs. 22.38 lakhs.
(OR)
- (iii). One similar work costing not less than Rs. 29.84 lakhs.

Similar works means **“Supply, installation, testing and commissioning of UPS of capacity not less than 100 KVA.”**

The value of executed works shall be brought to current level by enhancing the actual value of work at simple rate of 7% per annum, calculated from the date of completion of work to the date of receipt of tender.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- (iv) Should have had average annual financial turnover of Rs. 18.65 lakhs on works during the last three year ending 31st March 2018. (Copy of Certificate from CA is required)
- (v) Should not have incurred any loss in more than two years during the last five years ending 31st March 2018. (Copy of Certificate from CA is required)
- (vi) Should have a solvency of Rs. 14.92 lakhs (Copy of the solvency certificate issued from the bank).
- (vii) Should have Valid Electrical License.
- (viii) Notarized Affidavit that "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 tendering in CPWD in future forever. Also, if such a violation comes to the notice of Department before date of start of work, the Engineer-in-Charge shall be free to forfeit the entire amount of Earnest Money Deposit/Performance Guarantee".
- (ix) Willingness certificate as per the Form-A.
- (x) Certificate of registration in the GST or proof for apply in the GST IN.

h) ELIGIBILITY CRITERIA FOR BMS WORK SUB-HEAD: -

The agency/firm should have satisfactorily completed similar works, as stated below, during the last 7 years Ending previous day of last date of submission of tenders.

- (i). Three similar works each work costing not less than Rs. 80.65 Lakhs.
(OR)
- (ii). Two similar works each work costing not less than Rs. 120.98 Lakhs.
(OR)
- (iii). One similar work costing not less than Rs. 161.31 Lakhs

Similar works means **"Supply, installation, testing and commissioning of BMS system."**

The value of executed works shall be brought to current level by enhancing the actual value of work at simple rate of 7% per annum, calculated from the date of completion of work to the date of receipt of tender.

- (iv) Should have had average annual financial turnover of Rs. 100.82 lakhs on works during the last three year ending 31st March 2018. (Copy of Certificate from CA is required)
- (v) Should not have incurred any loss in more than two years during the last five years ending 31st March 2018. (Copy of Certificate from CA is required)
- (vi) Should have a solvency of Rs. 80.65 lakhs (Copy of the solvency certificate issued from the bank).
- (vii) Should have Valid Electrical License or undertaking that any electrical work involve in the BMS work at site should be done by the contractor having the Valid Electrical License.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- (viii) Notarized Affidavit that “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 tendering in CPWD in future forever. Also, if such a violation comes to the notice of Department before date of start of work, the Engineer-in-Charge shall be free to forfeit the entire amount of Earnest Money Deposit/Performance Guarantee”.
- (ix) Willingness certificate as per the Form-A.
- (x) Certificate of registration in the GST or proof for apply in the GST IN.

i) ELIGIBILITY CRITERIA FOR LAN & EPBAX WORK SUB-HEAD: -

The agency/firm should have satisfactorily completed similar works, as stated below, during the last 7 years Ending previous day of last date of submission of tenders.

- (i). Three similar works each work costing not less than Rs. 232.62 Lakhs.
(OR)
- (ii). Two similar works each work costing not less than Rs. 348.93 Lakhs.
(OR)
- (iii). One similar work costing not less than Rs. 465.24 lakhs

Similar works means **“Supply, installation, testing and commissioning of LAN & EPBAX system.”**

The value of executed works shall be brought to current level by enhancing the actual value of work at simple rate of 7% per annum, calculated from the date of completion of work to the date of receipt of tender.

- (iv) Should have had average annual financial turnover of Rs. 290.78 lakhs on works during the last three year ending 31st March 2018. (Copy of Certificate from CA is required)
- (v) Should not have incurred any loss in more than two years during the last five years ending 31st March 2018. (Copy of Certificate from CA is required)
- (vi) Should have a solvency of Rs. 232.62 lakhs (Copy of the solvency certificate issued from the bank).
- (vii) Should have Valid Electrical License or undertaking that any electrical work involve in the LAN work at site should be done by the contractor having the Valid Electrical License.
- (viii) Notarized Affidavit that “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 tendering in CPWD in future forever. Also, if such a violation comes to the notice of Department before date of start of work, the Engineer-in-Charge shall be free to forfeit the entire amount of Earnest Money Deposit/Performance Guarantee”.
- (ix) Willingness certificate as per the Form-A.
- (x) Certificate of registration in the GST or proof for apply in the GST IN.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

j) ELIGIBILITY CRITERIA FOR CCTV AND ACCESS CONTROL WORK SUB-HEAD: -

The agency/firm should have satisfactorily completed similar works, as stated below, during the last 7 years Ending previous day of last date of submission of tenders.

- (i). Three similar works each work costing not less than Rs. 32.18 lakhs.
(OR)
- (ii). Two similar works each work costing not less than Rs. 48.27 lakhs.
(OR)
- (iii). One similar work costing not less than Rs. 64.36 lakhs.

Similar works means **“Supply, installation, testing and commissioning of CCTV and Access control system.”**

The value of executed works shall be brought to current level by enhancing the actual value of work at simple rate of 7% per annum, calculated from the date of completion of work to the date of receipt of tender.

- (iv) Should have had average annual financial turnover of Rs. 40.23 Lakhs on works during the last three year ending 31st March 2018. (Copy of Certificate from CA is required)
- (v) Should not have incurred any loss in more than two years during the last five years ending 31st March 2018. (Copy of Certificate from CA is required)
- (vi) Should have a solvency of Rs. 32.18 lakhs (Copy of the solvency certificate issued from the bank).
- (vii) Should have Valid Electrical License or undertaking that any electrical work involve in the CCTV work at site should be done by the contractor having the Valid Electrical License.
- (viii) Notarized Affidavit that “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 tendering in CPWD in future forever. Also, if such a violation comes to the notice of Department before date of start of work, the Engineer-in-Charge shall be free to forfeit the entire amount of Earnest Money Deposit/Performance Guarantee”.
- (ix) Willingness certificate as per the Form-A.
- (x) Certificate of registration in the GST or proof for apply in the GST IN.

k) ELIGIBILITY CRITERIA FOR SOLAR WATER HEATING SYSTEM WORK SUB-HEAD: -

The agency/firm should have satisfactorily completed similar works, as stated below, during the last 7 years Ending previous day of last date of submission of tenders.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- (i). Three similar works each work costing not less than Rs. 14.60 lakhs.
(OR)
- (ii). Two similar works each work costing not less than Rs. 21.91 lakhs.
(OR)
- (iii). One similar work costing not less than Rs. 29.21 lakhs.

Similar works means **“Supply, installation, testing and commissioning of Solar water heating System.”**

The value of executed works shall be brought to current level by enhancing the actual value of work at simple rate of 7% per annum, calculated from the date of completion of work to the date of receipt of tender.

- (iv) Should have had average annual financial turnover of Rs. 18.26 lakhs on works during the last three year ending 31st March 2018. (Copy of Certificate from CA is required)
- (v) Should not have incurred any loss in more than two years during the last five years ending 31st March 2018. (Copy of Certificate from CA is required)
- (vi) Should have a solvency of Rs. 14.60 lakhs (Copy of the solvency certificate issued from the bank).
- (vii) Should have Valid Electrical License or undertaking that any electrical work involve in this work at site shall be done by the contractor having the Valid Electrical License.
- (viii) Notarized Affidavit that “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 tendering in CPWD in future forever. Also, if such a violation comes to the notice of Department before date of start of work, the Engineer-in-Charge shall be free to forfeit the entire amount of Earnest Money Deposit/Performance Guarantee”.
- (ix) Willingness certificate as per the Form-A.
- (x) Certificate of registration in the GST or proof for apply in the GST IN.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

LIST OF DOCUMENTS TO BE SCANNED AND UPLOADED WITH IN THE PERIOD OF BID SUBMISSION

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

AE-I
(EPD-4)

EE
(EPD-4)

AE (P)
(CPM (Housing))

EE(P)
(CPM (Housing))

List of Documents to be submitted by the main contractor within 30 days after the award of work:

1. Copy of certificate of registration in CPWD of appropriate class and category as per eligibility criteria mentioned above for different sub-head.
2. Valid Electrical License as per the eligibility criteria mentioned above for different sub-head.
3. Certificates of Work Experience issued by an officer of rank not below Executive Engineer as per the eligibility criteria mentioned above for different sub-head. (As per the Form D).
4. Certificate of Financial Turnover and profit loss statement from CA as per the eligibility criteria mentioned above for different sub-head. (As per the Form B)
5. Valid Bank Solvency Certificate not more than three month old from the date of submission of tender as per the eligibility criteria mentioned above for different sub-head. (As per the Form C).
6. Willingness certificate from the Sub contractor. (As per the Form-A)
7. Notarized Affidavit that “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 tendering in CPWD in future forever. Also, if such a violation comes to the notice of Department before date of start of work, the Engineer-in-Charge shall be free to forfeit the entire amount of Earnest Money Deposit/Performance Guarantee” as per the eligibility criteria mentioned above for different sub-head.
8. Certificate of registration in the GST or proof for apply in the GST IN as per the eligibility criteria mentioned above for different sub-head.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

FORM-A

WILLINGNESS

CERTIFICATE

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

AE-I
(EPD-4)

EE
(EPD-4)

AE (P)
(CPM (Housing))

EE(P)
(CPM (Housing))

FORM – ‘A’**WILLINGNESS CERTIFICATE FROM CONCERNED COMPETENT ELECTRICAL CONTRACTOR****(Separate for each sub head of E&M work)**

Name of work : Construction of Stage-I of Phase-II, Delhi Technological University at Bawana Road, Delhi. (SH: C/o Academic block AB-3, AB-4, Boys Hostel H-5, Girls Hostel HG-5 & HG-6 including External Development works, Internal Electrical Installation, External Lighting, lifts, central air conditioning , fire fighting system, fire alarm with PA System, D.G. Sets, Electric Sub-Station & allied works, HVAC works).

I hereby give my willingness to work as electrical contractor for the above-mentioned work, for the E and M Sub-head.....(Mentioned the Sub-Head for Which apply for Sub-contractor)

I will execute the work as per specifications and conditions for the agreement and as per direction of the Engineer-in-charge. Also, I will employ full time technically qualified supervisor for the works.

I will attend inspection of officers of the department as and when required.

Dated:

Signature of Main Contractor

Signature of Associate Electrical

Contractor

Date:

Date:

Place:

Place:

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

AE-I
(EPD-4)

EE
(EPD-4)

AE (P)
(CPM (Housing))

EE(P)
(CPM (Housing))

FORM-B FINANCIAL INFORMATION**FORM 'B'****FINANCIAL INFORMATION**

(To be submitted separately for each sub-head as required)

Financial Analysis Details to be furnished duly supported by figures in balance sheet / profit & Loss account for the last five years duly certified by the Chartered Accountant as submitted by the applicant to the Income Tax Department or equivalent Competent Authority (Copies to be attached)

S. No	Particulars	2017-18	2016-17	2015-16	2014-15	2013-14
(i)	Gross Annual turnover					
(ii)	Profit / Loss					

following certificates shall be enclosed:

- A. Solvency Certificate from Bankers of applicant in the prescribed form 'C'.
- B. Copy of Annual Turn Over for last 5 years certified by Chartered Accountant.

Signature of Chartered Accountant with Seal Signature of Applicant(S)

1. Balance Sheet / Audit report is not required to be submitted.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

FORM-C BANKERS CERTIFICATE FOR SOLVENCY**FORM 'C'****FORM OF BANKERS CERTIFICATE FROM A SCHCAPFIMSLE
BANK****(To be submitted separately for each sub-head as required)**

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

(Rupees.....
)

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

(Signature)**For the Bank**

NOTE:-

(1) Bankers Certificate should be on letter head of the Bank and
 addressed to tendering authority.

(2) In case of partnership firm, Certificates should include names of all
 partners as recorded with the Bank.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

FORM-D PROFORMA FOR COMPLETION CERTIFICATE**FORM 'D'**

**Proforma of Completion/Performance Certificate for the Work
issues in the letter head of the organization not below the rank of
Executive Engineer**

- (1) Name of Work/Project Location:
- (2) Name and address of the agency:
- (3) Agreement Number:
- (4) Tendered cost:
- (5) Work done amount:
- (6) Date of start:
- (7) Stipulated date of completion:
- (8) Actual date of completion:
- (9) Amount of compensation Levied for delayed completion if Any:
- (10) Amount of reduced rate items if Any:
- (11) Brief scope of work as per the schedule of work in the agreement:
- (12) Performance Report:
- (13) Quality of Work:
- (14) Financial Soundness:
- (15) Technical Proficiency:
- (16) Resourcefulness:
- (17) General Behaviors:
- (18) Details of arbitration/court cases if any including amount Awarded
and present position:
- (19) Details of Personal and establishment used for the work:
- (20) Details of T & P used for the work:

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

GENERAL TERMS AND CONDITION FOR ELECTRICAL AND MECHANICAL WORK

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

General Terms and Condition for Electrical Works

- 1.1. The work shall be generally carried out in accordance with tender specifications and the following specification rules, unless otherwise specified the latest amended edition of all such codes/specification/manuals on the last date of submission of the tender would be applicable.
 - a) CPWD General Specifications for Electrical Works Part I Internal – 2013 as amended up to date.
 - b) CPWD general specification for electrical work part II External 1994 as amended up to date.
 - c) General Specifications for Electrical Works (Part-III-LITS & Escalators) – 2003 as amended up to date.
 - d) CPWD general specification for electrical work part IV Sub-Station 2013 as amended up to date.
 - e) CPWD General Specifications for Electrical Works Part VII D.G. Sets - 2013 as amended up to date.
 - f) General Specifications for Heating, Ventilation & Air-Conditioning(HVAC) – 2017 as amended up to date.
 - g) Indian Electricity Act 2003 amended up to date.
 - h) National Electrical Code 2008 and NFPA (National Fire Protection Association) 70.
 - i) Indian Electricity Rule 1956 amended up to date.
 - j) National Building Code 2016
 - k) BIS codes as applicable.
 - l) Other standards and codes as applicable in the electrical and mechanical works.
- 1.2. All materials required to be used on works shall be got approved from the Engineer-in-charge well in advance.
- 1.3. All the equipments used in this project shall BMS compatible as per the IO summary attached in the BMS specification. All the cards etc required for the BMS compatibility should be incorporated in the equipments for this nothing extra will be paid by the department.
- 1.4. Earthing, cement concrete works and testing of the installation shall be done in presence of the Engineer -in-charge or his authorized representative.
- 1.5. On completion of work the contractor shall test the installation and produce test certificate in accordance with the CPWD specification failing which a penalty @ 2.5% of Tendered cost of the sub-head shall be recovered from the dues paid to the contractor.
- 1.6. Water and electricity shall be arranged by contractor for installation at site of work. However, the Department shall provide electricity and water for the final testing, commissioning of the installation.

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

- 1.7. All debris at site shall have to be removed by the contractor before handing over the installation to the department.
- 1.8. Cement required for the work shall have to be procured by the Contractor himself. Electrical Contractor will make recess in brick work by cutting chases for provision of conduits and metal boxes according to the elevational drawings for electrical services. Electrical contractor will fix the conduits and boxes and there after close the chases up to the surface of masonry work in cement mortar 1:4 (1 cement :4 sand). Thereafter surface of chases shall be plastered and finished by the contractor to ensure smooth and even surface. Nothing extra shall be paid to the contractor for above operations irrespective of whether the chases are carried out before or after plastering of the wall.
- 1.9. The successful tenderer shall make his own arrangement for storage and watch and ward of materials whether the same brought by him or supplied by the department. He shall remain responsible for watch and ward of installation and other fittings till these are taken over by the department.
- 1.10. Contractor is strongly advised to visit the site of work to have an idea for the execution of work, failure to do so will not absolve him of responsibility to do the work as specified in agreement.
- 1.11. Any damage made to wall ceiling etc. of the building made by the contractor shall have to be made good up to the original finish as per requirement within the tendered amount. Nothing extra will be paid on this account.
- 1.12. **Rates:**
The work shall be treated as on works contract basis and the rates tendered shall be for complete items of work (except the materials, if any, stipulated for supply by the department) inclusive of all taxes (including works contract tax, if any), duties, and levies etc. and all charges for items contingent to the work, such as, packing, forwarding, insurance, freight and delivery at site for the materials to be supplied by the contractor, watch and ward of all materials (including those, if any, supplied by the department) for the work at site etc.
Prices quoted shall be firm. Price adjustments shall however be governed by Clause 10CC of the Conditions of Contract given in form CPWD 7 or 8 of the tender documents, for works executed under these forms. All relevant documents shall be produced by the contractor to the Engineer-in-charge, whenever called upon by him to do so, for working out such adjustments in rates.
- 1.13. **Taxes and Duties:**

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Rates are inclusive of all taxes and duties nothing extra will be paid in this regard. The change of taxation and introduction of new tax after the date of submission of tender will be governed as per the General Condition of Contract 2016.

No tax exemption certificate issued by the department.

The Goods and Service tax shall be deducted from the bills of the contractor as per the statutory orders issued by the Government time to time.

1.14. Mobilization Advance:

No mobilization advance shall be paid for the work, unless otherwise stipulated in tender papers for any individual works/ composite work.

1.15. Completeness of Tender:

All sundry fittings, assemblies, accessories, hardware items, foundation bolts, termination lugs for electrical connections as required, and all other sundry items which are useful and necessary for proper assembly and efficient working of the various components of the work shall be deemed to have been included in the tender, whether such items are specifically mentioned in the tender documents or not.

1.16. Works to be Arranged by the Department

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

- (i) Water and Electricity supply for the Final testing and commissioning of the E and M equipments.
- (ii) Storage space for all equipments, components and materials for the work.

1.17. Works to be done by the contractor:

Unless and otherwise mentioned in the tender documents, the following works shall be done by the contractor, and therefore their cost shall be deemed to be included in their tendered cost: -

- (i) Foundations for equipment's and components where required, including foundations bolts.
- (ii) Cutting and making good all damages caused during installation and restoring the same to their original finish.
- (iii) Sealing of all floor openings provided by him for pipes and cables, from fire safety point of view, after laying of the same.
- (iv) Painting at site of all exposed metal surfaces of the installation other than pre-Painted, items like fittings, fans, switchgear / distribution gear items, cubicle switch board etc. Damages to finished surfaces of these items while handling and erection, shall however be rectified to the satisfaction of the Engineer-in-Charge.
- (v) Testing and commissioning of completed installation.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- (vi) All the Electrical works to be done after the approval of the shop drawings by the Engineer-in-Charge. The shop drawing will be submitted by the contractor well in advance for the approval. These shop drawing are prepared on the basis of the working drawing issued by the Engineer-in-Charge time to time as per the progress of work. Penalty of Rs 25000/- per day will be levied and recovered from the contractor for each days delays in submitting the same over the time period as specified by the Engineer-in-Charge.
- (vii) The contractor will be responsible for getting all the approval from the local body and other statutory authority as applicable for the electrical work. The statutory fees payment will be borne by the department.

1.18. Storage and Custody of Materials:

The contractor has to make his own arrangement for the storage of the material at site & necessary watch and ward of the electrical installation during the execution of work till the same is handed over to the department. No extra payment will be made on this account. The storage space shall however be arranged by the department at site, if available.

The contractor shall arrange for proper storage of the electrical fans and fittings at site and that double lock system shall be arranged for the fans and fittings after receipt at site until the time they are taken for installation. The contractor shall however be responsible for proper storage and safe custody of the same till their installation and handing over to the department.

1.19. Electric Power Supply and Water Supply:

Power and water supply will be arranged by the contractor at the site for installation purpose. However, for final testing purpose after complete installation of the electrical items, electricity supply will be made available free of cost to the contractor. Contractor will take due care to ensure safety of electrical installation during execution of work.

1.20. Tools for handling and Erecting:

All tools and tackles required for handling of equipment's and materials at site of work as well as for their assembly and erection and also necessary test instruments shall be the responsibility of the contractor.

1.21. Payment Terms:

Payment shall be made as per the payment condition mentioned below:-

S. No.	Stage of Work	Percentage of Rate
1.	Supply of Panels, feeder pillars, DB's, Transformers, HT panel, rising main, DG	80%

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

	sets, CCTV cameras, EPBAX exchange, lifts, pumps, fire alarm panel, detectors, workstation, chillers, cooling tower, AHU, ventilation fans, pressurization fans, server for LAN, items of BMS system, water treatment plant, RO plant, Solar water heating plant etc	
2.	Supply for rest of the items except wires and modular switch socket and accessories	70%
2.	Installation of the items mentioned in the Sr. No. 1	10%
3.	Installation of other items	20%
4.	Testing, commissioning, NOC from the statutory authority as applicable and handed over to the department.	10%

NOTE:- Secured advanced payment will be applicable for the payment against the supply of Conduits, Wires and Modular switch socket and other modular accessories.

1.22. Co-ordination with other agencies:

The contractor shall co-ordinate with all other agencies involved in the building work so that the building work is not hampered due to delay in his work. Recessed conduit and other works, which directly affect the progress of building work, should be given priority.

1.23. Care of buildings:

Care shall be taken by the contractor to avoid damage to the building during execution of his part of the work. He shall be responsible for repairing all damages and restoring the same to their original finish at his cost. He shall also remove, at his costs, all unwanted and waste materials arising out of his work, from the site.

1.24. Structural Alterations to Buildings:

- (i) No structural member in the building shall be damaged/alterd, without prior approval from the competent authority through the Engineer-in-charge.
- (ii) Structural provisions like openings, cutouts, if any, provided by the department for the work, shall be used. Where these required modifications, or fresh provisions are required to be made, such contingent works shall be carried out by the contract at his cost.
- (iii) All such openings in floors provided by the department shall be closed by the contractor after installing the cables/conduits/rising

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

mains/ducts/pipes etc. as the case may be, by any suitable means as approved by the Engineer-in-charge without any extra payment.

- (iv) All chases required in connection with the electrical works shall be provided and filled by the contractor at his own cost to the original architectural finish of the buildings.

1.25. Addition to an installation:

Any addition, temporary or permanent, to the existing electrical installation shall not be made without a properly worked out scheme/design by a qualified Electrical Engineer to ensure that such addition does not lead to overloading, safety violation of the existing system.

1.26. Work in occupied buildings:

- (i) When work is executed in occupied buildings, there would be minimum of inconvenience to the occupants. The work shall be programmed in consultation with the Engineer-in-charge and the occupying department. If so required, the work may have to be done even before and after the office hours.
- (ii) The contractor shall be responsible to abide by the regulations or restrictions set in regard to entry into, and movement within the premises.
- (iii) The contractor shall not tamper with any of the existing installations including their switching operations or connections there to without specific approval from the Engineer-in-charge.

1.27. Drawings:

- (i) The work shall be carried out in accordance with the shop drawing prepared by the contractor and approved by the Engineer-in-charge. The shop drawing will be prepared as per the working drawing issued by the department or attached in the NIT.
- (ii) After the completion of work as built drawing, completion drawing, completion plan, Single Line Diagram etc will be submit by the contractor for each Electrical Sub-head.

1.28. Conformity to IE act, IE Rules, and standards:

All electrical works shall be carried out in accordance with the provisions of Indian Electricity Act, 1910, Indian Electricity Rules, 1956 amended up to date, NBC 2016, statutory approval from the different authorities, BIS codes as applicable, CPWD specification etc (Date of call of tender unless specified otherwise). List of rules of particular importance to electrical installations under these General Specifications is given in NIT.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

1.29. Quality of material:

All materials and equipments supplied by the contractor shall be new. They shall be of such design, size and materials as to satisfactorily function under the rated conditions of operation and to withstand the environmental conditions at site.

1.30. Inspection and Testing of materials and equipments:

- a) Materials and equipments to be used in the work shall be inspected by the Departmental officers. Such inspection will be of following categories:
 - i) Inspection of materials/ equipments to be witnessed at the manufacturer's premises in accordance with relevant BIS/ Agreement Inspection Procedure.
 - ii) To receive materials at site with Manufacturer's Test Certificate(s).
 - iii) To inspect materials at the authorized dealer's go downs to ensure delivery of genuine materials at site.
 - iv) To receive materials after physical inspection at site.
- b) The Departmental officers will take adequate care to ensure that only tested and genuine materials of proper quality are used in work.
- c) Material will be ordered & delivered at site only with the prior approval of the Engineer-in-Charge to ensure timely delivery.
- d) As and when the order is placed for the material, its copy shall be endorsed to the Engineer-in-charge.
- e) The firm will be required to procure all the material directly from the manufacturer/ authorized dealers to ensure genuineness & quality and as per the approved makes only. Proof in this regard shall be submitted by the contractor if required by the department.
- f) Inspection at factory or at go down of the manufacturer, as required, shall be arranged by the firm for a mutually agreed date. Certificate for genuineness of the equipments/fittings shall have to provided duly signed by the manufacturer's officer not below the rank of Regional Manager. The
- g) Delivery of material shall be taken up only with the consent of Engineer-in-Charge, after clearance of the material.
- h) Engineer-in-Charge shall reserve the right for waiver off inspection in lieu of suitable test certificate, at its discretion.
- i) Similarly, for fabricated equipments, the contractor will first submit dimensional detailed drawings for approval before fabrication is taken up in the factory. Suitable stage inspection at factory also will be made to ensure proper use of materials, workmanship and quality control.
- j) The third-party testing in the test lab for the materials/ equipments as per the direction of Engineer-in-Charge. In case testing fails, the testing charges will be borne by the contractor.

1.31. Ratings of components:

- (i) All components in a wiring installation shall be of appropriate ratings of voltage, current and frequency, as required at the respective sections of the electrical installations in which they are used.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

- (ii) 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 their respective ratings being exceeded.

1.32. Conformity to standards:

- (i) All components shall conform to relevant Indian Standard Specifications wherever existing. Materials with ISI certification mark shall be preferred.
- (ii) Relevant Indian Standards including amendments or revisions thereof up to the date of tender acceptance shall be applicable in the respective contracts for respective items, firm to ensure its compliance.

1.33. Interchangeability:

Similar parts of all switches, lamp holders, distribution fuse boards, Switch gears, ceiling roses, brackets, pendants, fans and all other fittings of the same type shall be interchangeable in each installation.

1.34. Workmanship:

- (i) Good workmanship is an essential requirement to be complied with. The entire work of manufacture/fabrication, assembly and installation shall conform to sound engineering practice.
- (ii) Proper supervision/skilled workmen: The contractor shall be a licensed electrical contractor of appropriate class suitable for execution of the electrical work. He shall engage suitably skilled/licensed workmen of various categories for execution of work supervised by supervisors / Engineer of appropriate qualification and experience to ensure proper execution of work. They will carry out instruction of Engineer-in-charge and other senior officers of the Department during the progress of work.
- (iii) Use of quality materials: Only quality materials of reputed make as specified in the tender will be used in work.
- (iv) Fabrication in reputed workshop: Switch boards and LT panels shall be fabricated in a factory/ workshop having modern facilities like quality fabrication, seven tank process, powder/epoxy paint plant, proper testing facilities, manned by qualified technical personnel. These shall be as per make / item approved.

1.35. Testing:

All test's prescribed in this General Specification, to be done before, during and after installation, shall be carried out, and the test results shall be submitted to the Engineer-in-charge in prescribed Performa, forming part of the Completion Certificate.

1.36. Commissioning on completion:

After the work is completed, it shall be ensured that the installation is tested and commissioned.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

The following NOC required from the Local Bodies and other authority will be arranged by the contractor before the final completion of the project. Without these NOC the project will not be treated as completed. The statutory fees required for applying the NOC will be borne by the department. :-

- 1) The NOC from the fire Department of GNCTD Delhi.
- 2) The NOC of the Electrical inspector of GNCTD Delhi.
- 3) The NOC from the Central Electricity Authority of Government of India for the Sub-station and DG set work.
- 4) The NOC and License from the Lift inspector for the operation of Lifts.
- 5) Other NOC as applicable for the electrical work.

1.37. Completion plan and completion certificate:

- (i) For all works completion certificate after completion of work as given in Appendix –E of CPWD Specification shall be submitted to the Engineer-in-charge.
- (ii) Completion plan drawn to a suitable scale in tracing cloth with ink indicating the following, along with three blue print copies of the same shall also be submitted.
- (iii) General layout of the building.
- (iv) Locations of main switchboard and distribution boards, indicating the circuit numbers controlled by them.
- (v) Position of all points and their controls.
- (vi) Types of fittings, viz. fluorescent, pendants, brackets, bulk head, fans, exhaust fans etc.
- (vii) Name of work, job number, tender reference, actual date of completion, names of Division/ Sub-division and name of the firm who executed the work with their signature.
- (viii) Delay in complying with any of the above requirement within the time period intimated by the Engineer-in-Charge will result in levy of penalty @ Rs. 10000/- per day for each such case of delay. The penalty would be recovered from the dues to the contractor.

1.38. Guarantee

The installation will be handed over to the department after necessary testing and commissioning and getting all the statutory approval from the competent authority. The installation will be guaranteed against any defective design/workmanship. Similarly, the materials supplied by the contractor will be guaranteed against any manufacturing defect, inferior quality. The guarantee period will be for a period of 12 months or otherwise mentioned for different items in the NIT or as per the OEM/OEA standard (Whichever is later) from the date of handing over to the department. Installation/Equipments or components thereof shall be rectified/ repaired to the satisfaction of the Engineer-in-charge. The firm will be required to submit guarantee for the major items as decided by the Engineer-in-Charge from the OEM/OEA only.

The amount of Security deposit will be released after the satisfactory completion of defect liability period of 12 month, but the items which are

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

having the defect liability period beyond 12 months, the Security Deposit of that item is only be released after the satisfactory completion of defect liability period of that item.

1.39. Supply of fittings, fixtures & other material:

The procurement of material for the works will be programmed as per the milestone given in the NIT or as per the progress of the work in consultation with the Engineer-in-Charge. The firm will be required to submit a detailed programme prior to the procurement of material will seek approval of the Engineer-in-Charge. The direction of the Engineer-in-Charge regarding timing & necessity of getting such material will be final & binding on the firm.

1.40. Order of Preference:

Should there be any difference or discrepancy between the description of items as given in the Schedule of Quantities, technical specifications for individual items of work (including additional and commercial conditions) and IS Codes etc., the following order of preference shall be followed:

- i. Schedule of quantities
- ii. General Conditions of Contract for CPWD Works
- iii. Technical specifications specified in the tender
- iv. Drawings
- v. CPWD General Specifications
- vi. Relevant IS or any other International code in case IS code is not available.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

REGULATION & STANDARDS

The installation shall conform in all respects to Indian standard Code of Practice for Electrical Wiring Installation I.S. - 732 and 'National Electrical Code-2016'. It shall be in conformity with the current I.E Rules and Regulations and requirements of the local Electric Supply Authority in-so-far as these become applicable to the installation. Wherever this specification calls for a higher standard of materials and/or workmanship then those required by any of the above regulations, these specifications shall take precedence over the said regulations and standards.

In general, the materials, equipments and workmanship not covered above, shall conform to the following Indian Standards (Latest Edition) unless otherwise called for:

S. No.	Item	IS Code
1	Requirements of A.C. Circuit Breakers. (ACBs & MCCBs)	IS 13947-1, 2/IEC 60947-1, 2
2.	Switches and Switch Isolators above 1000V But Not Exceeding 1.1 KV	IS 4710
3.	Markings & arrangements for switchgear bus-bars, main connection & auxiliary wiring	IS 375
4.	Specification for normal duty air break switches & composite units for air break switches and fuses for voltage not exceeding 1000 Volts.	IS 4064
5.	Heavy duty air-break switches and composite units of air-break switches and fuses for voltages not exceeding 1000 Volts.	IS 4047
6.	Specification for miniature circuit breakers.	IS 8828
7.	Specification for enclosed distribution, fuse boards and cut-outs for voltage not exceeding 1000 Volts	IS 2675
8.	Installation and maintenance of switchgear.	IS 3072 (Part I)
9.	HRC cartridge fuse links 650 Volts.	IS 9224
10.	Specification for XLPE insulated armoured, PVC Sheathed cables (11kV/22kV/33kV)	IS 7098 (Part-II)
11.	Specification for PVC insulated (Heavy Duty) electric cables for Voltage upto 1100 Volts	IS1554
12.	Specification for XLPE insulated cables (for voltage upto 1100 V) with	IS 7098 (Part-I)

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

	Aluminium conductors	
13.	Specification for rigid steel conduit for electrical wiring.	IS 9537
14.	Specifications for rigid non-metallic conduits for electrical installations	IS 9537
15.	Specifications for accessories for rigid steel conduits for Electrical wiring	IS 3837
16.	Box for the enclosure of electrical accessories steel and C.I. Boxes	IS 5133 (Part I)
17.	3Pin plugs and sockets outlets	IS 1293
18.	Ceiling Roses	IS 371
19.	Adhesive insulating tapes for Electrical purposes (Part- I & II)	IS 2448
20.	General and safety requirements for Electrical lighting fittings	IS 1913
21.	Watertight electric light fittings.	IS 3553
22.	Flood Lights.	IS 1947
23.	Ceiling fans and regulators.	IS 374
24.	Propeller type AG Ventilating fans	IS 2312
25.	Code of Practices for earthing.	IS 3043
26.	Glossary of terms for electrical cable and conductors.	IS 1885
27.	Code of Practice for buildings (General) Electrical installation	IS 1646
28.	Protection of buildings and allied structures against lightning.	IS 2309
29.	Current Transformers	S 2705 (Part-I to III)
30.	Voltage Transformer	S 3156 (Part-I to III)
31.	Power Transformer	S 2026-1977 (Part-I to IV)
32.	Installation and maintenance of transformers	IS 10028 (Part - II & III)
33.	Shunt capacitors for Power system	IS 2834
34.	Direct acting electrical indicating instruments	IS 1246
35.	Factory assembled switchgear	IS 8623
36.	Rating for Cable	IS 3961 (Part -II)
37.	Earthing	IS 3843
38.	High Voltage alternating current circuit breakers	IS 13118 : 1991, IEC 60056
39	Glossary of Terms Used in Refrigeration & Air Conditioning.	IS 3615
40	Three phase Induction Motors	IS 325

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

41	Motor Starters of voltage Not Exceeding 1000 volts	IS 1822
42	Burden Tube Pressure and Vacuum Gauges	IS 3624
43	Timber for cooling towers	IS 2372
44	Gode of practice for selection of standard worm and helical gear boxes	IS 7403
45	Horizontal centrifugal pumps for clear, cold, fresh water	IS 1620
46	Single phase small A.C. and Universal motors	IS 996
47	Mild steel tubes, tubulars and other wrought steel fittings	IS 1239
48	Electrically welded steel pipes for water, gas and sewage,	IS 3589
49	Steel pipe flanges	IS 6392
50	Gun metal gate, globe and check valves for general purpose	IS 778
51	Recommendation for methods of measurement of fluid flow by means of orifice plates and nozzles	IS 2592
52	Galvanized steel sheets	IS 277
53	Wrought aluminium and aluminium alloy sheet and strip for general engineering purposes.	IS 737
54	Metal air ducts	IS 655
55	Code of practice for electrical wiring and fittings for buildings	IS 732
56	A.C.circuit breakers	IS 2516
57	Code of practice for installation and maintenance of induction motors	IS 900
58	Direct acting electrical indicating instruments	IS 1248
59	A.C. circuit breakers for voltages not exceeding 1000 volts	IS 2516
60	Heavy duty air break switches and composite units of air break switches and fuses for voltage not exceeding 1000 volts.	IS 4047
61	HRC cartridge fuse links upto 650 volts	IS 2208
62	PVC insulated (heavy duty) electric cables for working voltage upto and including 1100 volts	IS 1554 (Part I)

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

63	Specification for bonded glass wool/mineral wool	IS 8183
64	Specification for expanded polystyrene for thermal insulation purposes.	IS 4671
65	Code of practice for testing of cooling towers.	IS 11561
66	Data for outside design conditions for air conditioning for summer month	IS 7896
67	Packages air conditioners	IS 8148
68	Sectional cold rooms (walk-in type)	IS 2370
69	Testing of refrigerant compressors	IS 5111
70	Thermostatic Expansion Valve	IS 10594
71	Energy efficient induction motors	IS 12615
72	Safety Code for Mechanical Refrigeration	IS 660
73	Safety Code for air conditioning	IS 659
74	Code of Practice for Fire precautions in welding and cutting operations	IS 3016
75	Code of practice for safety and health requirements in electrical and gas welding and cutting operations.	IS 818
76	Code for safety procedure and practice in electrical works	IS 5216
77	Safety code for scaffolds and ladders	IS 3696
78	Glossary of items associated with fire safety.	IS-8757
79	Specification for first-aid hose reel for fire fighting.	IS-884
80	Specification for coupling, double male and double female instantaneous pattern for fire fighting.	IS-901
81	Specification for suction hose coupling for fire fighting purposes.	IS-902
82	Specification for fire hose delivery coupling, branch pipe, nozzle and nozzle spanner.	IS-903
83	Specification for two-way and three-way suction collecting heads for fire fighting purposes.	IS-904
84	Specification for suction strainers, cylindrical type for fire fighting purposes.	IS-907
85	Specification for fire hydrant, stand post type.	IS-908

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

86	Specification for under ground fire hydrant.	IS-909
87	Non percolating flexible fire fighting delivery hose.	IS-636
88	Glossary of items for fire fighting equipment.	IS-7637
89	Specification for washers for water fittings for fire fighting purposes.	IS-937
90	Code of practice for fire safety of building (general): General principles for fire grading and classification.	IS-1641
91	Code of practice for fire safety of building (general): Details of construction.	IS-1642
92	Code of practice for fire safety of building (general): Exposure hazard.	IS-1643
93	Code of practice for fire safety of building (general): Exit requirements and personal hazard.	IS-1644
94	Code of practice for fire safety of building (general): Electrical installations.	IS-1646
95	Specification for branch pipe, universal for fire fighting purposes.	IS-2871
96	Functional requirement for hose laying tender for fire brigade use.	IS-2930
97	Specification for landing valves.	IS-5290
98	Specification for coupling, branch pipe, nozzle, used in hose reel tubing for fire fighting.	IS-8090
99	Specification for stand post type water monitor for fire fighting.	IS-8442
100	Specification for automatic sprinkler heads.	IS-9972
101	Specification for extended branch pipe for fire brigade use.	IS-11101
102	Fire protection-Safety sign.	IS-12349
103	Graphic symbols or fire protection plan.	IS-12407
104	Code of practice for provision and maintenance of water supplies and fire fighting.	IS-9668
105	Code of practice for installation and maintenance of internal fire hydrant and hose reel on premises.	IS-3844

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

106	Specification for thermoplastic house (Textile Reinforced) for Water Genset purpose.	IS-12585
107	Code of practice for coating and wrapping of underground mild steel pipe lines.	IS-10221
108	Design and installation for fixed automatic sprinkler fire extinguisher system-Code of Practice.	IS-15105
109	Three phase induction motors.	IS-325
110	Motor starter for voltage not exceeding 1000 volts.	IS-1822
111	Burden tube pressure and vacuum gauges.	IS-3624
112	Horizontal centrifugal pumps for clear, cold, fresh water.	IS-1520
113	Mild steel tubes, tubular and other wrought steel fittings.	IS-1239
114	Electrically welded steel pipes for water, gas and sewage.	IS-3589
115	Steel pipe flanges.	IS-6392
116	Gun metal gate, globe and check valves for general purposes.	IS-778
117	Recommendation for methods of measurement of fluid flow by means of orifice plates and nozzles.	IS-2592
118	Code of practice for electrical wiring and fittings of building.	IS-732
119	Code of practice for installation and maintenance of induction motor.	IS-900
120	Direct acting electrical indicating instruments.	IS-1248
121	A.C. circuit breakers for voltages not exceeding 1000 volts.	IS-2516
122	Heavy duty air break switched and composite units of air break switches and fuse for voltage not exceeding 1000 volts.	IS-4047
123	HRC cartridge fuse links upto 650 volts.	IS-2208
124	PVC insulated (heavy duty) electric cables for working voltage upto and including 1100 volts.	IS-1554 (Part I)
125	Centrifugally Cast Iron Pipe.	IS-1536
126	Vertically Cast Iron Pipe.	IS-1537

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

127	Cast Iron Pipe Fitting.	IS-1538
128	Sluice valve for water works purposes (50 to 300 mm.size)	IS-780
129	Butter Fly valves.	IS-13095
ELECTRO-TECHNICAL VOCABULARY		
130	Fundamental definition	IS-1885 (Part-I) : 1661
131	Secondary cells and batteries (Superseding IS 1147 : 1957)	IS-1885 (Part-VII): 1986
132	Electrical power system protection	IS-1885 (Part-X): 1993
133	Electrical measurement	IS-1885 (Part-XI): 1966
134	Switchgear and control gear (First version)	IS-1885 (Part-XVIII): 1979
135	Overhead transmission and distribution of electric energy	IS-1885 (Part-XXX): 1971
136	Cables, conductor and accessories for Electrical supply (Superseding IS 1591:1960)	IS-1885 (Part-XXXII): 1993
137	Transformers (First version)	IS-1885 (Part-XXXVIII): 1993
GRAPHICAL SYMBOLS USED IN ELECTRO TECHNOLOGY		
138	Guide for preparation of diagram, chart & tables or election technology, Definitions and classifications [Superseding IS 2032 (Part-I) : 1962]	IS 8270 (Part-I) : 1976
139	Item designation	IS 8270 (Part-II) : 1976
140	General requirement for diagram	IS 8270 (Part-III) : 1977
141	Circuit diagram	IS 8270 (Part-IV) : 1977
142	Inter connection diagram and table	IS 8270 (Part-V) : 1976
CONDUCTOR AND POWER CABLES		
143	PVC insulated cable for working voltages and including 1100 volts (Second version) [Superseding IS 3035 (Part-I) : 1965]	IS 694 : 1940
144	PVC insulated (Heavy duty) working dielectric cables for voltage upto & i/c	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	1100 volts (Second version)	IS 1554 (Part-I) :
145	For working voltage from 3.3 KV upto and i/c 11 KV	1988
146	Recommended current ratings for cable: Paper insulated lead sheathed cables.	IS 3961 (Part-I): 1967
147	PVC insulated and PVC sheathed heavy duty cables.	
148	Application guide for non-linear resistor type surge arrester for alternating current system (First version).	IS 15086 (Part-5)
149	Recommended short circuit ratings of high voltage PVC cable.	IS 5819 : 1970
150	Conductors for insulated electric cables and flexible cords	IS 8130 : 1984
151	Busbar trunking system (Air insulated & sandwich insulated type).	IS 8623 Part-I & II : 1993, IES 60439 Part I & II
ELECTRICAL INSTALLATION CODE OF PRACTICE		
152	Installation and maintenance of transformers	IS 10028 (Part- II & III)
153	Insulation oil in service, maintenance and supervision code of practice for	IS 1866 : 2000
154	Earthing	IS 3043 : 1987
155	Guide for short circuit calculations	IS 13234
156	Electrical wiring installation (system voltage not exceeding 650 volts)	IS 732 : 1989
157	Paper insulated power (Upto and i/c 33 KV First version)	IS 1255 : 1983
SWITCH GEAR AND CONTROL GEAR		
158	Degree of protection by the (enclosure for low voltage switchgear and control gear)	IS 13947 (Part-I)
159	HRC carttidge fuse links upto 650 volts	IS 9224 (Part-II)
160	Circuit breaker AV requirement & tests for voltage not exceeding 1000 Volts a.c. or 1200 volts d.c.	IS 13947 (Part-II)
161	General and definition. Section 2-voltage above 1000 volt a.c.	IS 13118 : 1991
162	Type tests & Routine test for voltage above 1000 volts a.c.	IS 13118 : 1991

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

163	Heavy duty air break switches and composite units of air break switches & fuses for voltage not exceeding 1000 volts.	IS 4064
164	General requirement for switch gear control gear for voltage not exceeding 1000 volts	IS 13947 (Part-I)
165	Factory built assemblies for switch gear and control gear for voltage upto & i/c 1000 V AC or 1200 V DC	IS 8623 : 1963
166	Particular requirement for bus bar trunking system (Bus ways)	
167	High voltage alternating current circuit breakers	IS 13118 : 1991 IEC 60056
168	High voltage Switches – Part-1 : Switches for Rated voltage above 1 KV and less than 52 KV	IS 9920 : 2002
169	A.C. Metal enclosure switchgear and control gear for rated voltage above 1 KV and upto and i/c 52 KV	IS 3427 : 1997
170	Electrical measurement instruments and their accessories	IS 1248
TRANSFORMERS AND REACTORS		
171	General	IS 2026 (Part-1) : 1977
172	Temperature rise	IS 2026 (Part-II) 1977
173	Insulating level and di-electric tests	IS 2026 (Part-III) : 1981
174	Distribution transformer	IS 1180 : 1989
175	Gas operated relays	IS 3637 : 1966
176	Power transformer fitting and accessories	IS 3639 : 1966
177	Guide for loading of oil immersed transformers	IS 6600 : 1972

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

178	Current transformers Part I to III	IS 2705 : 1992
179	Voltage transformers Part I to III	IS 3156 : 1992
180	Outdoor type three-phase distribution transformers	IS 2099 : 1986
CHEMICALS		
181	Colors for ready mixed paints and enamels	IS 5 : 1994 (Third revision)
182	Ready mixed paint brushing zinc chrome priming	IS 104 : 1979 (Second revision)
183	Enamel, synthetic exterior (a) under coating (b) finishing	IS 2932 : 2003 (First revision)
INSULATING LIQUIDS		
184	Special resistance (resistivity) or electrical insulating liquids, methods of tests for	IS 6103 : 1971
185	Electric strength of insulating oils, methods for determinations of	IS 6792 : 1992
186	New insulation oils for transformers and switchgears (Second version)	IS 335 : 2005
187	Insulating Mats	IS 15625 : 2006
SAFETY EQUIPMENT		
188	CO2 based fire Extinguisher	IS 2878 : 1976
189	Chemical based Fire Extinguisher	IS 2171 : 1976
190	HCFC Blend – A Extinguisher System	IS 15505 : 2004
Generating Set		
191	Application, rating and performances.	ISO 8528 Part – I
192	Engine	ISO 8528 Part – II
193	A.C Generator for generating set	ISO 8528 Part – III
194	Control gear and switch gear	ISO 8528 Part – IV
195	Generating Sets	ISO 8528 Part – V
196	Test Methods	ISO 8528 Part – VI
197	Technical declaration for specification and design	ISO 8528 Part – VII

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

198	Low power general purpose generating sets	ISO 8528 Part – VIII
199	Measurement and evaluation of mechanical vibration	ISO 8528 Part – IX
200	Measurement of Airborne Noise – Enveloping surface method	ISO 8528 Part - X
201	Security generating sets with uninterruptible power system	ISO 8528 Part – XI
Engines		
202	Methods of tests for I.C. Engines Part – I – Glossary of terms relating of test method	IS 10000 (Naturally Aspirated) Part – I 1980
203	Standard reference condition	IS 10000 (Naturally Aspirated) Part – II 1980
204	Measurement for testing units and limits of accuracy.	IS 10000 (Naturally Aspirated) Part – III 1980
205	Declaration of power, Efficiency, fuel consumption, lubricating oil consumption.	IS 10000 (Naturally Aspirated) Part – IV 1980
206	Preparation for tests and measurement of wear	IS 10000 (Naturally Aspirated) Part – V
207	Recording of test results.	IS 10000 (Naturally Aspirated) Part – VI
208	Governing test for constant speed engines and selection of engines for use with electrical generators.	IS 10000 (Naturally Aspirated) Part – VII
209	Performances tests	IS 10000 (Naturally Aspirated) Part – VIII
210	Endurance test	IS 10000 (Naturally Aspirated) Part – IX
211	Tests for smoke level, limit and correction for smoke level for variable speed.	IS 10000 (Naturally Aspirated) Part – X
212	Information to be supplied by the	IS 10000 (Naturally Aspirated) Part – XI

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

	purchaser to the manufacturer and information to be supplied by the manufacturer alongwith the engine.	
213	Specimen test certificates	IS 10000 (Naturally Aspirated) Part – XII
214	Recommendations on nature of tests required for functional changes in critical components.	IS 10000 (Naturally Aspirated) Part – XIII
215	Reciprocating Internal Combustion engines.	BS 5514 Part 5-1979
216	Performance, torsional vibrations.	ISO 3046 Part – V 2001
217	Declaration of powers, fuel and lubrication oil consumption and test methods.	ISO 3046 Part – I 2002
218	Test measurement	ISO 3046 Part – 3 – 1989
219	Speed Governing	ISO 3046 Part – 4 – 1997
220	Overspeed protection.	ISO 3046 Part – 6 – 1990
221	Reciprocating Internal Combustion engines, performances, torsional vibrations.	BS 649
Alternator		
222	For declaring efficiency of electrical machines.	IS 4889/BS-269
223	Capability of machine to withstand over current/overload.	IS 4722- 1992
224	Alternator – Voltage Regulation upto 20 KVA	IS – 13364 Part I 1992
225	Alternator – Voltage Regulation above 20 KVA to 80 KVA	IS – 13364 Part II 1992
226	Rotating Electrical machines – Rating & Performances	IEC 34-1-1983
227	Alternator (Degree of Protection)	IP-21 IS – 4691/85

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Acoustic Enclosure		
228	Insulation material for sound absorption	IS – 8183
229	Acoustics – Determination of sound power levels of noise sources.	ISO 3744 1998 (E)
230	Measurement of Air borne noise by enveloping surface method.	ISO 8528 Part-10 1998 (E)
231	Requirement of grade-II. Accuracy for insulation	ISO 9614-1993 Part-I
232	Requirement of grade-II. Accuracy for insulation	ISO 9614-1996 Part-II
Control Panel / AMF Panel		
233	Degree of protection.	IS-2147 1962
234	H.V. testing for panel	IS – 4722

For
the
IS

codes and other standards not mentioned in the table refer CPWD specifications for Electrical work and other standard IS codes and standard for different E and M services.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

TECHNICAL

IS CODES FOR

ELECTRICAL AND

MECHANICAL

WORKS

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

REGULATION & STANDARDS

The installation shall conform in all respects to Indian standard Code of Practice for Electrical Wiring Installation I.S. - 732 and 'National Electrical Code-2016'. It shall be in conformity with the current I.E Rules and Regulations and requirements of the local Electric Supply Authority in-so-far as these become applicable to the installation. Wherever this specification calls for a higher standard of materials and/or workmanship then those required by any of the above regulations, these specifications shall take precedence over the said regulations and standards.

In general, the materials, equipments and workmanship not covered above, shall conform to the following Indian Standards (Latest Edition) unless otherwise called for:

S. No.	Item	IS Code
1	Requirements of A.C. Circuit Breakers. (ACBs & MCCBs)	IS 13947-1, 2/IEC 60947-1, 2
2.	Switches and Switch Isolators above 1000V But Not Exceeding 1.1 KV	IS 4710
3.	Markings & arrangements for switchgear bus-bars, main connection & auxiliary wiring	IS 375
4.	Specification for normal duty air break switches & composite units for air break switches and fuses for voltage not exceeding 1000 Volts.	IS 4064
5.	Heavy duty air-break switches and composite units of air-break switches and fuses for voltages not exceeding 1000 Volts.	IS 4047
6.	Specification for miniature circuit breakers.	IS 8828
7.	Specification for enclosed distribution, fuse boards and cut-outs for voltage not exceeding 1000 Volts	IS 2675
8.	Installation and maintenance of switchgear.	IS 3072 (Part I)
9.	HRC cartridge fuse links 650 Volts.	IS 9224
10.	Specification for XLPE insulated armoured, PVC Sheathed cables (11kV/22kV/33kV)	IS 7098 (Part-II)
11.	Specification for PVC insulated (Heavy Duty) electric cables for Voltage upto 1100 Volts	IS1554

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

12.	Specification for XLPE insulated cables (for voltage upto 1100 V) with Aluminium conductors	IS 7098 (Part-I)
13.	Specification for rigid steel conduit for electrical wiring.	IS 9537
14.	Specifications for rigid non-metallic conduits for electrical installations	IS 9537
15.	Specifications for accessories for rigid steel conduits for Electrical wiring	IS 3837
16.	Box for the enclosure of electrical accessories steel and C.I. Boxes	IS 5133 (Part I)
17.	3Pin plugs and sockets outlets	IS 1293
18.	Ceiling Roses	IS 371
19.	Adhesive insulating tapes for Electrical purposes (Part- I & II)	IS 2448
20.	General and safety requirements for Electrical lighting fittings	IS 1913
21.	Watertight electric light fittings.	IS 3553
22.	Flood Lights.	IS 1947
23.	Ceiling fans and regulators.	IS 374
24.	Propeller type AG Ventilating fans	IS 2312
25.	Code of Practices for earthing.	IS 3043
26.	Glossary of terms for electrical cable and conductors.	IS 1885
27.	Code of Practice for buildings (General) Electrical installation	IS 1646
28.	Protection of buildings and allied structures against lightning.	IS 2309
29.	Current Transformers	S 2705 (Part-I to III)
30.	Voltage Transformer	S 3156 (Part-I to III)
31.	Power Transformer	S 2026-1977 (Part-I to IV)
32.	Installation and maintenance of transformers	IS 10028 (Part - II & III)
33.	Shunt capacitors for Power system	IS 2834
34.	Direct acting electrical indicating instruments	IS 1246
35.	Factory assembled switchgear	IS 8623
36.	Rating for Cable	IS 3961 (Part -II)
37.	Earthing	IS 3843
38.	High Voltage alternating current circuit breakers	IS 13118 : 1991, IEC 60056

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

39	Glossary of Terms Used in Refrigeration & Air Conditioning.	IS 3615
40	Three phase Induction Motors	IS 325
41	Motor Starters of voltage Not Exceeding 1000 volts	IS 1822
42	Burden Tube Pressure and Vacuum Gauges	IS 3624
43	Timber for cooling towers	IS 2372
44	Gode of practice for selection of standard worm and helical gear boxes	IS 7403
45	Horizontal centrifugal pumps for clear, cold, fresh water	IS 1620
46	Single phase small A.C. and Universal motors	IS 996
47	Mild steel tubes, tubulars and other wrought steel fittings	IS 1239
48	Electrically welded steel pipes for water, gas and sewage,	IS 3589
49	Steel pipe flanges	IS 6392
50	Gun metal gate, globe and check valves for general purpose	IS 778
51	Recommendation for methods of measurement of fluid flow by means of orifice plates and nozzles	IS 2592
52	Galvanized steel sheets	IS 277
53	Wrought aluminium and aluminium alloy sheet and strip for general engineering purposes.	IS 737
54	Metal air ducts	IS 655
55	Code of practice for electrical wiring and fittings for buildings	IS 732
56	A.C.circuit breakers	IS 2516
57	Code of practice for installation and maintenance of induction motors	IS 900
58	Direct acting electrical indicating instruments	IS 1248
59	A.C. circuit breakers for voltages not exceeding 1000 volts	IS 2516
60	Heavy duty air break switches and composite units of air break switches and fuses for voltage not exceeding 1000 volts.	IS 4047
61	HRC cartridge fuse links upto 650 volts	IS 2208

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

62	PVC insulated (heavy duty) electric cables for working voltage upto and including 1100 volts	IS 1554 (Part I)
63	Specification for bonded glass wool/mineral wool	IS 8183
64	Specification for expanded polystyrene for thermal insulation purposes.	IS 4671
65	Code of practice for testing of cooling towers.	IS 11561
66	Data for outside design conditions for air conditioning for summer month	IS 7896
67	Packages air conditioners	IS 8148
68	Sectional cold rooms (walk-in type)	IS 2370
69	Testing of refrigerant compressors	IS 5111
70	Thermostatic Expansion Valve	IS 10594
71	Energy efficient induction motors	IS 12615
72	Safety Code for Mechanical Refrigeration	IS 660
73	Safety Code for air conditioning	IS 659
74	Code of Practice for Fire precautions in welding and cutting operations	IS 3016
75	Code of practice for safety and health requirements in electrical and gas welding and cutting operations.	IS 818
76	Code for safety procedure and practice in electrical works	IS 5216
77	Safety code for scaffolds and ladders	IS 3696
78	Glossary of items associated with fire safety.	IS-8757
79	Specification for first-aid hose reel for fire fighting.	IS-884
80	Specification for coupling, double male and double female instantaneous pattern for fire fighting.	IS-901
81	Specification for suction hose coupling for fire fighting purposes.	IS-902
82	Specification for fire hose delivery coupling, branch pipe, nozzle and nozzle spanner.	IS-903
83	Specification for two-way and three-way suction collecting heads for fire fighting purposes.	IS-904
84	Specification for suction strainers, cylindrical type for fire fighting purposes.	IS-907
85	Specification for fire hydrant, stand post	IS-908

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

	type.	
86	Specification for under ground fire hydrant.	IS-909
87	Non percolating flexible fire fighting delivery hose.	IS-636
88	Glossary of items for fire fighting equipment.	IS-7637
89	Specification for washers for water fittings for fire fighting purposes.	IS-937
90	Code of practice for fire safety of building (general): General principles for fire grading and classification.	IS-1641
91	Code of practice for fire safety of building (general): Details of construction.	IS-1642
92	Code of practice for fire safety of building (general): Exposure hazard.	IS-1643
93	Code of practice for fire safety of building (general): Exit requirements and personal hazard.	IS-1644
94	Code of practice for fire safety of building (general): Electrical installations.	IS-1646
95	Specification for branch pipe, universal for fire fighting purposes.	IS-2871
96	Functional requirement for hose laying tender for fire brigade use.	IS-2930
97	Specification for landing valves.	IS-5290
98	Specification for coupling, branch pipe, nozzle, used in hose reel tubing for fire fighting.	IS-8090
99	Specification for stand post type water monitor for fire fighting.	IS-8442
100	Specification for automatic sprinkler heads.	IS-9972
101	Specification for extended branch pipe for fire brigade use.	IS-11101
102	Fire protection-Safety sign.	IS-12349
103	Graphic symbols or fire protection plan.	IS-12407
104	Code of practice for provision and maintenance of water supplies and fire fighting.	IS-9668
105	Code of practice for installation and maintenance of internal fire hydrant and hose reel on premises.	IS-3844
106	Specification for thermoplastic house	IS-12585

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

	(Textile Reinforced) for Water Genset purpose.	
107	Code of practice for coating and wrapping of underground mild steel pipe lines.	IS-10221
108	Design and installation for fixed automatic sprinkler fire extinguisher system-Code of Practice.	IS-15105
109	Three phase induction motors.	IS-325
110	Motor starter for voltage not exceeding 1000 volts.	IS-1822
111	Burden tube pressure and vacuum gauges.	IS-3624
112	Horizontal centrifugal pumps for clear, cold, fresh water.	IS-1520
113	Mild steel tubes, tubular and other wrought steel fittings.	IS-1239
114	Electrically welded steel pipes for water, gas and sewage.	IS-3589
115	Steel pipe flanges.	IS-6392
116	Gun metal gate, globe and check valves for general purposes.	IS-778
117	Recommendation for methods of measurement of fluid flow by means of orifice plates and nozzles.	IS-2592
118	Code of practice for electrical wiring and fittings of building.	IS-732
119	Code of practice for installation and maintenance of induction motor.	IS-900
120	Direct acting electrical indicating instruments.	IS-1248
121	A.C. circuit breakers for voltages not exceeding 1000 volts.	IS-2516
122	Heavy duty air break switched and composite units of air break switches and fuse for voltage not exceeding 1000 volts.	IS-4047
123	HRC cartridge fuse links upto 650 volts.	IS-2208
124	PVC insulated (heavy duty) electric cables for working voltage upto and including 1100 volts.	IS-1554 (Part I)
125	Centrifugally Cast Iron Pipe.	IS-1536
126	Vertically Cast Iron Pipe.	IS-1537
127	Cast Iron Pipe Fitting.	IS-1538
128	Sluice valve for water works purposes (50 to 300 mm.size)	IS-780

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

129	Butter Fly valves.	IS-13095
ELECTRO-TECHNICAL VOCABULARY		
130	Fundamental definition	IS-1885 (Part-I) : 1661
131	Secondary cells and batteries (Superseding IS 1147 : 1957)	IS-1885 (Part-VII): 1986
132	Electrical power system protection	IS-1885 (Part-X): 1993
133	Electrical measurement	IS-1885 (Part-XI): 1966
134	Switchgear and control gear (First version)	IS-1885 (Part-XVIII): 1979
135	Overhead transmission and distribution of electric energy	IS-1885 (Part-XXX): 1971
136	Cables, conductor and accessories for Electrical supply (Superseding IS 1591:1960)	IS-1885 (Part- XXXII): 1993
137	Transformers (First version)	IS-1885 (Part- XXXVIII): 1993
GRAPHICAL SYMBOLS USED IN ELECTRO TECHNOLOGY		
138	Guide for preparation of diagram, chart & tables or election technology, Definitions and classifications [Superseding IS 2032 (Part-I) : 1962]	IS 8270 (Part-I) : 1976
139	Item designation	IS 8270 (Part-II) : 1976
140	General requirement for diagram	IS 8270 (Part-III) : 1977
141	Circuit diagram	IS 8270 (Part-IV) : 1977
142	Inter connection diagram and table	IS 8270 (Part-V) : 1976
CONDUCTOR AND POWER CABLES		
143	PVC insulated cable for working voltages and including 1100 volts (Second version) [Superseding IS 3035 (Part-I) : 1965]	IS 694 : 1940
144	PVC insulated (Heavy duty) working dielectric cables for voltage upto & i/c 1100 volts (Second version)	IS 1554 (Part-I) : 1988
145	For working voltage from 3.3 KV upto	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	and i/c 11 KV	
146	Recommended current ratings for cable: Paper insulated lead sheathed cables.	IS 3961 (Part-I): 1967
147	PVC insulated and PVC sheathed heavy duty cables.	
148	Application guide for non-linear resistor type surge arrester for alternating current system (First version).	IS 15086 (Part-5)
149	Recommended short circuit ratings of high voltage PVC cable.	IS 5819 : 1970
150	Conductors for insulated electric cables and flexible cords	IS 8130 : 1984
151	Busbar trunking system (Air insulated & sandwich insulated type).	IS 8623 Part-I & II : 1993, IES 60439 Part I & II
ELECTRICAL INSTALLATION CODE OF PRACTICE		
152	Installation and maintenance of transformers	IS 10028 (Part- II & III)
153	Insulation oil in service, maintenance and supervision code of practice for	IS 1866 : 2000
154	Earthing	IS 3043 : 1987
155	Guide for short circuit calculations	IS 13234
156	Electrical wiring installation (system voltage not exceeding 650 volts)	IS 732 : 1989
157	Paper insulated power (Upto and i/c 33 KV First version)	IS 1255 : 1983
SWITCH GEAR AND CONTROL GEAR		
158	Degree of protection by the (enclosure for low voltage switchgear and control gear)	IS 13947 (Part-I)
159	HRC carttidge fuse links upto 650 volts	IS 9224 (Part-II)
160	Circuit breaker AV requirement & tests for voltage not exceeding 1000 Volts a.c. or 1200 volts d.c.	IS 13947 (Part-II)
161	General and definition. Section 2-voltage above 1000 volt a.c.	IS 13118 : 1991
162	Type tests & Routine test for voltage above 1000 volts a.c.	IS 13118 : 1991
163	Heavy duty air break switches and composite units of air break switches & fuses for voltage not exceeding 1000 volts.	IS 4064

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

164	General requirement for switch gear control gear for voltage not exceeding 1000 volts	IS 13947 (Part-I)
165	Factory built assemblies for switch gear and control gear for voltage upto & i/c 1000 V AC or 1200 V DC	IS 8623 : 1963
166	Particular requirement for bus bar trunking system (Bus ways)	
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169	A.C. Metal enclosure switchgear and control gear for rated voltage above 1 KV and upto and i/c 52 KV	IS 3427 : 1997
170	Electrical measurement instruments and their accessories	IS 1248
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180	Outdoor type three-phase distribution transformers	IS 2099 : 1986
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181	Colors for ready mixed paints and	IS 5 : 1994 (Third

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	enamels	revision)
182	Ready mixed paint brushing zinc chrome priming	IS 104 : 1979 (Second reision)
183	Enamel, synthetic exterior (a) under coating (b) finishing	S 2932 : 2003 (First revision)
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185	Electric strength of insulating oils, methods for determinations of	IS 6792 : 1992
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189	Chemical based Fire Extinguisher	IS 2171 : 1976
190	HCFC Blend – A Extinguisher System	IS 15505 : 2004
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192	Engine	ISO 8528 Part – II
193	A.C Generator for generating set	ISO 8528 Part – III
194	Control gear and switch gear	ISO 8528 Part – IV
195	Generating Sets	ISO 8528 Part – V
196	Test Methods	ISO 8528 Part – VI
197	Technical declaration for specification and design	ISO 8528 Part – VII
198	Low power general purpose generating sets	ISO 8528 Part – VIII
199	Measurement and evaluation of mechanical vibration	ISO 8528 Part – IX
200	Measurement of Airborne Noise – Enveloping surface method	ISO 8528 Part - X
201	Security generating sets with uninterruptible power system	ISO 8528 Part – XI
Engines		

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

202	Methods of tests for I.C. Engines Part – I – Glossary of terms relating of test method	IS 10000 (Naturally Aspirated) Part – I 1980
203	Standard reference condition	IS 10000 (Naturally Aspirated) Part – II 1980
204	Measurement for testing units and limits of accuracy.	IS 10000 (Naturally Aspirated) Part – III 1980
205	Declaration of power, Efficiency, fuel consumption, lubricating oil consumption.	IS 10000 (Naturally Aspirated) Part – IV 1980
206	Preparation for tests and measurement of wear	IS 10000 (Naturally Aspirated) Part – V
207	Recording of test results.	IS 10000 (Naturally Aspirated) Part – VI
208	Governing test for constant speed engines and selection of engines for use with electrical generatos.	IS 10000 (Naturally Aspirated) Part – VII
209	Performances tests	IS 10000 (Naturally Aspirated) Part – VIII
210	Endurance test	IS 10000 (Naturally Aspirated) Part – IX
211	Tests for smoke level, limit and correction for smoke level for variable speed.	IS 10000 (Naturally Aspirated) Part – X
212	Information to be supplied by the purchaser to the manufacturer and information to be supplied by the manufacturer alongwith the engine.	IS 10000 (Naturally Aspirated) Part – XI
213	Specimen test certificates	IS 10000 (Naturally Aspirated) Part – XII
214	Recommendations on nature of tests required for functional changes in critical components.	IS 10000 (Naturally Aspirated) Part – XIII
215	Reciprocating Internal Combustion engines.	BS 5514 Part 5-1979
216	Performance, torsional vibrations.	ISO 3046 Part – V 2001

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

217	Declaration of powers, fuel and lubrication oil consumption and test methods.	ISO 3046 Part – I 2002
218	Test measurement	ISO 3046 Part – 3 – 1989
219	Speed Governing	ISO 3046 Part – 4 – 1997
220	Overspeed protection.	ISO 3046 Part – 6 – 1990
221	Reciprocating Internal Combustion engines, performances, torsional vibrations.	BS 649
Alternator		
222	For declaring efficiency of electrical machines.	IS 4889/BS-269
223	Capability of machine to withstand over current/overload.	IS 4722- 1992
224	Alternator – Voltage Regulation upto 20 KVA	IS – 13364 Part I 1992
225	Alternator – Voltage Regulation above 20 KVA to 80 KVA	IS – 13364 Part II 1992
226	Rotating Electrical machines – Rating & Performances	IEC 34-1-1983
227	Alternator (Degree of Protection)	IP-21 IS – 4691/85
Acoustic Enclosure		
228	Insulation material for sound absorption	IS – 8183
229	Acoustics – Determination of sound power levels of noise sources.	ISO 3744 1998 (E)
230	Measurement of Air borne noise by enveloping surface method.	ISO 8528 Part-10 1998 (E)
231	Requirement of grade-II. Accuracy for insulation	SO 9614-1993 Part-I
232	Requirement of grade-II. Accuracy for insulation	SO 9614-1996 Part-II
Control Panel / AMF Panel		
233	Degree of protection.	IS-2147 1962

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

234	H.V. testing for panel	IS – 4722
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For the IS codes and other standards not mentioned in the table refer CPWD specifications for Electrical work and other standard IS codes and standard for different E and M services.

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

1.0 INTERNAL ELECTRICAL WORKS

MAIN / SUB DISTRIBUTION BOARDS. (FLOORWISE ELECTRICAL PANELS)/ FEEDER PILLAR

GENERAL

MDB/ SDB shall be metal clad totally enclosed, rigid, floor mounting, air insulated, compartmentalized cubicle type Panel Board for use on 415 Volts, three phases, 50 cycle system. Equipment shall be designed for operation in high ambient temperature and humidity tropical atmospheric conditions. MDB/ SDB shall have minimum IP 54 Protection.

STANDARDS

The equipment shall be designed to conform to the requirements of :

- a) IS 8623 IS/IEC 60439 - Factory Built Assemblies of switchgear and control gear.
- b) IS / IEC 60947 - General requirements for switchgear and control gear for voltage not exceeding 1000 volts.
- c) IS 2147-Degrees of protection provided by enclosures for low voltage switchgear and control gear.
- d) IS 375 - Marking and arrangement of busbars.

Individual equipment housed in the MDB / SDB shall conform to the following IS specifications:

- | | | |
|----------------------------------|---|-----------------------|
| a) Moulded Case Circuit Breakers | - | IS/IEC -60947 (2). |
| b) Current Transformers | - | IS : 2705. |
| c) Indicating Instruments | - | IS : 1248. |
| d) Integrating Instruments | - | IS : 722. |
| e) HRC fuse links | - | IS : 13703 / IEC 269. |

CONSTRUCTIONS

MAIN / SUB DISTRIBUTION BOARD

Main / Sub Distribution Boards shall be constructed only of materials capable of withstanding the mechanical, electrical and thermal stresses, as the effects of humidity, which are likely to be encountered in normal service.

Each vertical section shall comprise of :

- a) A front framed structure of rolled/folded sheet steel channel section, of minimum 2mm thickness, rigidly bolted together. This structure shall house the components contributing to the major weight of the equipment, such as circuit breaker cassettes, fuse switch units, main horizontal busbars, vertical risers and other front mounted accessories.
- b) The structure shall be mounted on a rigid base frame of folded sheet steel of minimum 2mm thickness and 100 mm height or 100 mm x 50mm x 5mm thick MS Channel. The design shall ensure that the weight of the

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

components is adequately supported without deformation or loss of alignment during transit or during operation.

- c) A side cable chamber in Main / Sub Distribution Boards for housing the cable end connections, and power/ control cable terminations. The design shall ensure generous availability of space for ease of installation and maintenance of cabling, and adequate safety for working in one vertical section without coming into accidental contact with live parts in an adjacent section.
- d) A cover plate at the top of the vertical section, provided with a ventilating hood where necessary. Any aperture for ventilation shall be covered with a perforated sheet having less than 1 mm diameter perforations to prevent entry of vermin.
- e) Front and rear doors fitted with dust excluding neoprene gaskets with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors, generous overlap shall be assured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust.
- f) All doors shall be lockable mounted lock.
- g) Gland plate shall be 3mm thick.
- h) The height of the Main / Sub Distribution Boards should not be more than 2000mm. The total depth of the panel should be adequate to cater to proper cabling space and should not be less than 400mm. Operating handle not higher than 1700mm and not lower than 300mm from bottom of MDB / SDB.
- i) Doors and covers shall be of minimum 1.6mm thick sheet steel. All Load bearing members Sheet steel shrouds and partitions shall be of minimum 2mm thickness. All sheet panels shall be smoothly finished, levelled and free from flaws. The corners should be rounded.
- j) The apparatus and circuits in the panel board shall be so arranged as to facilitate their operation and maintenance and at the same time to ensure the necessary degree of safety.
- k) Apparatus forming part of the Main / Sub Distribution Boards shall have the following minimum clearances.
 - i. Between phases - 32mm.
 - ii. Between phases and neutral - 26mm.
 - iii. Between phases and earth - 26mm.
 - iv. Between neutral and earth - 26mm.
- l) When, for any reason, the above clearances are not available, suitable insulation shall be provided. Clearances shall be maintained during normal service conditions.
- m) Creepage distances shall comply to those specified in relevant standards.
- n) All insulating material used in the construction of the equipment shall be of non-hygroscopic material, duly treated to withstand the effects of the high humidity, high temperature tropical ambient service conditions.
- o) Functional units such as circuit breakers and fuse switches shall be arranged in multi-tier formation, except that not more than two air circuit

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

breakers shall be housed in a single vertical section. Cable entry for various feeders shall be from the rear / front. Panel board shall be suitable for termination of cable for incoming breakers.

- p) Metallic/perforated barriers shall be provided within vertical sections and between adjacent sections to ensure prevention of accidental contact with:
- q) Main busbars and vertical risers during operation, inspection or maintenance of functional units and front mounted accessories.
- r) Cable termination of one functional unit, when working on those of adjacent unit/units.
- s) All doors/covers providing access to live power equipment/ circuits shall be provided with tool operated fasteners to prevent unauthorized access.
- t) Provision shall also be made for permanently earthing the frames and other metal parts of the switchgear by two independent connections.

METAL TREATMENT AND FINISH.

All metal work used in the construction of the MDB / SDB should have under gone a rigorous metal treatment process as follows.

- a) Effective cleaning by hot alkaline degreasing solution followed by cold water rinsing to remove traces of alkaline solution.
- b) Picking in dilute sulphuric acid to remove oxide scales & rust formation, if any, followed by cold water rinsing to remove traces of acidic solution.
- c) A recognized phosphating process to facilitate durable coating of the paint on the metal surfaces and also to prevent the spread of rusting in the event of the paint film being mechanically damaged. This again, shall be followed by hot water rinsing to remove traces of phosphate solution.
- d) Passivating in de-oxalite solution to retain and augment the effects of phosphating.
- e) Drying with compressed air in a dust free atmosphere.
- f) A finishing coat of powder coat painted having a paint thickness of 60 micron & of Siemens grey colour.

BUSBARS

The busbars shall be air insulated and made of high conductivity, high strength aluminium alloy complying with the requirement of grade E-9IE of IS-5082.

The busbars shall be suitable braced with non-hygroscopic SMC supports to provide a through fault withstand capacity of 50KA RMS symmetrical for one second and a peak short circuit withstand capacity of 105KA. The neutral as well as the earth bar should be capable of withstanding the above level. Ridges shall be provided on the SMC supports to prevent tracking between adjacent busbars. Large clearances and creepage distances shall be provided on the busbar system to minimize possibilities of fault. Bus bar joint shall be thoroughly cleaned & a suitable oxidizing grease shall be applied before molding the joint. High tensile bolts, plain & spring washers shall be provided to ensure good contact at joints.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Overlap of the Busbar at joint shall be not less than the area of the cross section of the Busbar.

The Panel shall be designed that the cables are not directly terminated on the terminals of breaker/switch fuse/fuse switch etc. but on cable termination links. Capacity of aluminium busbars shall be as per Clause no/Para no. 7.2(iii) of CPWD general specification Electrical Works Part-1(2013). The main busbars shall have continuous current rating throughout the length of L.T. Panel. The cross section of neutral busbars shall be same as that of phase busbar for busbars of capacity upto 200Amp; for higher capacity the neutral busbar shall not be less than half (50%) the cross section of that the phase busbars. The busbar system shall consist of main horizontal busbar and auxiliary vertical busbars run in busbar alley/chamber on either side in which the circuit could be arranged/connected with front access. Connections from the main busbars to functional circuit shall be arranged and supported to withstand without any damage or deformation the thermal and dynamic stresses due to short circuit currents. Busbars to be colour coded with PVC sleeves. Busbar & main connection shall be marked by colour a letter as per table-VII of CPWD general specification for Electrical work Part-1(2013).

MOULDED CASE CIRCUIT BREAKERS

GENERAL

Moulded Case Circuit Breakers shall be incorporated in MDB/SDB wherever specified. MCCB's shall conform to IS/IEC 60947-2 and shall have test certificate for breaking capacities from independent test authorities CRPI / ERDA. MCCB's shall be suitable either for single phase AC 230 volts or three phase 415 volts. MCCB shall be with thermal magnetic release type upto 200A. All MCCB of 250Amp and above rating shall have microprocessor release in MDB/EMDB microprocessor based MCCB's should be with inbuilt Earth fault protection. Rated service breaking capacity should be equal to rated ultimate breaking capacity ($I_{cs} = I_{cu}$)

FRAME SIZES

The MCCB's shall have the following frame sizes subject to meeting the fault level specified elsewhere.

- i) Up to 100A rating 100Amp frame.
- ii) Above 100A to 250A 250Amp frame.
- iii) Above 250A to 400A..... 400Amp frame.
- iv) Above 400A to 630A..... 630Amp frame.
- v) Above 630A to 800A..... 800Amp frame.

CONSTRUCTIONS

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

The MCCB cover and case shall be made of high strength heat treatment and flame retardant thermo-setting insulating material. Operating handle shall be of quick make/quick break, trip-free type. The operating handle for simultaneous operation and tripping of all the three phases.

Suitable fire arc extinguishing device shall be provided for each contact. Tripping unit shall be of thermomagnetic type provided in each pole and connected by a common trip bar such that tripping of any one pole operates all three poles to open simultaneously. MCCB shall be line load reversible type. MCCB's shall be site adjustable thermal release (80% to 100%) of rated current. Device shall have IDMT characteristics for sustained overload and short circuits. MCCB shall be current limiting type MCCB shall be provided with rotary handle and Spreader Terminals.

Contacts tips shall be made of suitable arc resistant, silver alloy for long electrical life. Terminals shall be of liberal design with adequate clearance.

RUPTURING CAPACITY.

The Moulded Case Circuit Breaker shall have a minimum fault breaking capacity (Ics) of not less than 25 KA RMS at 415 volts for MDB / SDB & Meter Boards and / or higher capacity as specified in individual panel item.

TESTING.

Test certificate of the MCCB as per relevant Indian Standards (IS) shall be furnished.

MEASURING INSTRUMENTS, FOR METERING.

GENERAL

Direct reading electrical instruments shall be in conformity with IS 1248. The accuracy of direct reading shall be 1.0 for voltmeter and 1.0 for ammeters. Other type of instruments shall have accuracy of 1.5. The errors due to variations in temperature shall be limited to a minimum. The meter shall be suitable for continuous operation between -10 degree Centigrade to + 50 degree Centigrade. All meters shall be of flush mounting type of 96mm square or circular pattern. The meter shall be enclosed in a dust tight housing. The housing shall be of steel or phenolic mould. The design and manufacture of the meters shall ensure the prevention of fogging of instruments glass. Instruments meters shall be sealed in such a way that access to the measuring element and to the accessories within the case shall not be possible without removal of the seal. The meters shall be provided with white dials and black scale markings. The pointer shall be black in colour and shall have zero position adjustment device which could be operated from outside. The direction of deflection shall be from left to right.

Suitable selector switches shall be provided for all ammeters and voltmeters intended to be used on three phase supply.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

The specifications herein after laid down shall also cover all the meters, instrument and protective devices required for the electrical work. The ratings type and quantity of meters, instruments and protective devices shall be as per the schedule of quantities.

DIGITAL AMMETERS

Ammeters shall be digital type 7 segment LED display. Ammeter shall be suitable for accuracy class 1.0 and burden 0.5 VA approx. The ammeters shall be capable of carrying sustained overloads during fault conditions without damage or loss of accuracy.

DIGITAL VOLTMETERS

Voltmeter shall be digital type 7 segment LED display. Voltmeter shall be suitable for accuracy class 1.0 and burden 0.5 VA approx. The range for 3 phase voltmeters shall be 0 to 500 volts. The voltmeter shall be provided with protection fuse of suitable capacity.

CURRENT TRANSFORMERS

Current transformers shall be in conformity with IS: 2705 (Part I, II & III) in all respects. All current transformers used for medium voltage applications shall be rated for 1kv. Current transformers shall have rated primary current, rated burden and class of accuracy as required. However, the rated secondary current shall be 5A unless otherwise specified. The acceptable minimum class of various applications shall be as given below:

Measuring : Class 0.5 to 1.

Protection : Class 5P10.

Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault of 50KA on medium voltage system. Terminals of the current transformers shall be marked permanently for easy identification of poles. Separate CT shall be provided for measuring instruments and protection relays. Each C.T. shall be provided with rating plate.

Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CT's shall be copper conductor, PVC insulated wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

MISCELLANEOUS

Control switches shall be of the heavy-duty rotary type with escutcheon plates clearly marked to show the operating position. They shall be semi-flush mounting with only the front plate and operating handle projecting.

Indicating lamps shall be of the LED type, and with translucent lamps covers.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Push buttons shall be on the momentary contact, push to actuate type fitted with self-reset contacts & provided with integral escutcheon plates marked with its functions.

CABLE TERMINATIONS

Cable entries and terminals shall be provided in the sub distribution boards to suit the number, type and size of aluminium conductor power cable and copper conductor control cable specified.

Provision shall be made for top or bottom entry of cables as required. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated. Cable glands shall be double compression type, barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.

Cable risers shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults.

CONTROL WIRING

All control wirings shall be carried out with 1100/660V grade single core PVC cable conforming to IS 694/ IS 8130 having stranded copper conductors of minimum 1.5 sq.mm for potential circuits and 2.5 sq.mm for current transformer circuits. Wiring shall be neatly bunched, adequately supported and properly routed to allow for easy access and maintenance. Wiring shall be identified by numbering ferrules at each end. All control fuses shall be mounted in front of the panel and shall be easily accessible.

TERMINAL BLOCKS

Terminal blocks shall be 500 Volts grade of the stud type. Insulating barriers shall be provided between adjacent terminals. Terminal block shall have a minimum current rating of 10 Amps and shall be shrouded. Provisions shall be made for label inscriptions.

LABELS

Labels shall be of anodized aluminium, with white engraving on black background. They shall be properly secured with fasteners.

TEST AT MANUFACTURES WORK

All routine tests specified in IS : 8623-1977 shall be carried out and test certificates submitted to the Engineer-in-Charge.

TESTING AND COMMISSIONING

Commissioning checks and tests shall be included all wiring checks and checking up of connections. Primary/secondary injection tests for the relays adjustment/

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

setting shall be done before commissioning in addition to routine meggar test. Checks and tests shall include the following.

- a) Operation checks and lubrication of all moving parts.
- b) Interlocking function check.
- c) **Insulation test** : When measured with 500V meggar, the insulation resistance shall not be less than 100 mega ohms.
- d) Trip tests & protection gear test.

MINIATURE CIRCUIT BREAKER

The MCB's shall be of the completely moulded design suitable for operation at 240/415 Volts 50 Hz system.

The MCB's shall have a rupturing capacity of 10 KA.

The MCB's shall have inverse time delayed thermal overload and instantaneous magnetic short circuit protection.

Type test certificates from independent authorities shall be furnished.

FEEDER PILLAR

Outdoor type Feeder Pillars shall be suitable for 3 phase, 50Hz, 415 volts, A.C. system and shall generally conform to IS 5039. Rating and size of Feeder pillar shall be as detailed in drawings and in BOQ.

The Feeder pillar shall be fabricated out of heavy gauge 2.00 mm thick MS sheet steel with suitable stiffeners. Feeder pillar shall be constructed with slanting roof top/overhang for protection against rain & weather and adequately ventilated by providing louvers with wire mesh from inside. The Feeder pillar shall be provided with degree of protection IP 54 as per IS : 2147.

Feeder pillar shall be double door construction with M.S. hinges and handle for opening the door. Each door shall open to minimum 135 degrees. Locking on both the doors with two keys for each lock shall be provided with each pillar. The Feeder pillar shall be dust, vermin proof and weatherproof type.

Neoprene gaskets shall be provided for the doors. The enclosure shall be provided with ventilated louver cover with wire mesh, lifting hooks, supporting legs and double earth terminal with double washer.

The metallic parts of the enclosure shall be subjected to seven-tank process to include cleaning, derusting, rinsing, phosphatising etc. and epoxy painted.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Feeder pillar shall be provided with suitable size of aluminium alloy busbars. Kilowatt hour meter with RS485 communication port shall be provided in Feeder pillar.

Moulded case circuit breaker shall be provided for incoming and MCB shall be provided for outgoing feeders & conforming to IS 8828-1978. Gland plate shall be 3mm thick with suitable number of flanged type brass cable glands of required sizes shall be provided. Provision shall be suitable for lighting the interior when the doors are open. Danger notice board shall be provided on front door of the Feeder Pillar. Feeder pillar shall be complete with contactor, timers & switch gears for auto / manual operation of Street / Road lighting & Compound Lighting.

Feeder pillar shall fully comply with CPWD General Specification for Electrical works (Part-II External-1994). Erection or installation shall also be carried out as specified in CPWD Specification 1994.

INSTALLATION

Feeder Pillar shall be erected/installed on brick masonry foundation 600mm above surrounding ground level. All civil work like excavation PCC base concrete, brick masonry work, plastering, refilling, painting of brick masonry pedestal/foundation of feeder pillar including providing PVC sleeves in foundation for cable entry shall deemed to be included in quoted rates of feeder pillar.

FRAME SIZES

The MCCBs shall be of the standard frame of the manufacturer sizes subject to meeting the fault level as specified elsewhere.

CONSTRUCTIONS

The MCCB's cover and case shall be made of high strength heat treatment and flame retardant thermo-setting insulating material. Operating handle shall be quick make/quick break, trip-free type. The operating handle shall have suitable "ON", "OFF" "and" "tripped" indicators. Three phase MCCBs shall have common operating handle for simultaneous operation and tripping of all the three phases. MCCB shall be load/line reversible type. MCCB shall be site adjustable type with thermal setting of 80% to 100%.

Suitable extinguishing device shall be provided for each contact. Tripping unit shall be of thermo-magnetic or static release type provided in each pole and connected by a common trip bar such that tripping of any pole operates all three poles to open simultaneously. MCCB shall be current limiting type.

Contacts trips shall be made of suitable air resistant, silver alloy for long electrical life. Terminals shall be of liberal design with adequate clearance.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

2.0 DISTRIBUTION BOARDS

GENERAL SPECIFICATION FOR: MEDIUM VOLTAGE DISTRIBUTION BOARDS

General:

Distribution boards for Power & light circuit distribution shall be factory built and shall be suitable for 415volts, 3phase or 230 volts single phase supply as specified in BOQ. The distribution boards shall conform to IS 8623 (for factory built assemblies).

Makes:

Makes of DB's MCB, MCB, RCCB, RCBO, Isolators, Blanking plate etc are of same make.

Type

The following boards shall be of cabinet design, totally enclosed and shall provide protection against ingress to IP 42 of IS 2147. Only those types of DBs which have been type tested and passed by a national laboratory for IP 42 shall be offered.

However, if none of the type available from the approved makes to meet the above requirements, alternative makes can be offered with technical literature and copy of test certificate.

Components:

Distribution boards shall generally be provided with the following major components:

- a. Miniature circuit breakers
- b. Residual Current circuit breakers
- c. Bus Bars
- d. Neutral links/bus
- e. Earth Bus

Miniature Circuit Breakers:

MCBs shall generally conform to IS 8828. The breaking capacity of MCBs shall not be less than 10kA the miniature circuit breakers shall suitable for snap fixing on a standard DIN rail. The MCBs shall be suitable for operating under full load under ambient temperature conditions (i.e. -10OC to 55OC in India. MCBs shall have terminals suitable for receiving aluminium cables of adequate cross section. (Upto 32A rating 16sq.mm. & 40, 50, 63A 35sq.mm cable). Three phase MCB's shall have common trip bar so that all the poles make and break simultaneously.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

Residual Current Circuit Breakers:

Residual Current circuit breakers shall be used as incomers in distribution boards wherever specially called for in SOQ, RCCB shall be suitable for incorporation in standard DB manufactured by the approved manufacturers. RCCBs shall be of core balance type and shall not cause nuisance tripping. The RCCB shall be rated for 100mA fault circuit tripping. RCCB shall be provided with a test lamp and push button to test the healthiness of the circuit.

Bus Bars:

The bus bars shall be of copper and duly tinned or plated. The bus bar rating shall be atleast 100A as per manufacturers design.

Single phase DBs shall have Bus bars solidly anchored with single pole MCBs of specified ratings. The bus bars shall be fully shrouded. The bus bars shall be able to accept single, double or triple pole MCBs.

Three phase DBs shall have single piece bus bar and coupling link avoiding drilling and bolting of bus bars.

However, if the above 'unique bus bars' system is not available from the approved manufacturers alternative makes can be offered with full technical particulars.

Cabinet:

The DB cabinet shall be made of atleast 1.6 mm thick sheet steel duly stove enameled or powder coated (as per standard manufacturing product). The cabinet shall be suitable for either recess mounting or surface mounting.

The cabinet shall be provided with conduit cable entry knock-outs at top and bottom or top and bottom plates shall be of detachable construction. The cabinet shall be dust and vermin proof with proper gaskets for the front door.

The DB cabinet and internal mounting arrangements shall be such that the entire bus and MCB assembly could be easily detachable from the cabinet.

DIRECTORY

Distribution boards shall be provided with a write and protect directory indicating the area of loads served by each circuit breakers, the rating of breakers, size of conductors, etc. The directory shall be mounted in front of cabinet with an acrylic door.

INSTALLATION:

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Distribution boards shall be surface mounted or recessed mounted as required. DBs shall be mounted at the locations as shown on the approved execution drawings.

Surface boards shall be fixed with suitable angle iron clamps and bolts. All the cables/ conduits shall be properly terminated using glands/ check nuts etc. Wiring shall be terminated properly using crimping lugs/ sockets & PVC identification ferrules. Distribution boards shall be bonded to the earth at least on two points using brass bolts & lugs. Suitable name plate and danger plate, indicating the voltage shall be fixed to the front cover.

TESTING:

Distribution boards shall be tested at factory as per IS 8623 and original test certificate shall be furnished.

INTERNAL LIGHTING & POWER WIRING

GENERAL:

Medium voltage distribution system shall be applicable for wiring 3Phase, 4 wire 415 Volts, 50 HZ, AC supply and single phase, 2 wire 230 Volts, 50 HZ, AC supply.

REGULATION AND STANDARDS

The system shall be governed by the requirements of IS: 732 and I.E Rules and NEC. IS standards and Codes applicable for medium voltage distribution is also listed in specification.

REGID STEEL/PVC CONDUIT AND ACCESSORIES:

Rigid ERW steel/PVC conduit (as per SOQ) shall be screwed, sheet steel electric resistance welded and black stove enamelled (outside) and shall conform to IS 9537 Part I.

Makes of DB's shall be as per Acceptable Material / Approved List.

In case, any of the above makes does not bear ISI certification mark the contractor shall furnish a list of makes, which bear ISI certification mark, to choose from.

The conduit shall be routine tested at the works as per IS specifications and original test certificate furnished along with each major consignment delivered. The engineer-in-charge will determine size of the consignments requiring the original test certificate.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

In general, conduits shall be of good quality and shall conform to the following requirements:

- a. Shall be free from welding burrs.
- b. Wall thickness shall be uniform as far as possible.
- c. Ends shall be screwed.

Conduit accessories such as bends, inspection tees, round junction boxes, elbows, draw boxes etc. shall be of good quality and shall generally be in conformity with IS specifications. The fittings and accessories shall have threads or shall have internally tapped spouts. Junction boxes/ inspection boxes shall have suitable covers with screws.

Installation of conduits:

a. Open/ Surface conduit system:

Wherever, specifically called for, surface conduit system shall be adopted. Conduits shall be run in square and symmetrical lines. Before the conduits are installed the exact route shall be marked at site and approval of the engineer shall be obtained. Conduits shall be fixed by saddles, secured to suitable raw plugs, at an interval of not more than 0.6 meter. Wherever couplers, bends or similar fittings are used, the saddles shall be provided on either side at a distance as directed by the engineer-in-charge. Conduits shall be jointed by means of screwed couplers and screwed accessories only. In long distance, straight runs of conduit inspection type couplers or running type couplers with jam nut shall be provided. Threading shall be long enough to accommodate pipes to the full threaded portion of the couplers and accessories. Cut ends of conduits shall have neither sharp edges nor any burrs left to avoid damage to the insulation of the conductors. The cut ends/edges shall be filed before installation.

Bends in conduit run shall be done by bending conduits by pipe bending machine or any other suitable device as far as possible. Bends which cannot be made by a pipe bends shall be accomplished by introducing solid bends, inspection bends or cast iron inspection box. Not more than two equivalent 90° bends shall be used in a conduit run from the inlet to outlet.

All the conduit openings shall be properly plugged with PVC stoppers/ bushes. A breather-drainer shall be provided in the lowest position of the conduit system. The conduits shall be adequately protected against rust by applying two coats of approved synthetic enamel paint after the installation is completed.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Wherever conduits terminate into point control box, outlet box, distribution board, etc. conduits shall be rigidly connected to the box/board with check nuts on either side of the entry to ensure proper electrical and mechanical continuity.

b. **Recessed Conduit System:**

All the conduits including, bends, unions, junction boxes etc. shall be cleaned and painted with one coat of bituminous paint before they are fixed in position. Conduits which are to be taken in the ceiling slab shall be laid on the prepared shuttering work of the ceiling slab before concrete is poured. The conduits shall be properly threaded and screwed into sockets, bends, junction boxes, outlet boxes. The conduits in ceiling slab shall be straight as far as possible to facilitate easy drawing of wires through them. Before conduits are laid in the ceiling the position of outlet points, point control boxes, Junction boxes shall be set-out clearly so as to minimize offset and bends. Conduits recessed in walls shall be secured rigidly by means of steel hooks/ staples at intervals as directed by the engineer. Before conduit is concealed in the walls, all chases, grooves shall be neatly made to proper dimensions to accommodate the required number of conduits. The outlet for drawing wires and proper size earth continuity wire shall be run throughout the length of the conduit with the earth wire being efficiently fastened to the conduit by means of special clamps. Copper clamps shall be used for copper earth wire and GI clamps for GI wires.

CABLE TRUNKING/ RACEWAYS:

Cable trunking or raceways shall be of sheet steel construction or G.I. sheet. The thickness of sheet steel shall not be less than 16 gauges or as per Mentioned in S.O.Q. The sheet steel before fabrication shall be given a rigorous anticorrosive treatment. The trunking shall be provided with removable, covers of 1 meter length. The trunkings shall be supplied in suitable lengths. However, the maximum length of a single trunking shall not exceed 6 metre. The trunking shall be complete with 90O bends 145O bends, adopters, tee-pieces, couplers etc. Removable cable retainers shall be provided wherever required.

INSTALLATION

Trunking/ raceways shall be installed in readily accessible places. Trunking shall be supported at regular intervals of 1.0 metre to 2.0 metres as required. Trunking shall be aligned properly during the erection to present a neat appearance. Standard lengths of trunkings shall be jointed together by suitable couplers. Wherever required right angles bends, 145 O bends, tees, etc. shall be provided in the run of cable trunk/ raceways. Trunking shall be so arranged that not more than 30 cables run in any section. However, not more than 60% of cross-sectional area of the raceway shall be occupied by the conductors at any section. Trunking/raceways shall be bonded to the earth by a suitable size earth continuity conductor. Trunking shall be painted with two coats of approved synthetic enamel paint.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

ENCLOSURE FOR ELECTRICAL ACCESSORIES:

Enclosure for electrical accessories such as switches, sockets, fan regulators, etc. shall be mild steel conforming to IS: 5133 Part-I. The dimensions of the enclosures shall be as per clauses 3.1 to 6.3.1 of IS: 5133. The wall thickness of MS enclosures shall be not less than 1.6mm wherever specially called for; galvanised sheet steel boxes shall be provided. The enclosure boxes shall be provided with a minimum of four fixing lugs located conveniently for fixing the covers. All fixing lugs shall have tapped holes to take machined brass screws.

Sufficient number of knockouts of 38mm/32mm/ 25mm/ 20mm dia shall be provided for conduit entries. Enclosures shall be sufficiently strong to resist mechanical damage under normal service conditions. Provisions shall be made for bonding the enclosures to the earth. The enclosures shall be adequately protected against rust and corrosion both inside and outside with suitable air drying paint. The enclosures shall be provided with 3mm thick phenolic laminated cover for mounting switches, sockets, etc. wherever different phase conductors are brought into the same enclosure, phase barriers shall be provided. Phase barriers shall be of MS of hylam inserted in the box with slide-fit arrangement. Alternatively, boxes could be partitioned during construction.

WIRING CONDUCTOR

All wiring conductors shall be FRLS PVC insulated, standard copper conductors of 1100V Grade. Wiring conductors shall conform in all respects to IS: 694 (Latest Edition). Solid conductors may be used if specifically called for.

The current ratings for wiring conductors shall be based on the following parameters.

- | | | | |
|-----|-----------------------|---|------|
| i. | Ambient temperature | - | 400C |
| ii. | Conductor temperature | - | 700C |

Wiring Conductor shall be supplied in Red, Black, Yellow & Blue colours for easy identification of wires. The wiring conductors shall be supplied in sealed coils of standard length. The wiring conductor shall bear manufacturer's trade mark, name, voltage grade & size etc.

Installation of wiring conductors/ cables

The wiring conductors shall not be drawn into the conduits until the works of any nature that may cause damage to the wires are completed. Before drawing the wires the conduits shall be thoroughly cleaned, drained and ventilated. Proper care shall be taken in pulling the wires. The installation and termination of wires shall be carried out with due regard to the followings:

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- a. While drawing the wiring conductors, care shall be taken to avoid scratches and kinks which cause breakage of conductors. There shall be no sharp ends in the conduit system.
- b. Insulation shall be shaved off like sharpening a pencil.
- c. Strands of the wires shall not be cut for connecting to the terminals or lugs. The terminals shall have adequate cross section to take all the strands.
- d. Ends of the wiring conductors shall be terminated by using crimping sockets. Soldering of sockets shall not be done unless otherwise approved by the engineer-in-charge.
- e. Brass flat washers of large area shall be used for bolted terminals.
- f. Bimetallic connectors should be used wherever copper conductors are tapped from aluminium mains or vice-versa.

Wiring for power and lighting circuits shall be carried out in separate and distinct wiring system. Wiring for emergency system shall also be carried out in a separate and distinct wiring system. Balancing of circuits in a three phase system shall be arranged before the installation is taken up.

The wiring system envisaged is generally shown on the layout drawing and line diagrams, however, a brief account of the general wiring system is given below:

- a. Sub mains wiring - Wiring from switch boards to the individual distribution boards.
- b. Circuit Wiring - Wiring from switch boards to the individual distribution boards.
- c. Power Wiring - Wiring from DBs to the power socket outlets.

The sub main wiring shall be either in 3 Phase 4 wire, or Single Phase, 2 wire system. Each sub main wiring circuit shall also have its own copper earth continuity wire. The number and size of copper earth continuity wire. The number and size of copper earth continuity wire shall be as per the detailed drawings and specification.

Circuit wiring shall generally be of single phase however, a maximum of 3 to 4 single phase circuits belonging to the same phase/ pole could be installed in the same conduit or raceway. Each circuit wiring shall be provided with suitable copper earth continuity conductor as per Earthing specifications. Not more than ten light points/ fan points shall be grouped on one lighting circuit. The load per circuit shall not exceed 800 Watts. The minimum size of conductor for wiring of lighting circuits shall

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

not less than 2.5sq.mm. in case of copper conductor. Power wiring shall not have more than two sockets connected to one circuit. 4.0sq.mm. copper conductors shall be used upto the power socket. All the wiring shall be carried out in looping-in-loop system.

The maximum number of various size conductors that could be drawn in various sizes of conduits shall be as per table II of IS: 732 (Latest Edition). The wiring shall be colour coded for easy identification of phases and neutral. The following colour code shall be adopted.

Phase :	R	-	Red
	Y	-	Yellow/ White
	B	-	Blue
Neutral:		-	Black
Earth :		-	Green

All circuit wiring shall be provided with printed PVC identification ferrules at either end bearing the circuit number and designation.

The circuit wiring may be separately measured or included in point wiring as per the nomenclature given in BOQ equipment schedule/ particular specifications.

SWITCHES, SOCKETS AND ACCESSORIES

General Requirements

Light control switches shall be 5A rating for controlling upto four light points and 16A rating for more than four light points. Light control switches shall be of modular type of poly carbonate with PVC moulded front plate & GI boxes design suitable for flush mounting for general lighting. Wherever specifically called for surface mounting.

All sockets 6A and 16A ratings shall be modular type flush mounting with control switches of the same rating as that of the sockets. All sockets shall be of poly carbonate with pins made of brass alloy and plated with a noble metal. Sockets shall be mounted on PVC moulded front plate & GI boxes.

The modular type switch, socket, modular accessories etc should be guarantee for the period of 10 years, for this contractor shall submit the guarantee certificate from the company/ Original manufacturer.

Industrial type Sockets

Industrial type sockets shall be provided wherever specifically called for. Industrial sockets shall be totally metal clad with porcelain base incorporating the pins. Socket shall have 3Pins for single phase application and 5pins for 3 phase application. The sockets shall be provided with suitable metal clad plug top with suitable cable entry.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Sockets shall have metal covers with chain. Industrial type sockets shall be provided with a suitable sheet steel housing made of 16 Gauge with the sockets mounted in flush with cover of the housing.

Lamp holders, ceiling roses, etc.

Accessories for light outlets such as lamp holders, ceiling roses, etc. shall be in conformity with requirements of relevant IS specifications. Only approved make of accessories shall be supplied, if required.

Installation of Switches, sockets and accessories

All the switches shall be wired on phase. Connections shall be made only after testing the wires for continuity, cross phase etc. with the help of a megger. Switches, sockets, fan regulator etc. shall be housed in proper GI boxes with PVC moulded front plate covers. Regulators shall be fixed on adjustable MS flat straps inside the enclosure. The arrangement of switches and sockets shall be neat and systematic, fixed to the enclosure in plumb with counter sunk head. For wall plug sockets, the conductors shall be terminated directly into the switches and sockets. The outlets, point control boxes etc. shall be set out as shown on the drawings. Before fixing these, the contractor shall obtain clearance from the engineer-in-charge with regard to their proper locations. The enclosures of sockets/ and 3rd pin of the sockets shall be connected to the ground through a proper size earth continuity wires as laid out in specification of earthing section.

FANS

Ceiling fans

Ceiling Fans shall conform to IS: 374 (Latest Edition) all respects fan shall be smooth and silent in operation. The fan motor shall be a capacitor type motor with internal starter and external rotor pattern. The blades shall be made of aluminium sheets painted in off white shade. The design and construction of blades shall be such that maximum quantity of air is displaced in smooth manner. The motor and blades shall be statically and dynamically balanced. The fans shall be provided with ball bearing which is accessible for lubrication. The ceiling fan shall be provided with rubber shackle and a down rod of at least 12" long. The suspension arrangement shall be jointed to the fan motor by means of a thread joint and a safety locking arrangement. Fans shall be provided with bottom cover and a top canopy. A regulator for 5 speed operation and stop shall be provided with every fan. Electronic stepless regulators shall be provided, if specified. Ceiling fans shall be suspended from the special hooks or special fan hook boxes. Where hooks are used the wiring to the fan shall be from a ceiling rose. Wherever special fan hook boxes are used, the fan wiring shall be terminated in porcelain/ PVC auto way connector. Lead-in-wires shall have cross-section area of not less than 1.5mm (Copper).

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Exhaust Fans

Propeller type exhaust fan shall conform to IS: 2312 (Latest Edition) in all respects. The motor shall be of die cast aluminium case. The fan motor shall be of sq. cage induction design. Single phase motors shall be capacitor-start and run type. Exhaust fans be provided with a special anticorrosive treatment to withstand normal concentrations of chemical fumes in the environment.

The fan shall be designed to withstand the effects of moisture under normal conditions of use. The design of motor and its windings shall be such that moisture in surrounding is not absorbed by the winding. Exhaust fans shall be complete with mounting rings, ring arms and a resilient suspension. The motor and blades shall be statically and dynamically balanced. The blades shall be of mild steel sheets and so designed that they operate smoothly with minimum noise. The fans shall be finished to be a glossy gray shade with approved enamel paint. The fans shall also be provided with gravity louvers for exhaust arrangement or bird screen for inlet arrangement.

Exhaust fans shall be fixed at the locations shown on the drawings. The fans shall be fixed by means of rag bolts grouted in wall. Exhaust fan be connected to the exhaust fan point by means of a flexible cord.

POINT WIRING

Point wiring shall commence from the first point control box/ local control box for the points connected to the same circuit. Point wiring for lights, fans, 5A sockets, call bells, etc. shall be carried out with copper conductor PVC insulated wires of 1.5 sq.mm cross section or as per SOQ. The point wiring shall be inclusive of 20mm/ 25mm/ 32mm sheet steel conduits of standard and approved make (as specified herein-before) along with approved quality conduit accessories such as bends, inspection bends, reducers, junction boxes, etc. together with wiring accessories such as switches, ferrules, PVC bushes, connectors, point control boxes (enclosure for electrical accessories) etc. point wiring shall be provided with 1.5sq. mm. PVC insulated copper earth continuity wire for earthing 3rd point of sockets, luminaries and fan fixtures. Light control shall be either single, twin or multiple points controlled by a switch as specified.

TESTING AND ELECTRICAL INSTALLATION

Testing and installation shall be as per IS : 732-1963

- a. The insulation resistance shall be measured by applying between earth and the whole system of conductors or any section thereof with all fuses in places and all switches closed and except in earthed concentric wiring all lamps in position or both poles of the installation otherwise electrically connected together, where a direct current pressure of not less than twice the working pressure, provided that it need

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

not exceed 500 Volts for medium voltage circuits. Where the supply is derived from the three wires (A.C. or D.C) or a poly phase system the neutral pole of which is connected to earth direct or through added resistance, the working pressure shall be deemed to be that which is maintained between the outer or phase conductor and the neutral.

b. The insulation resistance measured as above shall not be less than 50 divided by the number of points on the circuits provided that the whole installation shall be required to have an insulation resistance greater than one meg-ohm.

c. Control rheostats, hearing and power appliances and electric signs may, if required, be disconnected from the circuit during the test, but in event the insulation resistance between the case of frame work and all live parts of each rheostat appliance and sign shall not be less than that specified in the relevant Indian Standard Specification or where there is no such specification shall not be less than half a meg-ohm.

d. The insulation resistance shall also be measured between all conductors connected to one pole or phase conductor of the supply and all the conductors connected to the middle wire or the natural or to the other pole or phase conductors of the supply and its value shall not be less than specified I sub-clause (b).

e. On completion of an electric installation (or an extension to an installation) a certificate shall be furnished by the Contractor countersigned by the certified supervisor under whose direct supervision the installation was carried out. The certificate shall be in prescribed form as required by the local electric supply authorities.

Testing of earth Continuity Path

The earth continuity conductor including metal conduits and metallic boxes / enclosure of in all cases shall be tested for electric continuity and the electrical resistance of the same along with the earthing lead but excluding any added resistance or leakage circuit breaker measured from the connection with the earth electrodes to any point in the earth continuity conductor in the completed installation shall not exceed one meg-ohm.

Testing of polarity of non-linked single pole switches

a. In a two wire installation a test shall be made to verify that all non linked single pole switches have been fitted in the same conductor throughout and such conductor shall be labelled or marked for connection to an outer on phase conductor or to the non-earthed conductor of the supply.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- b. In a three wire or four wires installation a test shall be made to verify that every non-linked single switch is fitted in a conductor which is labelled, marked for connection to one of the outer phase conductor of the supply.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

AE-I
(EPD-4)

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(EPD-4)

AE (P)
(CPM (Housing))

EE(P)
(CPM (Housing))

3.0 **POINT WIRING & SUBMAIN WIRING**

(A) CONDUITING & WIRING FOR POINT WIRING

Conduiting & Wiring of Light point / Fan point / Exhaust Fan Point / Light plug Point / Power outlet point / Call Bell etc shall be carried out as per CPWD General specification 2013 for Internal Electrical Works & as Specified in BOQ items. Conduiting for Point Wiring & Submain wiring shall be carried out with MS Conduit. Conduiting shall be recessed in ceiling slab/wall. Incase of false ceiling area conduiting may be carried out on surface above false ceiling and recessed in wall below false ceiling.

CONDUITING & WIRING FOR SUB MAINS (ELECTRICAL)

Conduiting & Wiring for Electrical Sub main wiring shall be carried out as per CPWD General Specification 2013 for Internal Electrical works and as specified / mention in BOQ Items.

Junction Box Provided in Submain wiring / Point wiring & at DB Location for termination & redressing of conduit / wiring & shall deemed to be included in quoted retes of Point / Submain wiring.

(A) INSTALLATION OF LIGHT FIXTURES

SUPPORTS AND FIXINGS

Where LED luminaires 1200 mm or more in length are supported directly by the conduit system they shall be fixed to two circular conduit boxes both of which shall form an integral part of the conduit system.

Where the weight of the luminaire is supported by a conduit box or cable trunking the fixing of the conduit box or trunking shall be adequate for the purpose and approved by Architect/Consultant.

Support of luminaires from cable trunking shall be by means of appropriate clamps or brackets.

Luminaires mounted on or recessed into suspended ceilings shall not be support on the false ceiling unless specifically shown and approved.

For wall mounted luminaires, the mounting height specified on drawings shall be above finished floor level measured to the centre of the conduit box, unless otherwise indicated.

WIRING CONNECTIONS

Where luminaires, other than those are fixed direct to circular boxes or supported by pendants or chains, the final circuit wiring shall terminate at a terminal block in the conduit box.

Where luminaires are fixed direct to circular conduit boxes, the final circuit wiring may be terminated within the luminaire unless otherwise indicated. The wiring shall enter each luminaire at the conduit entry nearest to the terminal block and

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

where the loop - in wiring system is used leave by same entry wiring shall not pass through a luminaire.

Where luminaires are mounted on or recessed into a suspended ceiling connection shall be by flexible cord from a plug in ceiling rose shall be located not more than 500 mm from the access panel in the ceiling and shall be firmly supported, unless otherwise approved by the consultant.

Cables and flexible cords for final connections to luminaires shall be suitable for the operating temperature of the luminaire. Flexible cords for chain suspensions, if any shall have a white sheath unless otherwise indicated.

The size of final connection cables or flexible cords shall be as indicated. Cables and cords passing close to ballast within a luminaire shall be suitable for the operating temperature of the ballast. Heat resistant sleeves shall be provided. A protective conductor shall connect the earthing terminal or earthing contact of each luminaire to an earthing terminal incorporated in the adjacent conduit box. Where the final connection is by flexible cord the protective conductor shall form part of the cord.

Where luminaires are recessed in the false ceiling, luminaires shall be suspended with MS conduit with ball & socket arrangement, checknut etc. Suspension arrangement shall be fixed to steel/RCC structure with suitable purpose made clamps etc. (Cost of suspension arrangement is deemed to be included in the rate of installation/erection of luminaires). Contractor shall submit the shop drawing for proposed suspension arrangement of various types of light fixtures in various type of ceiling and shall obtain necessary approval from the Engineer-in-Charge.

The light fixtures and fans shall be assembled and installed in position complete and ready for service in accordance with the detailed drawings, manufacturer's instructions and to the satisfaction of the Engineer - In - Charge. Fixtures shall be suspended true to alignment plumb level and capable of resisting all lateral and vertical forces and shall be fixed as required. All ceiling fans shall be provided with suspension arrangement in the concrete slab/roof members. It shall be the duty of the contractor to make these provisions at the appropriate stag & locations shown on the drawings. Fan box with MS hook shall be as per CPWD specifications. Suspended type fluorescent light fixture shall be fixed to circular junction box with a metallic ball and socket arrangement. Light fixture in general shall be directly fixed to ceiling slab with rawl plugs. All switch and outlet boxes shall be bonded to earth through connector blocks. MS pipe shall be fixed with suitable fixing accessories and metal continuity shall be maintained.

SPECIFICATION FOR LED

SCOPE

- This specification covers for supply of Light Emitting Diode (LED) lighting that shall be used as general lighting.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- The lumen maintenance of the LED fittings (of the system not chip) shall not be less than 70% after 50000 hrs. i.e. (L70; B10). It shall have a warranty of 5 years after delivery.
- The product should be latest state of art and compliant to relevant IEC 60598- 1, 2, 3, or their latest edition depending on the type of luminaire. In addition to the above luminaire shall adhere to relevant BIS standards IS 15885, 16101, 16104, 16105, 16106, 16107 (Part I & II) as per the application. The product shall be of proven design & manufacturer shall provide type test certificate / performance certificate from any NABL accredited laboratory. The product and its major components shall be state of art and of proven design.

FIXTURES

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

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- The fixture shall be provided with proper wiring up to terminal along with proper earthing arrangements. All Internal wiring for the luminaires shall be FRLSZH type.
- Provision shall be made for main connection directly & the location of connector shall be finalized in discussion with Employer's representative for ease of execution.
- All the indoor luminaires shall have minimum system efficacy of 80lm/w with exception for decorative luminaires & bulkhead luminaires. The bulk head luminaire shall have minimum system efficacy of 60lm/w. All outdoor luminaires shall have minimum system efficacy of 90lm/w except for post-tops, bollards, landscape lighting luminaires, façade lighting luminaires or any other decorative luminaires.

LED FEATURES

- Manufacturer should have LM-80 report and projected life of the chip. Manufacturer has to submit the LM-79 test report for luminaires.
- High lumen efficacy LEDs suitable for the application along with following features shall be used:
- LED Efficacy at the chip level shall > 100 lumen/watt (For High power LED)
- The efficiency of the LED at 85 Degree C junction temperatures shall be more than 85%.
- The minimum system luminous efficacy of LED luminaire' shall be as under:-
Efficacy > 75 lumen/Watt for low wattage luminaries (<45W); and
Efficacy > 90 lumen/watt for high wattage luminaries (>45W)
For decorative luminaires: 60lm/w.

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

- Minimum view angle of the LED shall not be less than 120°C.
- Power factor of complete fitting shall be more than 0.9.
- LED shall be surface mounted type duly soldered to PCB by Reflow system or COB type. The Solder used shall be ROHS compatible for environment friendliness.
- Input frequency range shall be between 50Hz±3%.
- Colour rendering index CRI >=80 for Indoor luminaires and CRI > = 70 for Outdoor luminaires except decorative luminaires.
- Correlated Colour Temperature shall be in the range of 3000K-6500K. While designing it should be taken care to choose CCT which helps in achieving higher system efficacy & consistency of CCT should be maintained in all areas & special care should be taken that luminaire with different CCT are not used across different areas.
- It shall have an SDCM (standard deviation in colour maintenance) of < 5.
- The LED efficiency shall be more than 85% at a junction temperature of 85°C.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- LED driver and Control Circuit Specification:-
- LED driver shall have following features:
- The LED driver shall be constant current type.
- Input voltage range within 160 V (RMS) to 270 V (RMS) at 50 HZ.
- The driver shall be able to withstand surge (EFT+ESD interference) of minimum 2 KV with a rise time of 20 nanoseconds.
- Output voltage of the driver shall be designed to meet the power requirement of the system.
- The driver shall have over voltage withstand protection & output short circuit protection.
- Output voltage ripple shall be within 3%.
- The LED drivers should have dimming option only if the same is mentioned in tender BOQ line item.
- The driver shall have an efficiency ~ 85%
- Total Harmonic Distortion shall be :-
- For 0- 50 W for shall be less than 25% (<25% for 0-50 W)
- bove 50 W rating shall be less than 15%. (<15% for >50 W)
- The Current waveform should meet EN 61000-3-2.
- LED driver shall withstand voltage of 340V for 2 hours and restore normal working when normal voltage is applied.
- The driver should comply with CISPR 15 for limits and methods of measurement of Radio Disturbance characteristics.
- The equipment should comply with IEC 61547 for EMC immunity requirements.
- The control gear should be compliant to IEC 61347-2-13, and IEC 62384.
- It shall have a power factor >.9.

General

- a. The lumen maintenance of the LED lightings shall not be less than 70% after 50,000 hours i.e. L70 (B50).
- b. The supplier shall provide evidence that the LED chipset manufacturer has the patent right to produce the supplied LED chipset to avoid infringement of white LED patent.
- c. **All the LED fitting, fixture shall be warranty for the period of 5 years from the date of handed over to the department. The warranty is directly from the original manufacturer. The contractor shall submit the warranty certificate from the OEM to the department. The warranty of replaced/rectified item shall remain for balance period from the date of rectification/replacement. Test reports for various parameters i.e. Flux, power, efficacy, chromaticity, Co related Colour.**
- d. All the lighting fixture to be installed in the false ceiling should be supported from the ceiling. For this adjustable suspension arrangement will

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

be used for hanging the fitting in the false ceiling. Nothing extra will be paid by the department in this regard.

OCCUPANCY SENSORS

Introduction

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

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

DESCRIPTION OF WORK

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

QUALITY ASSURANCE

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

CEILING MOUNTED OCCUPANCY SENSORS

1. Sensors shall operate on a class 2, three-conductor system. Sensors shall operate at nominal 24VDC.
2. Sensor shall immediately turn on lighting when occupancy is detected.
3. Sensor shall employ Power Pack to supply power to sensor.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

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

4.0 CONDUITING & WIRING FOR TELEPHONE / SATELLITE MASTER ANTENNA TELEVISION (SMATV) SYSTEM.

GENERAL

Contractor shall supply & install conduit for outlet points for Telephone & SMATV System, complete as required.

CONDUITING

Conduiting shall be carried out in MS Conduit. Separate conduit shall be provided for Telephone & SMATV system. Conduiting shall be carried out as per as per CPWD General Specification for Electrical Works Part I (Internal).

TELEPHONE WIRING

Each telephone outlet shall be wired in conduit with 0.50 mm dia annealed tinned copper conductor PVC insulated and PVC sheathed unarmoured cable from floor-wise Telephone Tag Block. Main Telephone tag block shall be fixed on ground floor. Floorwise tag block shall be wired from Main telephone tag block with multi-paired armoured 0.50 mm dia annealed copper conductor PVC insulated & PVC sheathed cables.

OUTLETS

All outlet boxes shall be modular plate type accessories. Cover plate shall match in shape & finish with other light and power accessories. For telephone outlet RJ-11

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Jack outlets shall be provided. Modular TV outlet point shall be provided for SMATV system. Wiring shall be done with RG6 & RG59 Cable as mention in BOQ item. Modular cover plate & socket shall be covered under respective subhead of SMATV system.

TELEPHONE DISTRIBUTION BOARD

Telephone Tag Block shall be fabricated from 1.63 mm thick M.S. Sheet duly powder coated after metal treatment. Telephone Distribution Board shall be equipped with krone type tag block of size as mentioned in BOQ. Tag block shall be double jumpering type and shall be suitable for termination of extra pair provided in wiring/ cabling of each outlet. Box shall have hinged cover and finish shall match with aesthetic finish of the building.

JUNCTION BOXES FOR SMATV/ TELEPHONE SYSTEM

Conduiting of outlet points shall terminate in a junction box in respective area. Junction box shall be sufficient dimension or as per dimension in BOQ to accommodate all the conduits. Junction box shall be of sheet steel of minimum 1.63mm thick and cover shall be of 3mm thick phenolic laminated sheet fixed to junction box with brass screws.

5.0 LIGHTNING PROTECTION SYSTEM (ESE TYPE)

- Early streamer emission based lightning protection shall be used with copper pipe and copper base plate. The arrestor / base plate shall be connected to separate earth pit with copper cable.
- The lightning rod shall be based on Early Streamer Emission (ESE) technology and shall be capable of operating in all weather conditions and shall comply to NFC-17-102 standards.
- It shall have a corrosion resistant stainless steel body (AISI 316 grade) capable of working in hazardous atmosphere.
- The lightning rod shall be self powered type and shall not require any form of external power supply / batteries for its operation.
- The lightning rod shall be designed and type tested for gain in anticipation time (ΔT) from any recognized / internationally reputed third party test house according to NFC-17-102.
- The entire lightning protection system including determining level of protection, mounting arrangement, number of down conductors, their routing, location of earth pits shall be designed as per NFC-17-102.
- The down conductor shall be either a copper flat / a PVC insulated cable of appropriate size (70 sqmm.)
- A lightning strike counter shall be installed at a convenient location on down conductor to indicate the number of lightning strikes that have taken place.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- The lightning rod shall be capable of being tested at site with a portable hand held tester. The tester shall be of self diagnostic type and shall have a sufficiently large LCD display to avoid errors during testing.

GROUNDING

- The maintenance free earthing should be done with 4 nos. of copper bonded steel earth rods of 250 microns with minimum 2metre length and 15mm diameter in radial fashion or any geometrical shape on site condition. All the joints must be properly clamped using high performance rod clamps. Electrically conductive GEM (Ground Enhancement Material) should be used in treating the earth to reduce the overall impedance offered by the earth. The earth test point (inspection pit of 300 X 300mm) will be provided for measuring the earth resistance less than 10 ohms as per the standards. Resistance value of less than 5 ohms is highly desirable.
- Required distance between lightning conductor & buried utilities as per NFC-102:1995 & NFC- 100: 1987 is to be ensured at time of execution
- 1. The distance between lightning conductor & H.V electrical should be 0.5m (ground resistivity less than 500 Ohm-m). For unearthed LV electrical 2m, for earth termination system/LV distribution 10 m, for metal pipe 2m.
- The distance between lightning conductor & H.V electrical should be 0.5m (ground resistivity greater than 500 ohm-m). For unearthed LV electrical 5m, for earth termination system/LV distribution 20m, for metal pipe 5m.

TESTING

- Following tests shall be performed by the manufacturer at manufacturer's premises in presence of Engineer-in-charge/Consultant and the results shall be recorded and submitted to client.
- The lightning rods shall be designed for operating efficiently upto an earth resistance value of 10 ohms.

6.0 CABLES (L.T. CABLES)

L.T. CABLES

GENERAL

L.T. Cables shall be supplied, inspected, laid tested and commissioned in accordance with drawings, specifications, relevant Indian Standards specifications and cable manufacturer's instructions. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drums. The recommendations of the cable manufacturer with regard to jointing and sealing shall be strictly followed.

MATERIALS

L.T. Cables shall be XLPE insulated and PVC sheathed aluminium conductor armoured cables conforming to IS: 7098 (Part I)-1988. Cables shall be of 1100volt and with ISI certification mark. Conductor of power cables shall be made of electrical purity aluminium conforming to IS 8130-1984. All power cables shall be FRLS type.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

INSTALLATION OF CABLES

Cables shall be laid directly in ground, pipes, masonry ducts, on cable tray, surface of wall/ceiling etc. as indicated on drawings and/or as per the direction of Engineer-in-Charge. Cable laying shall be carried out as per CPWD specifications.

INSPECTION

All cables shall be inspected at site and checked for any damage during transit.

JOINTS IN CABLES

The Contractor shall take care to see that the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilization and avoiding of cable joints. This apportioning shall be got approved from Engineer-in-Charge before the cables are cut to lengths.

LAYING CABLES IN GROUND

Cables shall be laid by skilled experienced workmen using adequate rollers to minimize stretching of the cables. The cable drums shall be placed on jacks before unwinding the cable. With great care it shall be unrolled on over wooden rollers placed in trenches at intervals not exceeding 2 metres. Cables shall be laid at depth of 0.75 metres below ground level. A cushion of sand total of 250mm shall be provided both above and below the cable, joint boxes and other accessories. Cable shall not be laid in the same trench or along side a water main.

The cable shall be laid in excavated trench over 80mm layer of sand cushion. The relative position of the cables, laid in the same trench shall be preserved. At all changes in direction in horizontal and vertical planes, the cables shall be bent smooth with a radius of bent not less than 12 times the diameter of cables. Minimum 3 metre long loop shall be provided at both end of cable.

Distinguishing marks may be made on the cable ends for identifications of phases. Insulation, tapes of appropriate voltage and in red, yellow and blue colours shall be wrapped just below the sockets for phase identifications.

HDPE PIPE

- a) The DWC high density polyethylene pipe having corrugation on outer wall & plain in inner wall should confirm to IS – 14930 Part – I & II amended upto date.
- b) Contractor has to arrange inspection of pipe at manufacturer's premises to carry out necessary test's contained in IS – 14930 part – I & II (compression test, impact test banding test etc.)
- c) Job includes accessories like HDPE snap fit coupler with required No. of neoprene 'O' rings in order to make water / damp proof joint.
- d) Contractor has to produce test report of anti rodant test, toxicity test of pipe from Govt. approved test house.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

PROTECTION OF CABLES

The cables shall be protected by bricks laid on the top layer of the sand for the full length of underground cable. Where more than one cables is laid in the same trench, the bricks shall cover all the cables and shall project a minimum of approximately 80mm on either side of the cables. Cable under road crossings and any other places subject to heavy traffic, shall be protected by running them through Hume Pipes of suitable size.

EXCAVATION & BACK FILL

All excavation and back fill required for the installation of the cables shall be carried out by the Contractor in accordance with the drawings and requirements laid down elsewhere. Trenches shall be dug true to line and grades. Back fill for trenches shall be filled in layer not exceeding 150mm. Each layer shall be properly rammed and consolidated before laying the next layer.

The Contractor shall restore all surface, road ways, sidewalks, kerbs wall or the works cut by excavation to their original condition to the satisfaction of the Engineer-in - Charge.

LAYING OF CABLES ON CABLE TRAY/SURFACE OF WALL/CEILING

Cable shall be laid on perforated / Ladder M.S. Cable tray. Cables shall be properly dressed before cable ties/clamps are fixed. Wherever cable tray is not proposed, cables shall be fixed on surface of wall or ceiling slab by suitable MS clamps/saddles. Care shall be taken to avoid crossing of cable.

CABLES ON HANGERS OR RACKS

The Contractor shall provide and install all iron hangers racks or racks with die cast cleats with all fixings, rag bolts or girder clamps or other specialist fixing as required.

Where hangers or racks are to be fixed to wall sides, ceiling and other concrete structures, the Contractor shall be responsible for cutting away, fixing and grouting in rag bolts and making good.

The hangers or racks shall be designed to leave at least 25mm clearance between the cables and the face to which it is fixed. Multiple hangers shall have two or more fixing holes. All cables shall be saddled at not more than 150mm centres. These shall be designed to keep provision of some spare capacity for future development.

CABLES TAGS

Cable tags shall be made out of 2mm thick aluminium sheets, each tag 1-1/2 inch in dia with one hole of 2.5mm dia, 6mm below the periphery. Cable designations are to be punched with letter/number punches and the tags are to be tied inside the panels beyond the glanding as well as below the glands at cable entries. Trays tags are to be tied at all bends. On straight lengths, tags shall be provided at every 5 metres.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

TESTING, MANUFACTURER'S TESTS, PRE-COMMISSIONING TESTS AND COMPLETE COMMISSIONING

The General intent of this specification is to mention the relevant tests to be done and furnished to the Engineer-in-Charge by the Contractor. These are guidelines. However the Contractor shall carry out all such tests and complete all formalities as per relevant Indian Standard Specifications, Fire Insurance Requirements and/or Electricity Rules and Regulations as per Government Gazette and Publications.

a) Testing of Equipment:

All equipment before installing on the site work shall be tested and all such results produced to the Engineer-in-Charge. Nothing shall absolve the Contractor from re-performing any tests that the Contractor may be called upon specifically by the Engineer-in-Charge or supply company or electrical inspector. All equipment shall be tested jointly with the Engineer-in-Charge as required by various sections of the specifications and test data shall be furnished as required.

b) Pre-commissioning Tests:

All rules, regulations and requirements of Electrical, Government or Local Authorities and of Indian Standard Specifications and/or Rules and Regulations stated in Indian Electricity Act shall be strictly complied.

On completion of erection the contractor shall clean all the equipment thoroughly and inspect the entire installation for correctness and shall furnish a report of completion to the Engineer-in-Charge. Pre-commissioning tests shall commence only on approval of this report by the Engineer-in-Charge.

All tests and the certification thereof shall only be carried out by those authorized, skilled, experienced and certified permit holders of the Supervisor Category of State Government's Industries and Labour Department. No unauthorized personnel shall ever carry out any such tests as stated herein under.

- i) Mechanical Operational tests for all movable parts of switchgears, breakers, tripping devices etc.
- ii) Phase sequence tests at all the relevant points for connecting correct R, Y and B as per the supply utility sequence.
- iii) All Panels to be tested for interlocks, control tripping and breakers to be tested for sequential tripping.
- iv) Continuity tests shall be done for noting any short circuits and/or earthing of phases.
- v) Earthing tests for continuity of Earth by earth megger, on L.V. side. The earth resistance values shall not exceed 5 ohm.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

7.0 CABLE TRAY

- PERFORATED TYPE

The cable tray shall be fabricated out of slotted/perforated MS sheets as channel sections, single or double bended. The channel sections shall be supplied in convenient lengths and assembled at site to the desired lengths. These may be galvanised or painted as specified.

Typically, the dimensions, fabrication details etc. are shown in CPWD General Specification for Electrical Works Part-II-External & sizes described in schedule of quantities.

The jointing between the sections shall be made with coupler plates of the same material and thickness as the channel section. Two coupler plates, each of minimum 200mm length, shall be bolted on each of the two sides of the channel section with 8mm dia round headed bolts, nuts and washers. In order to maintain proper earth continuity bond, the paint on the contact surface between the coupler plates and cable tray shall be scraped and removed before the installation.

The maximum permissible uniformly distributed load for various sizes of cable trays and for different supported span are as per Table-IV of CPWD General specifications of Electrical Work Part-II - 1994. The sizes shall be specified considering the same.

Factory fabricated bends, reducers, tee/cross junctions, etc. shall be provided as per good engineering practice (Details are typically shown in figure-3 of CPWD General specifications of Electrical Work Part-II – 1994). The radius of bends, junctions etc. shall not be less than the minimum permissible radius of bending of the largest size of cable to be carried by the cable tray.

The entire tray (except in the case of galvanised type) and the suspenders shall be painted with two coats of red oxide primer paint after removing the dirt and rust, and finished with two coats of spray paint of approved make synthetic enamel paint.

LADDER TYPE

Ladder type cable tray shall be fabricated out of double bended channel section longitudinal members with single bended channel section rungs of cross members welded to the base of the longitudinal members at a centre to centre spacing of 250mm. The channel sections shall be supplied in convenient lengths and assembled at side to the desired lengths. These may be galvanised or painted to the desired lengths.

Typically, the dimensions, fabrication details etc. are shown in CPWD General Specification for Electrical Works - Part II -External, 1994.

The jointing between the sections shall be made with coupler plates of the same material and thickness as the channel section. Two coupler plates, each of minimum 200mm length, shall be bolted on each of the two sides of the channel section with 8mm dia round headed bolts, nuts and washers. In order to maintain

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

proper earth continuity bond, the paint on the contact surfaces between the coupler plates and cable tray shall be scraped and removed before the installation.

The maximum permissible uniformly distributed load for various sizes of cables trays and for different supported span are as per CPWD General Specification of Electrical Work Part II -1994. The sizes shall be specified considering the same.

The width of the cable tray shall be chosen so as to accommodate all the cable in one tier, plus 25% additional width for future expansion. This additional width shall be minimum 100mm.

Factory fabricated bends, reducers, tee/cross junctions, etc. shall be provided as per good engineering practice. Details are typically shown in figure 3 of CPWD General Specification of Electrical Work Part-II-1994. The radius of bends, junctions etc. shall not be less than the minimum permissible radius of bending of the largest size of cable to be carried by the cable tray.

The entire tray (except in the case of galvanized type) and the suspenders shall be painted with two coats of red oxide primer paint after removing the dirt and rust, and finished with two coats of spray paint of approved make synthetic enamel paint.

The cable tray shall be bonded to the earth Terminal of the switch bonds at both ends.

INSTALLATION & MEASUREMENT OF CABLE TRAY/ LADDER

The cable tray shall be suspended from the ceiling slab with the help of 10mm dia MS rounds or 25mm x 5mm flats at specified spacing as per of CPWD General Specification of Electrical Work Part II -1994. Flat type suspenders may be used for channels upto 450mm width bolted to cable trays. Round suspenders shall be threaded and bolted to the cable trays or to independent support angles 50mm x 50mm x 5mm at the bottom end as specified. These shall be grouted to the ceiling slab at the other end through an effective means, as approved by the Engineer, to take the weight of the cable tray with the cables.

The cable trays shall be measured on unit length basis, along the center line of the cable tray, including bends, reducers, tees, cross joints, etc, and paid for accordingly.

8.0 EARTHING

- SCOPE

This section covers the essential requirements of earthing system components and their installation. for details not covered in these specifications, IS Code of Practice on Earthing (IS : 3043-1987) shall be referred as per relevant Indian Electricity Rules 1956 Ammended upto date, shall conform to CPWD General specifications for

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

Electrical works (part-I-Internal) & part IV-substation as amended upto date and in the regulations of the local Electrical Supply Authority shall be referred to.

APPLICATION:

- i) The electrical distribution system is with earthed neutral (i.e. neutral earthed at the transformer/ generator end). In addition to the neutral earthing, provision is made for earthing the metallic body of equipments and non-current carrying metallic components in the substation & DG set, as well as in the internal/ external electrical installations.
- ii) Earthing requirements are laid down in Indian Electricity Rules, 1956 and Indian standard Specification IS:3043:1987 with latest amendment as amended from time to time, and in the Regulations of the Electricity Supply Authority concerned. These shall be complied with.
- iii) Number & type of Earth Electrode size of Earth continuity conductor and recommended material (Copper 7 G.I.) shall be as per CPWD General specification for Electrical Works Part-1(Internal-2013), Part-IV (Substation-2013), Appendix-F & Table VIII of CPWD Specification Internal-2013.

MATERIALS

The material of earth and earth conductor shall be as specified in BOQ.

EARTH ELECTRODES

The type of earth electrode shall be any of the following:-

- a) Plate/ Pipe earth electrode as specified in BOQ.

Electrode materials and dimensions

The materials and minimum sizes of earth electrodes shall be as specified.

EARTHING CONDUCTOR

The earthing conductor (protective conductor from earth electrode upto the main earthing terminal/ earth bus, as the case may be) shall be of the same material as the electrode, viz. GI or copper and in the form of wire or strip as specified. The size of earthing conductor shall be as specified.

Each equipment shall be connected with two independent earth conductors to earth bar located in respective area. Each earth bar shall be connected to Earth Grid by two independent earth conductors. Earthing Grid shall be directly connected by two independent earth electrodes. Earthing shall be of GI or Copper.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

HARDWARE ITEMS

All hardware items used for connecting the earthing conductor with the electrode shall be of GI in the case of GI pipe and GI plate earth electrode and forged tinned brass in case of copper plate electrodes.

PROTECTIVE (EARTH CONTINUITY/ LOOP EARTHING) CONDUCTOR

- i) The material and size of protective conductors shall be as specified.
- ii) Unless otherwise specified, GI conductor should not be ordinarily used as protective conductor within any circuit beyond a Distribution Board downstream.

LOCATION FOR EARTH ELECTRODES

Normally an earth electrodes shall not be located closer than 1.5 m from any building. Care shall be taken to see that the excavation for earth electrode does not affect the foundation of the building; in such cases electrodes may be located further away from the building, with the prior approval of the Engineering-In-Charge.

The location of the earth electrode shall be such that the soil has a reasonable chance of remaining moist as far as possible. Entrances, pavements and roadways, shall be avoided for locating earth electrodes.

INSTALLATION

ELECTRODES

PIPE ELECTRODE

Earthing electrode shall consist of a medium class GI Pipe of approved make not less than 40mm dia and 4.0 meters long. GI Pipe electrode shall be cut tapered at the bottom and provided with holes of 12mm dia drilled at not less than 75mm interval upto 2 meters length from bottom. The electrode shall be buried vertically in the ground as far as practicable below permanent moisture level with its top at not less than 20cm below ground level. The electrode shall be in one piece and no joints shall be allowed in the electrode. Wherever possible earth electrodes shall be located as near water tap, water drain or a down take pipe. Earth electrodes shall not be located in proximity to a metal fence. It shall be kept clear of the building foundations and in no case shall be nearer than 2 meters from the outer face of the wall. Refer Sketch for additional details.

The pipe earth electrode shall be kept vertically and surrounded with 150mm thick layer of charcoal dust and salt mixture upto a height of 2.0 meters from the bottom. At the top of the electrode a funnel with a mesh shall be provided for watering the earth. The main earth conductors shall be connected to the electrode

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

just below the funnel, with proper terminal lugs and check nuts. The funnel over the GI pipe and earth connection housed in a masonry chamber, approximately 350mm deep. The masonry chamber shall be provided with a MS frame with MS cover, 6mm thick, and having locking arrangement shall suitably embedded in masonry enclosure.

In locations where the full length of pipe electrode is not possible to be installed due to meeting a water table, hard soil or rock, the electrode may be reduced length, provided the required earth resistance result is achieved with or without additional electrodes, or any alternative method of earthing may be adopted, with the prior approval of the Engineer-In-Charge. Pipe electrodes may also be installed in horizontal formation in such exceptional cases.

When more than one electrode (plate/ pipe) are to be installed, a separation of 3m shall be maintained between adjacent electrodes.

PLATE EARTH ELECTRODE

Earthing shall be provided with GI /copper plate electrode as mentioned in BOQ of following.

- i. GI Plate Electrode. : 600mm x 600mm x 6mm thick
- ii. Copper Plate Electrode. : 600mm x 600mm x 3mm thick

The electrode shall be buried in ground with its faces vertical and not less than Three (3) metres below ground level. 20mm dia medium class GI pipe shall be provided and attached to the electrode. A funnel with mesh shall be provided on the top of this pipe for watering and earth electrode. Earth electrode the watering funnel attachment shall be housed in masonry enclosure of not less than 300 x 300 x 300mm deep. A cast iron MS frame with cover having locking arrangement shall be provided at top of chamber. Earth electrode shall not effect the column footing or foundation of the building. In such cases electrode shall be further away from the building.

ARTIFICIAL TREATMENT OF SOIL

When artificial treatment of soil is to be resorted to, the electrode shall be surrounded by charcoal/ coke and salt and as indicated in enclosed drawings. In such cases, excavation for earth electrode shall be increased as per the dimensions indicated in these figures.

WATERING ARRANGEMENT

- i) In the case of plate earth electrodes, a watering pipe of 20mm dia. medium class GI pipe shall be provided and attached to the electrodes as shown in the drawing and a funnel with mesh shall be provided on the top of this pipe for watering the earth.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- ii) In the case of pipe electrodes, a 40mm x 20mm reducer shall be used for fixing the funnel with mesh.
- iii) The watering funnel attachment shall be housed in a masonry enclosure of size not less than 30 cm x 30 cm x 30 cm.
- iv) A cast iron/MS frame with MS cover of 6mm thick, and having locking arrangement shall be suitably embedded in the masonry enclosure.

EARTH CONDUCTOR

In the case of plate earth electrodes, the earthing conductor shall be securely terminated on to the plate with two bolts, nuts, check nuts and washers.

In the case of pipe earth electrodes, wire type earthing conductor shall be secured as indicated in drawing using a through bolts, nuts and washers and terminating socket.

The earthing conductor from the electrode upto the building shall be protected from mechanical injury by a medium class, 15mm dia GI pipe in the case of wire, and by a minimum of 40mm dia, medium class GI pipe in the case of strip. The protection pipe in ground shall be buried at least 30 cm deep (to be increased to 60 cm in case of road crossing and pavements). The portion within the building shall be fixed on walls.

The earthing conductor shall be securely connected at the other end to the earth stud/ earth bar provided on the switch board by Soldered or preferably crimped lug, bolt, nut and washer in the case of wire, and, Bolt nut and washer in case of strip conductor.

EARTH BUS AND MAIN EARTHING TERMINAL

In all installations, main earthing terminal shall be provided at the main switchboard. This may be in the form of earth stud or single earth bar depending on the type of the switchboard.

Following conductors shall be terminated on to the main earthing terminal.

- a) Earth connection from electric supply company (where provided)
- b) Earthing conductor from electrode.
- c) Protective conductors
- d) Equi-potential bonding conductors.

PROTECTIVE (LOOP EARTHING/ EARTH CONTINUITY) CONDUCTOR

Earth terminal of every switchboard in the distribution system shall be bonded to the earth bar/ terminal of the upstream switchboard by protective conductors.

Two protective conductors shall be provided for a switchboard carrying 3 phase switchgear thereon.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

EARTH RESISTANCE

The earth resistance at each electrode shall be measured. No earth electrode shall have a greater ohmic resistance than 5 ohms as measured by an approved earth testing apparatus. In rocky soil the resistance may be upto 8 ohms.

Where the above stated earth resistance is not achieved, necessary improvement shall be made by additional provisions, such as additional electrode (s), different type of electrode, or artificial chemical treatment of soil etc., as may be directed by the Engineer-In-Charge.

MARKING

- i) Earth bars/ terminals at all switch board shall be marked permanently, as 'E'.
- ii) Main earthing terminal shall be marked 'SAFETY EARTH- DO NOT DISCONNECT'.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

AE-I
(EPD-4)

EE
(EPD-4)

AE (P)
(CPM (Housing))

EE(P)
(CPM (Housing))

I) **SPECIFICATION OF UPS SYSTEMS CONNECTED IN N+1 “PARALLEL REDUNDANT CONFIGURATION”**

SCOPE

The scope of the work includes **Supply, installation, testing, integration & commissioning of True On-line, double conversion, IGBT Technology , Fully Microprocessor controlled UPS systems with inbuilt isolation galvanic transformer working N + 1 “Parallel redundant configuration”.**

The specification shall include design, manufacture, fabrication, assembly, proper packing for transportation delivery at site, unloading, storage, erection, integration with related equipments, and putting all UPS Systems together with all accessories and auxiliaries as specified hereinafter in a fully operational condition acceptable to the owner. The offered system shall be fully in compliance with the requirements stated herein.

The Contractor shall be responsible for engineering and providing all materials, equipments and services specified or otherwise, which are required to fulfill the intent of ensuring operability, maintainability, completeness and reliability of the total work covered under this specification within his quoted price.

The design manufacture, inspection, testing and installation of the UPS System covered under this specification shall conform to the latest international standards such as:

EN 62040-1	-	General Safety Regulations.
EN 62040-2	-	EMC Regulations.

APPLICATION :-

This UPS system is intended to provide electrical power supply on continuous and consistent basis for unbalanced different loads in the environmental conditions given below: -

- (a) Maximum temperature: 40 deg. C
- (b) Minimum Temperature: 0 deg. C
- (c) Altitude: 1000 meters above MSL
- (d) Relative humidity: upto 90% (Non – Condensing)

SCOPE OF SUPPLY:

- a) Each UPS module must have the following built in parts / features:
 - IGBT PWM Rectifier based input charger (float cum equalizing)
 - IGBT /technology based Inverter.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

- Automatic Bi-directional Static switch
 - Inbuilt Manual Bypass Switch.
 - Galvanic inverter output isolation transformer (inbuilt / External).
 - Fully Microprocessor Controlled Circuitry.
 - Input phase reversal protection (The system should run in mains operation in spite of phase sequence reversal) & same should be shown in SLD.
 - Provision for separate Input for rectifier and for Bypass
 - Event Monitoring & Diagnostics: Last 100 events with exact date & time should be monitored from the front LCD panel of the UPS & upto 900 events from UPS system memory using Laptop.
 - The input voltage window must be from 320 V to 480 V
- b. Rack Mounted External Battery Bank Sealed Maintenance Free (12V SMF,VRLA) Lead Acid Battery Bank suitable for 15 min backup with each module & on full load. Battery Sizing needs to be submitted with Proposal & **minimum VAH required with each UPS.**

EQUIPMENT ARRANGEMENT AND OPERATION :

SYSTEM CONFIGURATION: -

The offered UPS units shall be connected in N+1 Parallel redundant configuration. The UPS system will be fully microprocessor controlled.

SYSTEM OPERATION: -

- (a) Under normal operating conditions, the input IGBT charger shall supply the 100% battery charge requirements and shall also supply the 100% inverter requirement, which shall provide the rated AC output continuously.
- (b) The UPS system will supply the regulated rated power through inverter at all the times in mains operation.
- (c) When the AC mains supply to the battery charger fail, the battery shall supply inverter demand with no break occurring in the AC output.
- (d) The UPS systems output voltage shall be maintained within specified tolerance ($\pm 1\%$) for all forms of incoming AC mains supply conditions.

CONFIGURATION DETAILS:

The UPS systems will be working in N+1) Parallel redundant mode. Battery backup has to be 15 minutes with each UPS module. Also battery bank to be connected in such a manner that in case of failure of any particular UPS, battery backup of that particular UPS to be available to working UPS system.

GENERAL

SUMMARY

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

The scope of the work includes Supply, installation, testing, integration & commissioning of **true on-line double conversion UPS system with IGBT PWM Rectifier at input and output. With isolation transformer at output side. Fully Microprocessor controlled UPS system working with standby N +1 redundant configuration.** i.e. the Rectifier of the UPS system converts the input AC power to DC and then the inverter converts the DC into clean AC power.

The specification shall include design, manufacture, fabrication, assembly; proper packing for transportation delivery at site, unloading, storage, erection, integration with related equipments, and putting both the UPS Systems together with all accessories and auxiliaries as specified herein after in a fully operational condition acceptable to the owner. The offered system shall be fully in compliance with the requirements stated herein.

The Contractor shall be responsible for engineering and providing all materials, equipments and services specified or otherwise, which are required to fulfill the intent of ensuring operability, maintainability, completeness and reliability of the total work covered under this specification within his quoted price.

The design manufacture, inspection, testing and installation of the UPS System covered under this specification shall conform to the latest international standards.

GENERAL

SUMMARY

This specification defines the electrical and mechanical characteristics and requirements for a continuous-duty three-phase, solid – state, uninterruptible power supply (UPS) system. The UPS shall provide high-quality AC power for sensitive electronic equipment loads. Three UPS Systems shall be connected to run in 2+1, Parallel redundant Current Sharing Mode so as to deliver uninterruptible power.

SYSTEM DESCRIPTION

DESIGN REQUIREMENTS - UPS MODULE

A. VOLTAGE.

Input / Out voltage specifications of the UPS shall be :

Input	:	415 Volts, three-phase, , 4-wire – plus ground
Bypass Input:		415 Volts, three-phase, 4-wire – plus ground
Output	:	415 Volts, three phase, 4-wire – plus ground

B. OUTPUT LOAD CAPACITY

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

Specified output load capacity of each UPS Module shall be at 0.9 lagging power factor.

C. BATTERY BACKUP AND CAPACITY

Each UPS Module shall be connected with its individual 100% rated Battery Bank consisting of Maintenance Free Valve Regulated Lead Acid (VRLA) 12 Volt Mono-blocks having 5 years designed life.

MODES OF OPERATION

The UPS shall be designed to operate as an on-line, double conversion type UPS strictly as per the definition of IEC 62040-3 as follows :

A. Normal Operation - The critical AC load should be continuously supplied by the UPS inverter. The IGBT PWM Rectifier should take power from the AC input source, convert it into suitable DC and supply to the Inverter as well as charge the Batteries on Automatic Float Mode cum Boost Mode.

B. Upon Mains Failure - Upon failure of AC input power, the critical AC load should continue to be supplied by the Inverter which, should obtain power from the battery. There shall be no interruption in power to the critical load upon failure or restoration of the AC input source.

C. Upon Mains Restoration - Upon restoration of AC input power, The IGBT/Charger should automatically restart, walk-in and gradually take-over the supply to Inverter and charging to the Battery.

D. Static Bypass – Each UPS Module should have in-built 100% rated static Bypass Line. In two UPS Modules connected in Parallel redundant Current Sharing Mode, in the event of any fault in one UPS, the faulty UPS should isolate itself and the other two healthy UPS's which normally shares the load 67%, should take-over the full load.

All the loads should be transferred to the Static Bypass Line of the UPS without any break if the input frequency is within 50 Hz +/- 2 Hz and with a break below 20 millise. if the input frequency is beyond 50Hz +/-2 Hz for the following conditions :

- i) If any two UPS fails simultaneously
- ii) If overload beyond 150% for 1 minute is faced by the UPS
- iii) If both UPS senses over temperature.
- iv) If both the UPS Inverters are put-off

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

E Maintenance Bypass – Each UPS Module should have in-built 100% rated Maintenance Bypass Line of its own in addition to the 100% rated Static Bypass Lines

F Equal Current Sharing by the Static Bypass of all the three UPS - Each UPS Module should compulsorily have in-built 100% rated Bypass Line Inductance as shown in attached Fig. 1, ensuring that Bypass Lines of the UPS's share the total load current equally.

PERFORMANCE REQUIREMENTS

1. AC Input to UPS

- A. Voltage Configuration: Three-phase, 4-wire plus ground
- B. Voltage: 380 / 400 / 415 V (User Selectable)
- C. Voltage Range: 320 V to 480 V
- D. Frequency: 50Hz
- E. Frequency Tolerance : +/- 10%

2. AC Output, UPS Inverter

- A. Voltage Configuration: Three-phase, 4-wire plus ground
- B. Voltage: 380 / 400 / 415 V (User selectable in steps of 1V from 380 to 415V)
- C. Voltage Regulation: +/- 1% steady state.
- D. Frequency: Auto Sensing 50 Hz or 60Hz,
- E. Frequency Slew Rate : 1 Hz/sec
- F. Phase Displacement : 120 Deg +/- 1 Electrical Degree for balanced load.
120 Deg +/- 1 Electrical Deg. for 100% unbalanced load.
- G. Voltage Distortion: < (<1%) for 100% linear loads
< (<3%) for 100% non-linear loads with 3:1 crest factor.
- H. Output Power Rating: 120 kVA at (0.9) lagging power factor ie. 120 KVA = 108 KW..
- I. Overload Capability (on Inverter) :
 - 110% for 10 minutes
 - 125% for 1 minutes
- J. Voltage Transient Response (for 0 – 100% load change) : < +/- 5%
- K. Transient Recovery Time (for 0-100% load change): Recovery to nominal within 20 millisecs

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- L. Voltage imbalance :
- For Balanced load : <1%
 - For 100% unbalanced load : < 2%

ENVIRONMENTAL CONDITION

The UPS shall be able to withstand the following environmental conditions without damage or degradation of operating characteristics:

A. **OPERATING AMBIENT TEMPERATURE**

UPS Module: 0°C to 40°C

Battery : 22 to 24 °C

B. **STORAGE/TRANSPORT AMBIENT TEMPERATURE**

-25°C to 70°C

C. **RELATIVE HUMIDITY:**

Upto 90% (Non Condensing) at 20°C

D. **ALTITUDE OPERATING:**

To 1000 meters above Mean Sea Level.

UPS DELIVERY SUBMITTALS

Submittal upon UPS delivery shall include one instruction manual. Manual shall include a functional description of the equipment with block diagrams, safety precautions, instructions, step-by-step operating procedures and routine maintenance guidelines, including illustrations.

WARRANTY

The manufacturer shall warrant all the supplied items against defects in materials and workmanship for 12 months after initial start-up & handing over to the owner.

QUALITY ASSURANCE

MANUFACTURER QUALIFICATIONS

The UPS equipment vendors quoting for the job should have a minimum of four year's first-hand experience in the design, manufacturing, and testing of solid-state UPS systems. Besides credentials of having supplied done more than 5 similar or bigger jobs, the firm should have ISO 9001, UL / CE certifications. The copies of the certificates must be submitted with offer.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

FACTORY TESTING

Before shipment, the manufacturer shall fully and completely test the system in India to ensure compliance with the major specifications.

PRODUCT

FABRICATION

MATERIALS

All materials of the UPS shall be new, of current manufacture, high grade and free from all defects and shall not have been in prior service except as required during factory testing.

CONSTRUCTION AND MOUNTING

The UPS unit, comprised of input isolator, rectifier/charger, inverter, static transfer switch, maintenance bypass switch, and static bypass input switch shall be housed in a free-standing steel enclosure with key-lockable doors. Front access only shall be required for expedient servicing, adjustments, and installation. The enclosure will be built to comply with IP20 when the doors are closed. The UPS cabinet shall be cleaned, primed, and painted with the manufacturer's standard colour. The UPS shall be constructed of replaceable subassemblies. Printed circuit assemblies shall be plug-in. Like assemblies and like components shall be interchangeable.

COOLING

Cooling of the UPS shall be forced-air. Low velocity fans shall be used to minimize audible noise output. Fan power shall be provided by the UPS output. Temperature will be monitored by thermal sensors.

COMPONENTS

RECTIFIER/CHARGER

A. GENERAL

The Rectifier cum Charger Unit should be of Three Phase, Fully controlled, (IGBT based Rectifier). The Input Power Factor should be (>0.99) and the Input Current Harmonic Distortion (THDi) should be $<3\%$. The Rectifiers should have Input and DC Current Limiting Circuitry. It should be capable of giving charging current upto maximum of (10%) of the Battery AH Capacity, while simultaneously supplying full load current to inverter.

B. INPUT CURRENT WALK-IN

The rectifier/charger shall contain a timed walk-in circuit that causes the unit to gradually assume the load over a 5 to 30 second time interval after input voltage is applied.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

C. DC FILTER

The rectifier/charger shall have an output filter to minimise ripple voltage into the battery. The Ripple voltage should be less than 2%.

D. BATTERY RECHARGE

In addition to supplying power for the inverter load, the rectifier/charger shall be capable of providing battery charging current to recharge the battery properly (upto 20% of Battery AH Capacity). After the battery is recharged the rectifier/charger shall maintain the battery at full charge until the next emergency operation. The charging shall be an automatic cycle i.e boost to floating charge switching, with current measuring criteria and control during recharge. Both float and recharge voltages shall be adjustable. The charge voltage can also be manually controlled. Dynamic Temperature compensated Charging Facility should be there. The Rectifiers/Chargers should automatically increase the DC End-of-Discharge voltage level sensing lesser loads, in order to protect the batteries from over discharge beyond their AH Capacities.

INVERTER

A. GENERAL

The Inverter should be Fully Microprocessor controlled Sinewave IGBT / PWM based employing High Switching Frequency, consisting of IGBT's.

B. OVERLOAD CAPABILITY

The inverter shall be capable of supplying current and voltage for overload of or mentioned earlier for 1 minute. A status indicator and audible alarm shall indicate overload operation. The UPS shall switch off its inverter output static switch when its overload capacity is exceeded.

C. FAULT CLEARING AND CURRENT LIMIT

Without bypass supply available to the inverter shall be capable of supplying an overload current of 200% of its full-load rating in excess of five Seconds. For greater currents or longer time duration, the inverter shall have electronic greater currents or longer time duration, the inverter shall have electronic current-limiting protection to prevent damage to components. The inverter shall be self-protecting against any magnitude of connected output overload (Vce Trip). Inverter control logic shall sense and disconnect the inverter from the critical AC load without the requirement to clear protective fuses.

D. OUTPUT FREQUENCY

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

The output frequency of the inverter shall be controlled by an oscillator. The oscillator shall hold the inverter output frequency to $\pm 0.01\%$ for steady state and transient conditions.

E. ISOLATION TRANSFORMER:

To isolate the input disturbances from the output side a double wound delta-zigzag transformer to galvanically isolate the input from output is mandatory to be included in the design at the output of the inverter.. The isolation transformer will be connected. The combination of the inverter and Output isolation txr shall form a separately derived source wherein the Input neutral and the three Phases are completely isolated from the output neutral and the three phases.

DISPLAY AND CONTROLS

A. MONITORING AND CONTROL

The UPS shall be provided with a microprocessor based unit status display and controls section designed for convenient and reliable user operation. A system controls section designed for convenient and reliable user operation. A system power flow diagram, a percentage load and battery time remaining display shall be provided as part of the monitoring and controls sections which depicts a single line diagram of the UPS. Illuminated visual indicators shall be of the long life light emitting diode (LED) type. All of the operator controls and monitors shall be located on the front of the UPS cabinet. The monitoring functions such as metering, and alarms shall be displayed on an alphanumeric LCD display. Additional features of the monitoring system shall include:

- Event Monitoring & Diagnostics: Last 100 events with exact date & time should be monitored from the front LCD panel of the UPS.

B. METERING

THE FOLLOWING PARAMETERS SHALL BE DISPLAYED:

- DC Voltage
- Battery voltage
- Battery charge & discharge current
- Input voltage and frequency
- Output AC voltage line-to-line and line to neutral and % load used of nominal
- Output AC current for each phase and neutral
- Output frequency
- Active Power (kW) Apparent Power (kVA)

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- Temperature - Ambient, battery, inverter and transformer

C. **WARNING AND ALARM MESSAGES**

- Normal Operation Input breaker open
- Output breaker open Rect. breaker open
- Battery breaker open On Manual bypass
- Bypass absent Bypass over limits
- Bypass under limits Bypass freq. over limit
- Bypass Phase Rotation Bypass SCR fail
- Bypass inhibit Local Bypass inhibit remote
- Load on bypass On bypass due to over temp
- Rectifier off Local Rect. off remotely
- Rectifier Block Rectifier overload
- Rectifier over temp Rectifier Fuse fail
- Inverter off local Invert. off remotely
- Inverter block Inverter overload
- Inverter over temp Inverter out of sync
- Inverter over voltage Inverter under volts
- Inverter fuse fail D.C Volts High
- D.C Volts low Inverter no voltage
- Inverter Peak Volts low Battery under test
- Battery test fail Discharge battery
- Battery E.O.D. Boost Charge
- DC Bus over volts Battery Low
- Battery Fuse Fail Bat. Fast over volt
- Bypass overuse Cut-off overload
- Cut-off over temp Cut-off emergency stop
- Overload Cut-off max overload

D. **CONTROLS**

Four pushbuttons shall be located on the operator control panel.

- Enter
- Escape
- Up

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

- Down

The push buttons shall permit the operator either to select options from a menu for display on the LCD winder or to change the value of some parameters. One push-button - alarm silence switch.

E. **POWER STATUS DIAGRAM**

A mimic panel shall be provided to depict a single line diagram of the UPS.

Indicating lights shall be integrated within the single line diagram to illustrate the status of the UPS. The three LEDs shall indicate the following status.

- Bypass voltage OK
- Load on bypass
- Load on inverter

Power status diagram shall be an LED bar graph indicating % load with amber overload indication. Also an LED bar graph indicating % battery time remaining shall be included.

F. **COMMUNICATION FEATURES**

Each UPS should have RS-232 interface port for serial port communicability, MODBUS for BMS Connectivity.

STATIC TRANSFER SWITCH

A. **GENERAL**

A static transfer switch and bypass circuit shall be provided as an integral part of the UPS. The static switch shall be naturally commutated high-speed static (SCR type) device rated to conduct upto 100% of full load current, continuously. Such Switch should be connected at both the Static Bypass as well as the Inverter Output to enable the critical load to be connected to the inverter output or bypass power source. the static transfer switch control logic shall contain an automatic transfer control circuit that senses the status of the inverter logic signals, and operating and alarm conditions. This control circuit shall provide an uninterrupted transfer of the load to an alternate bypass source, without exceeding the transient limits specified herein, when an overload or malfunction occurs within the UPS, or for bypassing the UPS for maintenance.

B. **UNINTERRUPTED TRANSFER**

The transfer control logic shall automatically turn on the static transfer switch, transferring the critical AC load to the bypass source, after the transfer logic senses any of the following conditions:

- Inverter overload capacity exceeded
- Critical AC load overvoltage or under-voltage

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- UPS fault condition.

The transfer control logic shall inhibit an automatic transfer of the critical load to the bypass source if any of the following conditions are present:

- Inverter/bypass voltage difference exceeding pre-set limits
- Bypass frequency out of limits
- Bypass out-of-synchronization range with inverter output.

C. **UNINTERRUPTED RETRANSFER**

Retransfer of the critical AC load from the bypass source to the invert output shall be automatically initiated unless inhibited by manual control. The transfer control logic shall inhibit an automatic retransfer of the critical load to the inverter if one of the following condition exists:

- Bypass out of synchronisation range with inverter output
- Inverter/bypass voltage difference exceeding pre-set limits
- Overload condition exists in excess of inverter full load rating
- UPS fault condition present.

MAINTENANCE BYPASS ISOLATOR

A. **GENERAL**

A manually operated maintenance bypass isolator shall be incorporated into the UPS cabinet to directly connect the critical load to the input AC power source, bypassing the rectifier/charger, inverter, and static transfer switch. Transfer from Inverter to the Manual Bypass should be possible without any interruption to the Loads.

B. **MAINTENANCE CAPABILITY**

With the critical load powered from the maintenance bypass circuit, it shall be possible to freely check out the operation of the rectifier/charger, invert, battery, and static transfer switch.

BYPASS LINE INDUCTANCES

A. **GENERAL**

An Inductance shall be incorporated into each UPS cabinet in the Bypass path connecting the critical load to the input AC power source, so as to equalize the currents shared by the Bypass paths of each UPS.

B. **LOAD SHARING BY BYPASS OF EACH UPS**

The inductances of all the UPS's should be identical having matching impedance. They should be 100% rated.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

ISOLATION TRANSFORMER AT OUTPUT OF INVERTER (INBUILT / EXTERNAL)

Each UPS should have double wound galvanic Isolation Transformer at the output of its Inverter ensuring that at no point of time there is any electrical connection of the phase wires between the Input Supply going into the UPS and the Output Supply coming out of the UPS.

BATTERY PATH PROTECTION

A suitable Amp rated MCCB should be provided with each UPS for connection between the UPS and its Battery Bank. The MCCB should be physically placed near the Battery Bank and should have thermal, magnetic as well as automatic remote tripping mechanism. In the event of any fire or emergency, it should be possible to immediately make the outputs of Rectifiers, Inverters and the battery banks devoid of electrical Potential by pressing the Emergency Stop button from UPS Front Panel.

INTERCONNECTING CABLES

Vendor shall provide all the interconnecting cables between Incoming MCCB Panel, the UPS Systems, the Battery banks and the Outgoing MCCB Panel.

PRODUCT STANDARDS

The UPS should be designed & manufactured in accordance to and as per the following international Standards:

ISO 9001, CE Certification / UL Certification.

FIELD ENGINEERING SUPPORT

The UPS manufacturer shall directly employ a national field service network staffed by factory trained field service engineers to provide start-up, maintenance and repair of the UPS equipment.

TECHNICAL DATA SHEET FOR UPS SYSTEMS

Please provide a complete compliance for each & every spec mentioned below.

	UPS TOPOLOGY	True on-line double conversion IGBT based with full Microprocessor controls.
A	INPUT	
1.	Input voltage	415V, 3 phase, 4 wires
2.	Input voltage tolerance	320 V to 420V. In case the same is not met an additional Servo Voltage stabilizer must be added at the input of the UPS unit

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

3.	Input frequency	50 Hz
4.	Input frequency tolerance	+/- 10%
5.	Input current limit	115% (Adjustable between 100 - 125%)
6.	Power walk - in period	30 seconds (extended upto 120 Sec)
7.	Input circuit	IGBT based.
8.	Inbuilt Input, Output & Bypass MCCBs	Required to be provided
B OUTPUT		
1.	Module full load rating KVA / KW	As per BOQ Items.
2.	Rated voltage	415 V 3 PH, N
3.	Rated current	Vendor to specify
4.	Phase Voltage asymmetry (For Three Phase output UPS only) a) Balance load b) 100% unbalanced load	1% 2%
5.	Voltage Phase shift (In case of three phase Output UPS) - With balanced load - With Unbalanced load	120 +/- 1 deg 120 +/- 1 deg
6.	Output voltage adjustment range	+/- 5%
7.	Phase displacement (In case of three phase Output UPS) a) Balance load b) 100% unbalanced load	120 deg. +/- 1 deg 120 deg. +/- 1 deg
8.	Output power factor	0.9
9.	Internal oscillator stability	+/- 0.2 %
10.	Mains synchronization tracking	+/- 1 Hz (settable to +/-2)
11.	Max. Rate of change of frequency	1 Hz. Per second
12.	Output voltage harmonics a) Linear load b) Non-linear load (Crest factor of 3:1)	< 1% < (3)%
13.	Crest Factor	3: 1 (Minimum)

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

14.	Overload rating	110% for 10 minutes 125% for 1 minutes
15.	Overall Efficiency	> 94 respectively
16.	Current limit short	Set at 150% of the output power
17.	Transient Response a) 100% load change b) Manual transfer of load from UPS to bypass and vice-versa C) Automatic transfer of load form UPS to bypass	< +/- 5% 0 msecs when in sync 0 msecs in sync
18.	Transient recovery time	Recovery to +/- 1 % in 10 msec
19.	Manual Bypass Isolator	One with each UPS Module
C	DC CHARACTERISTICS	
1.	Nominal DC bus voltage	Vendor to specify
2.	Battery isolation	Battery Circuit Breaker with Fuse in enclosure
3.	Battery fully discharge voltage	Vendor to specify
4.	Allowable voltage drop in battery cables	3 volts at end of discharge voltage
5.	Battery float voltage	Vendor to specify
6.	Battery end voltage	Vendor to specify
7.	DC Bus voltage ripple	< 1 RMS
8.	Battery recharge current limit	Amps, Vendor to specify
9.	No. Of cells & VAH	Vendor to specify.
D	CONTROLS	
1.	Charger input MCCB	
2.	Battery Fuse Box /circuit breaker (mounted separately in its own enclosure)	
3.	Inverter output MCCB	
4.	Bypass line MCCB	
5.	Maintenance Bypass Isolator	
6.	Alarm acknowledge / Reset button	
7.	Inverter On-Off Pushbutton for Manually switching of the Inverter	
8.	Emergency off push button	
E	MEASURING INSTRUMENTS	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

1.	LCD panel for Measuring Input Voltage, Output voltages, Output currents and Frequency, Battery Voltage and Charging / Discharging current
2.	LCD panel should display status of the Battery capacity and backup Time in minutes
3.	Diagnostic Feature: Each UPS module must have this feature & atleast last 100 events with exact date & time should be visible on the front LCD panel of the UPS.

F	PROTECTIONS
1.	RC surge suppressor
2.	Sustained under voltage on input side
3.	Phase loss on input side.
4.	Negative sequence on input side
5.	Semiconductor fuses in the lines for thyristor
6.	Snubber circuit for device dv/ dt protection
7.	Charger input current limit
8.	HRC fuses for filter capacitors
9.	Battery current limit
10.	DC over voltage
11.	Low battery
12.	Semiconductor fuses at inverter output
13.	Overload
14.	Over temperature for the inverter
15.	HRC fuses in the control circuit
F	INDICATIONS (ALARMS)
1.	Inverter Failure
2.	Overload (if load exceeds 100%)
3.	Overload shutdown
4.	Emergency shutdown
5.	Equipment over temperature
6.	Maintenance Bypass ON
7.	DC over voltage

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

8.	Low battery	
9.	Battery circuit breaker open	
10.	Battery on load	
11.	Mains failure	
12.	Rectifier Failed or Off	
13.	Inverter Unsynchronized	
14.	Load on bypass	
15.	Output voltage error	
G.	DC link characteristic with 15 Min backup Battery bank of Rating as per BOQ Item	
	NO. of 12V SMF lead acid batteries	Vendor to specify
	AH rating for each UPS	Vendor to Specify rating and no
	Model / Make	Amara Raja / rocket / Panasonic / Exide
	Float voltage	Vendor to specify
	Final discharge voltage	Vendor to specify
	Voltage tolerance	+/- 1 %
	DC ripple	< 1 %
	Charging current limit	10 % of Ah rating.
	Battery Isolation	Battery Circuit Breaker with fuse in enclosure.
	Minimum VAh	Vendor to specify the offered Vah
	Mechanical Dimensions:	
	Weight of UPS – Kg	Vendor to specify
	Dimension of UPS (L x D x H) in mm	Vendor to specify
	Ventilation	Forced air cooled with internal fans
	Protection Level: * With enclosure closed * With front doors open	IP 20 IP 20
	Environmental	
	Operating temperature	0 – 40 deg. C
	Relative humidity	< 90 % (Non Condensing)
	Altitude	1000 m
	Storage temp	From -20 to + 70 deg. C
	General	
	Generator Compatibility	Program the Unit for soft start for

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

		use with a generator
	Push Buttons	On/OFF push buttons to connect or disconnect critical loads to be provided
	Potential free contacts	Six contacts to be provided.
	Communication interface board	For contacts to be provided
		RS232 serial ports.
		COM-PORT with the following normally open or normally closed potential free contracts:
		UPS on.
		Static bypass operation.
		Battery operation.
		Battery low.
	Remote UPS monitoring kits	Software for Automatic shutdown with following systems to be provided
		Microsoft windows 3.1, 3.11
		Microsoft windows 95
		Microsoft Windows NT
	Software capability	The UPS shall be capable to communicate with network operating system and shall be capable of doing safe shutdown of critical load by means of auto shutdown software.

II) SPECIFICATION FOR IP BASED CCTV & ACCESSCONTROL SYSTEM

INTRODUCTION AND GENERAL SITE INFORMATION

This complex is consisting of following major blocks:-

- Academic & Hospitality Block
- Hostel Block
- Workshop Block

IP based CCTV Systems shall be deployed to ensure security environment within the buildings and overall complex.

SPECIAL TECHNICAL CONDITIONS:

The Security Vendor shall supply and commission an **IP Camera based CCTV system with the** objective shall be to provide High degree of Video surveillance system to all the critical locations within the building premises, general site & all entry / exit gates.

The purpose is to monitor & supervise the entire area for security purposes, as well as the record and inform officials on unwanted, untoward incidents. **It is also**

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

essential to have recording to be stored at least for 30 days of all area's to facilitate investigations of a reported case.

The Bidder is expected to study the scheme with floor plan drawings and in case Bidder need IT / Server or Networking hardware more than what is specified for and provided for in the tender, then the Bidder needs to inform officially during pre bid meeting.

In order to maintain the expected reliability levels of the offered system should compulsorily meet all the requirements of Failover Management application, Failover recording and Redundant recording requirements as described in detailed specifications.

Solution Overview

The present proposed system consist of approximately 260 IP cameras, required servers, storage, workstations, monitors, Central Video management software and cabling etc.

All these cameras should be connected to central Monitoring Station at CCTV control room through dedicated LAN network (dedicated for CCTV) with fiber backbone. Fiber backbone is not part of CCTV works.

CCTV Control room should be equipped with servers and storage to record all the cameras with minimum of 30 days retention period.

Storage calculation should be good enough for recording cameras at same resolution as of camera at 25 fps with motion based recording

Servers and storage should be equipped with highest level of reliability by providing specified failover and redundant mechanism.

Monitoring of all the cameras should be possible from CCTV control room.

CCTV control room should be equipped with 40" Monitors, NVR's, PC & all required hardware and software etc.

The system should provide the flexibility to display any content on any of the monitor as per situational requirements.

All systems and components shall have been thoroughly tested and proven in actual use and should not be getting obsolete for minimum of next 5 years.

SCOPE OF WORKS

Scope of works include the provisioning of a fully functional IP Based CCTV system, complete end to end solution, including:

Supply of all related active and passive Network components, including Servers and Switches, Convertors, Patch Cords etc.

Supply and Programming of Central Management Software.

Supply, installation of Cameras as per Tender BOQ.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

Supply of Auxiliary components such as Camera Mounts, Yard Poles to Mount Cameras, Network Racks, Power Supplies etc.

Programming of the Software Features to meet the Security needs of the multiple use building.

Interfacing with BMS.

Testing and Commissioning of the entire system.

Formal Handover after due diligence of the system performance.

Training of Operating Personnel and Documentation.

- **CODES AND STANDARDS**

1) APPLICABLE STANDARDS

Original Equipment Manufacturer Standard

2) APPROVALS

A. UL Listed and

B. FCC

TECHNICAL SPECIFICATIONS FOR CLOSED CIRCUIT TELEVISION SYSTEM

TECHNICAL REQUIREMENTS:

i) CAMERA SPECIFICATIONS

a) 1080P Resolution IP IR Indoor Dome should have following Features:

4MP IP IR Dome Camera Specifications :		
1	Type of Camera	Dome
2	Image Sensor	1/2.8" or 1/3" progressive Scan CMOS
3	Signal System	PAL/NTSC
4	Resolution & frame rate	2560(H)x1440(V), 25Fps (2560x1440)
5	Minimum Illumination	0.01Lux@ F1.2, AGC ON, 0.0 lux with IR, (Wide, 50IRE, 5600K with 80% reflection ratio, AGC on) or better
6	Imaging	1/3s to 1/100000s, Auto Gain Control, White Balance- Auto (2000K to 10000K), Back Light Compensation, Multi zone Privacy Masking, HLC, Digital defog
7	Signal to Noise Ratio	50 dB or more

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

8	Auto Iris	DC Drive
9	Lens Type	4MP IR 6/8/12 MM fixed Lens
10	Focus	Fixed
11	Day & Night	True Day & Night High Performance Mechanical IR cut filter with auto switch, IR Source- Inbuilt Smart IR LED's with effective distance 50 Mtr or better
12	IR Life	40000 Hours or higher
13	Video Compression (Minimum)	H.265
14	Video Bit Rate	32KBPS- 8 MBPS or better
15	Wide Dynamic Range	WDR (100db or more)
16	Digital Noise Reduction	DNR (2D+3D) On/Off
17	Streaming	Dual
18	Heartbeat Image	Camera should support hourly heartbeat image on ftp server through 4G/3G
19	Connection Support	WPS Connection Support this feature is of 4G Wi-Fi router if camera is not Wi-Fi enabled.
20	Image Setting	Rotate Mode, saturation, brightness, contrast, sharpness adjustable through client software or web browser
21	Profile Management	User configuration import, export
22	Security	User Authentication, Water Marking- 64/128 bit , WPA/WPA2, WPA-PSK/WPA2-PSK, WPS this feature is of 4G Wi-Fi router if camera is not Wi-Fi enabled.
23	Onboard Storage	Camera should support built in Micro SD/SDHC/SDXC Card slot and should be supplied with class 10 Micro SD/SDHC/SDXC Card of 64 GB or better.
24	Recording Management	Format SD, overwrite, storage management, video to support NAS device, remote archive access via FTP login
25	Alarm Trigger	Motion detection, Camera Tampering alarm, IP

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

		address conflict, storage full, storage error.
Wi-Fi Features for Camera (N/A if providing 4G Wi-Fi Router in Solution)		
26	Wi-FiStandard	IEEE802.11b, 802.11g, 802.11n
27	Frequency Range	2.4Ghz - 2.483GHz
28	Communication Bandwidth support	20/40Mhz
29	Transmission Range	Outdoor/ Indoor: 50m or better (with clear line of sight)
Network Compatibility		
30	Network Protocol	TCP/IP/ICMP, HTTP, HTTPS, FTP, DHCP, DNS, DDNS, RTP, RTSP, RTCP, PPPoE, NTP, Upnp, SMTP, SNMP, IGMP, 802.1X, QoS, IPv6, Bonjour, IPv4
31	User Access	5 User Simultaneously or more
32	System Capability	Onvif
33	VMS (ONVIF compliant)(shall be supplied by contractor free of cost within scope of their work along with camera)	Camera shall support open source VMS. Software supplied should support the De-Coupled mode of operation which means that the even in case of failure of central server, the camera recording should not be impacted. The VMS software and cameras may or may not be from the same OEM but the VMS OEM shall ensure seamless integration of both and smooth functioning of the system.
34	Mobile Client application	Support Android and iOS App for smart phone and tablet. Bidders may please note that it shall be possible to view the live recording of the cameras within 50 mtr. range on mobile phone without adding any other device or internet connection to the cameras.
35	Ethernet	IEEE 802.1X, 1RJ 45 10/100 Ethernet port
36	Connectivity Media	4G SIM Slot with backward compatibility for 3G & 2G(Either in Camera / NVR / Wi-Fi router which will also be used for SMS purpose. Dongle integration is not allowed for SMS purpose).
37	Power Input	Standard DC Jack

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

38	Power Requirement	12VDC +- 10%
39	Power Consumption	Max 9 W
40	Enclosure	IP66 weather proof, IK10, Metallic body
41	Operating Condition	-10°C to 60°C, humidity 95% (max) (non-condensing)
42	Standards	CE, FCC, RoHS, UL/EN/IS Certified
43		Cage for camera protection from monkey etc.

B	4MP IP IR Bullet Camera Specifications :	
1	Type of Camera	Bullet
2	Image Sensor	1/2.8" or 1/3" progressive Scan CMOS
3	Signal System	PAL/NTSC
4	Resolution & frame rate	2560(H)x1440(V), 25Fps (2560x1440)
5	Minimum Illumination	0.01Lux@ F1.2, AGC ON, 0.0 lux with IR, (Wide, 50IRE, 5600K with 80% reflection ratio, AGC on) or better
6	Imaging	1/3s to 1/100000s, Auto Gain Control, White Balance- Auto (2000K to 10000K), Back Light Compensation, Multi zone Privacy Masking, HLC, Digital defog
7	Signal to Noise Ratio	50 dB or more
8	Auto Iris	DC Drive
9	Lens Type	4MP IR 6/8/12 MM fixed Lens
10	Focus	Fixed
11	Day & Night	True Day & Night High Performance Mechanical IR cut filter with auto switch, IR Source- Inbuilt Smart IR LED's with effective distance 50 Mtr or better
12	IR Life	40000 Hours or higher
13	Video Compression (Minimum)	H.265

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

14	Video Bit Rate	32KBPS- 8 MBPS or better
15	Wide Dynamic Range	WDR (100db or more)
16	Digital Noise Reduction	DNR (2D+3D) On/Off
17	Streaming	Dual
18	Heartbeat Image	Camera should support hourly heartbeat image on ftp server through 4G/3G
19	Connection Support	WPS Connection Support this feature is of 4G Wi-Fi router if camera is not Wi-Fi enabled.
20	Image Setting	Rotate Mode, saturation, brightness, contrast, sharpness adjustable through client software or web browser
21	Profile Management	User configuration import, export
22	Security	User Authentication, Water Marking- 64/128 bit , WPA/WPA2, WPA-PSK/WPA2-PSK, WPS this feature is of 4G Wi-Fi router if camera is not Wi-Fi enabled.
23	Onboard Storage	Camera should support built in Micro SD/SDHC/SDXC Card slot and should be supplied with class 10 Micro SD/SDHC/SDXC Card of 64 GB or better.
24	Recording Management	Format SD, overwrite, storage management, video to support NAS device, remote archive access via FTP login
25	Alarm Trigger	Motion detection, Camera Tampering alarm, IP address conflict, storage full, storage error.
Wi-Fi Features for Camera (N/A if providing 4G Wi-Fi Router in Solution)		
26	Wi-FiStandard	IEEE802.11b, 802.11g, 802.11n
27	Frequency Range	2.4Ghz - 2.483GHz
28	Communication Bandwidth support	20/40Mhz
29	Transmission Range	Outdoor/ Indoor: 50m or better (with clear line of sight)
Network Compatibility		

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

30	Network Protocol	TCP/IP/ICMP, HTTP, HTTPS, FTP, DHCP, DNS, DDNS, RTP, RTSP, RTCP, PPPoE, NTP, Upnp, SMTP, SNMP, IGMP, 802.1X, QoS, IPv6, Bonjour, IPv4
31	User Access	5 User Simultaneously or more
32	System Capability	Onvif
33	VMS (ONVIF compliant)(shall be supplied by contractor free of cost within scope of their work along with camera)	Camera shall support open source VMS. Software supplied should support the De-Coupled mode of operation which means that the even in case of failure of central server, the camera recording should not be impacted. The VMS software and cameras may or may not be from the same OEM but the VMS OEM shall ensure seamless integration of both and smooth functioning of the system.
34	Mobile Client application	Support Android and iOS App for smart phone and tablet. Bidders may please note that it shall be possible to view the live recording of the cameras within 50 mtr. range on mobile phone without adding any other device or internet connection to the cameras.
35	Ethernet	IEEE 802.1X, 1RJ 45 10/100 Ethernet port
36	Connectivity Media	4G SIM Slot with backward compatibility for 3G & 2G(Either in Camera / NVR / Wi-Fi router which will also be used for SMS purpose. Dongle integration is not allowed for SMS purpose).
37	Power Input	Standard DC Jack
38	Power Requirement	12VDC +- 10%
39	Power Consumption	Max 9 W
40	Enclosure	IP66 weather proof, IK10, Metallic body
41	Operating Condition	-10°C to 60°C, humidity 95% (max) (non-condensing)
42	Standards	CE, FCC, RoHS, UL/EN/IS Certified
43		Cage for camera protection from monkey etc.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

C. 33x , 25/20fps 200 MtrIR Illuminated Full HD, IP PTZ, H.265, True Day/Night Outdoor Weatherproof High Speed Dome Camera should have following features:

- Full HD (1080p Resolution) .
- 33x Optical Zoom, TDN, WDR (120dB), HLC, 3DNR
- H.265, H.264 / MJPEG, Triple streams
- Frame rate should be 1080P (1920×1080): Max.60 fps
- Motion detection, network fail detection, privacy zones
- Pan: 360° continuous rotation; Tilt: 0° - 90°rotation; 256 presets, no blind spot
- ONVIF

Specifications	
Analog / IP	IP
Type of Camera	High Speed Dome PTZ Camera
Video Format	PAL
Image Device	1 / 2.8" to 1/3" 4 Megapixel progressive scan CMOS Image Sensor
Minimum Illumination	IR LED ON - 0 Lux, IR LED OFF - ,Color: 0.02 Lux, F1.6 (50 IRE AGC ON) B/W: 0.001 Lux, F1.6 (50 IRE AGC ON)
Electronic Shutter	1/6 ~1/100000 s
Signal-to-Noise Ratio	> 50dB(AGC Close)
BLC	OFF / BLC / HLC
Frame Rate	Up to 25fps PAL for all profiles
Network Protocols	IPv4, TCP, UDP, HTTP, HTTPS, SMTP, FTP, NTP, DNS, DDNS, DHCP, ARP, UPnP, RTSP, RTP, RTCP, PPPoE, ICMP, SNMP
Lens	f= 4.5mm ~ 148.5mm
Auto Gain Control	On
Privacy Mask	8
S/N Ratio	> 50dB(AGC Close)
Pan Angle	360° Rotation Capability
Tilt Angle	- 15° ~90°

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

Pan Speed	0. 1°~ 240°/Sec
Tilt Speed	0° ~ 160°/Sec
Preset Speed	Pan: 300° /s; Tilt: 240° /s
Accuracy	0.1°
Preset Positions	256
Proportional Pan & Tilt	Auto
ROI	ON/OFF
Image Inverse	OFF / V-rotation / H-rotation / Flip
White Balance	Manual/Auto/Indoor/Outdoor/ATW
Wide Dynamic	ON/OFF
Motion Detection	ON / OFF (programmable zones)
Zoom	33x Optical Zoom, 12x Digital Zoom
PTZ Tours (Pattern)	4
ONVIF	Mandatory Required
Edge Analytics	Intrusion, Line Crossing , Motion detection, Audio detection, Face detection, People counting and Auto Tracking
Audio	Camera should have 1/1 audio In/ Out Support
Alarm	Camera should have 2/1 alarm In/ Out Support
Alarm Events	SD card video recording / FTP Upload / Email / Snapshot / Preset / Alarm output / CMS
Protection Class	IP66 Rating, weather and vandal proof
Ethernet	10/100M auto negotiation
Housing	IP66
Certificate	UL, CE, FCC

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

64-Ch Network video Recorder (NVR)

The specifications of the NVR are given below:

- Real-time recording: up to 64 channels @ D1 1080P.
- Live view: 64 channels @ 1080P.
- H.265, H.264 high quality decoding
- 1 / 4 / 6 / 8 / 9 / 16 / 32 channel display mode
- 4-channel simultaneous playback , 30s instant playback
- Up to 64 TB storage with 8 SATA interface
- 320 Mbps Incoming/Outgoing Bandwidth
- Intelligent event-trigger recording and alarm linkage, flexible schedule alarm configuration
- NVR should support Video resolution : 3840×2160, 1920×1080, 1280×1024, 1280×720, 1024×768
- Remote IP camera setup and image enhancement.
- Disk space quota for different IP cameras to help store critical video for longer time
- E-signature (watermark) verification by ONVIF Player to protect against video tampering
- Dual Ethernet bonding supports three work mode: Standalone, Failover (to protect from network failure), Load balance (to distribute network load to different Ethernet interfaces)
- Support ONVIF Profile S, HTTPS
- Suitable for operation on 230 V \pm 10%50 Hz AC Supply

Specification	
Processor	High performance Quad-core embedded processor
Video Input	Minimum 64 channels @ 1080p.
Compatible Protocol	Compliant to ONVIF Profile S
Video Output	2 x HDMI (1920 x 1080, 1280 x 1024), 1 VGA (1920 x 1080, 1280 x 1024), 1 BNC (800 x 600)
Video Standard	PAL
Compression	H.265, H.264 / MJPEG
Video Recording	64 channels @ 1080p
Multi-screen Channels	1 / 4 / 6 / 8 / 9 / 16 / 32-channel display mode
Audio Input	Audio input with video streams.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

Motion Detection	Support.
Alarm Event	Recording, PTZ preset, Alarm, Buzzer, Screen tips and Email
Alarm Input	16 alarm inputs (rear panel), 32-ch alarm inputs (IP camera)
Alarm Output	4 outputs
HDD	Should support minimum 8 SATA ports, Up to 64 TB and 1x eSATA Port
Backup	USB storage device, Network download
HDD Management	HDD, quote, virtual disk, HDD faulty alarm
Recording Mode	Manual, Schedule, Motion detection trigger and Alarm trigger
Search Mode	Date/Time, Event (Alarm, Motion detection), Accurate search (to second), Log link
Playback	1/4 channel simultaneous playback (Forward / Reverse, Fast playback, Slow playback, Freeze, Full screen, Shuffle, Backup selection) .Up to 4 channel Instant Playback for 30s duration.
Digital Zoom	Digital zoom in live view and playback
Protocol Support	HTTP/HTTPS, TCP/IP, RTSP, UDP, NTP, DHCP, IPC Search
Remote Client Control Function	Monitor, PTZ control, Playback, Configuration, File download, Log information, firmware upgrade
RAID Support	NVR should support RAID 0, 1, 5, 6, 10
E-Signature (Watermark)	Verified via ONVIF Certification
User	32 Users simultaneously
Network Interface	2 RJ-45 port (10/100M/1000M)
USB Interface	3 ports
Serial Interface	1 RS-232
PTZ Control Interface	1 RS-485

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

Power Input	230 V _± 10% AC, 50 Hz
Operating Temperature	-10°C ~ 55°C
Relative Humidity	20% to 80%
Weight	6.0kg (without HDD)
Mounting	Rack
Certification	CE, FCC, ,UL

Note: All proposed Cameras & NVR should be from single OEM and OEM should have Registration in India min from 7 Years

Central Management Software

The central management software is for NVRs for easy and flexible video surveillance. Featuring a user-friendly interface, the software should efficiently performs device add-on, configurations, status monitoring, alarm event checking, PTZ control, video live view, playback, recording and video wall control. To further enhance installation and operation efficiency, it should also feature device configuration functions and automatic device synchronization.

It should support up to 4screens and 36 live view windows on each screen for up to 10 units of NVR's the joystick keyboard should also be compatible with software to operate PTZ control of cameras efficiently.

FEATURES

- Multiple NVR management; support up to 10 units of NVRs
- Up to 4 screens, 1 main screen, 3 extended screens Main screen for live view and playback, Extended screen for live view
- Up to 36 live view windows on each screen
- Up to 16 channels of playback
- Alarm management and inter linkage control
- PTZ control – Pan/Tilt/Zoom/Preset/Tour
- Video Snap shot
- ONVIF Profile S
- Video Display Unit – 1/4/6/8/9/ 16/36 for each screen
- Video Playback – 1/4/16 channels simultaneous playback (forward / reverse, fast playback, slow playback, full screen)
- Snapshot – Live View & Playback
- Local Recording – Live View

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

- Alarm Management – Alarm Log, Deal Alarm
- Sound Management – Auto Siren When Alarm Triggered
- Device Management – Auto Device synchronous & Manual Add.

Work Station for Central Management Software with 40 inches. LED HD Monitor

PC for Central Management software should be of following configuration:

CPU - Intel® Core™ i5 750 2.66 GHz

Memory – 4GB RAM

Optical Drive – DVD-R

HDD – 500GB

Graphics Adapter - NVIDIA® 9200 or above, 1GB independent graphic card

OS - Windows® 7 Professional 32-bit / Windows 7 Ultimate 32-bit / Windows 7 Enterprise 32-bit / Windows 7 Enterprise 64-bit

24 Port Network Switch should have the following features

- 24 Ports 10/100/1000 ports (24 PoE+ ports)
- Auto Surveillance VLAN Support.
- 2 combo mini-GBIC ports
- Switching capacity of 52Gbps
- Forwarding rate of 38.69mpps
- Static routing, IP Interface and Layer 3 Routing between VLANs
- IPv6 support
- Dual image support
- Dual Configuration files support
- Remote management
- OAM Support for cable diagnostics
- Switch should support Green Ethernet.

8 Port Network Switch should have the following features

- 8 Ports 10/100/1000 PoE+ ports with power budget)
- 2 combo mini-GBIC ports
- Switching capacity of 20Gbps
- Forwarding rate (64-byte packets) of 14.88 mpps
- Static routing/Layer 3 switching between VLANs
- IPv6 support
- Dual image support
- Dual Configuration files support
- Remote management
- OAM Support for cable diagnostics
- Switch should support Green Ethernet.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

S. No.	Minimum Specifications / Functionalities / Capabilities	Make, OEM Model/ OEM Part No.	Meets Spec [Y/N]	Deviations, if any
I.	UTP Cable, TIA-568C.2, Category-6 , IEC-60332-1/UL 1666 (305 Mtrs./1000 feet per Box)			
1	Minimum Specifications			
1.1	Shall be of 4 twisted pairs of 23 AWG solid conductors			
1.2	Shall support network line speeds up to 1 gigabits per second.			
1.3	Shall be 4-pair Unshielded twisted pair with a cross filler/ isolator (+), meeting Category 6 tested to 250 MHz or more as per TIA-568C.2.			
1.4	Should comply with all of the performance requirements for current and proposed applications such as Gigabit Ethernet, 100BASE-Tx, token ring, 155 Mbps ATM, 100 Mbps TP-PMD, ISDN, analog (broadband, baseband) and digital video and analog and digital (VoIP) voice.			
1.5	Shall be Fire-Retardant, Low-Smoke & Zero-Halogen as per IEC 60332-1, IEC 61034-2 & IEC 60754-1 respectively			
1.6	Shall be supplied in Reel of 305 Meters/ 1000 feet packed in Boxes			
II.	<u>Cat 6 UTP Patch Cable, TIA-568C Category-6, UL-listed</u>			
1	Minimum Specifications			
1.1	Length shall be available in 1/2/3/5 meters or equivalent length in feet			

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

1.2	All patch cords shall conform to Category 6 & conductor shall be stranded for better flexibility			
1.3	Shall support network line speeds up to 1 Gbps			
1.4	Shall have RJ-45 jacks with transparent plugs at both the ends			
1.5	All patch cords shall be factory crimped and packed			
1.6	Shall be RoHS Compliant			
1.7	Shall have LSZH jacket for safety measures			
1.8	Shall have a transparent / clear boot			
1.9	Shall support applications such as 155 Mbps ATM, token ring & VOIP.			
1.10	Colors- Blue, Grey, Yellow, Red & Orange			

CONICAL POLES (TUBULAR) For mounting of PTZ camera

Design:

The Conical shall be designed to withstand the maximum wind speed as per IS 857. The top loading i.e. area and the weight of fixtures are to be considered to calculate maximum deflection of the same shall meet the requirement of BSEN 40-3-3:2003, pr EN-40-3-3. Structural design calculations shall be submitted to justify the pole dimensions.

Pole Shaft:

The pole shaft shall have Conical cross section and shall be preferably continuously tapered with single longitudinal welding.

Pole shaft shall be provided with a rigid flange plate of suitable thickness with provision for fixing 4 foundation bolts. This base plate shall be fillet welded to the pole shaft at two locations i.e. from inside and outside. Structural design calculations shall be submitted to justify the flange & foundation bolt dimensions.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Door opening:

Conical poles shall have of approximately 500 mm Door opening length at the elevation of 500 mm from the base plate. The door shall be vandal resistant and shall be weather proof to ensure safety of electrical connections inside the pole. The door shall be flush with locking facility. The pole shall be additionally reinforced with a welded steel section, so that the section at door is unaffected and undue bucking of the cut section is prevented.

Material of construction shall be:

Conical Pole shaft	HT Steel Conforming to grade S355
Pole Base Plate	Fe 410 conforming to IS 226 / IS 2062
Pole Foundation Bolts	EN. 8 grade

Welding:

The welding shall be carried out confirming to approve procedures duly qualified by third party inspection agency.

Pole shall be hot dip galvanized as per IS 2629 / IS 2633 / IS 4759 standards with average coating thickness of 70 micron. The galvanizing shall be done in single dipping.

The poles shall be bolted on a pre-cast or cast in -situ RCC foundation on studs with nuts & washers and with a set of four foundation bolts for greater rigidity.

Manufacturing Unit:

The pole manufacturing & galvanizing unit shall be ISO 9001:2000, ISO 14001 & BS OHSAS 18001 certified to ensure consistent quality & environmental protection.

The manufacturing unit shall have in-house pole testing facility for validation of structural design data. The pole testing facility shall conform to BS EN 40-3-2-2000 part 3-2.

INSTALLATION OF CONICAL POLE**Foundation****a) Design & Approval:**

The foundation shall be designed to withstand the wind velocity (not less than 47m/ sec) and maintaining the maximum deflection of the pole as specified with bracket & fixtures within limits of specified standard. The successful tenderer has to submit the design calculation & foundation drawing duly vetted / certified by recognized Govt. engineering college viz. IIT/NIT etc or by approved structural

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

consultant of Department for approval of Engineer-in-charge before casting the foundation.

b) Casting of Foundation:

Reinforced cement concrete (RCC) foundation of M 20 grade shall be casted as per item nomenclature given in the schedule of work and approved drawing. The curing shall be done sufficiently before loading the pole. The foundation shall project above ground by 200mm which shall be neatly finished with sand cement plaster.

c) Cable Guard pipe:

50mm (OD) ISI marked HDPE pipe as required shall be laid for of loop-in loop-out cables in concrete foundation for easy laying & relaying of cable without any change to the RCC foundation work. The end of the pipe shall be sealed after cable is laid & tested. Only one pipe will be used for laying of a single cable.

Installation of Pole

- The poles shall be installed in a workman like manner so that it is leveled, properly aligned and oriented.
- Care shall be taken in handling the pole to avoid any distortion to the supporting structure or damage to the delicate instruments & electrical parts.
- After erection of pole, bracket and all accessories, the pole should be numbered as per the direction of Engineer-in-charge and the exposed portion of concrete foundation shall be painted with black and yellow zebra pattern. The cost of the same is deemed to be included within the quoted cost.

- PVC JUNCTION BOX – POLE MOUNTED

The Box shall have the following features.

1. Shock proof & Rust Proof.
2. Rot proof and Termite Resistant.
3. Cable entry from bottom & / or side.
4. 100% Weather proof.
5. Pole mounting arrangement.
6. Tamper proof.
7. Restricted unauthorized tapping.
8. Maintenance Free.
9. Fire Retardant – Class FV – 0 as per IS: 11731 Part –II V-0 as per UL 94.
10. High heat distortion temperature (200 °C as per IS: 1092).

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- **6 FIBER SC STYLE POLE MOUNTED BOX**

The Box shall have the following features.

1. Fiber Splicing and patching for 8 fibers.
2. Wall / Pole Mount configuration.
3. Made of 16 SWG aluminium and passivated for better environmental protection.
4. Large bend radius controlled splice tray.
5. Isolation of provider and customer sides with screw fitment.
6. Cable entry point from top.
7. Strength member tie down point included.
8. Fiber guides radius controls and secure tie downs.
9. SC Duplex type adaptors pre fitted on to the LIU.
10. Hinged and stacked splice trays.
11. Sealed cable entry points.
12. Compact Size (mm).
- 13.

200 (L) X 150 (W) X 65 (D) Approximate size for reference only

- **HDPE PIPE**

- a) The DWC high density polyethylene pipe having corrugation on outer wall & plain in inner wall should confirm to IS – 14930 Part – I & II amended upto date.
- b) Contractor has to arrange inspection of pipe at manufacturer's premises to carry out necessary test 's contained in IS – 14930 part – I & II (compression test, impact test banding test etc.)
- c) Job includes (laying of pipe item No. 8 of BOQ) accessories like HDPE snap fit coupler with required No. of neoprene 'O' rings in order to make water / damp proof joint.
- d) Contractor has to produce test report of anti rodent test, toxicity test of pipe from Govt. approved test house.

EXCAVATION & BACK FILL

All excavation and back fill required for the installation of the cables or laying of HDPE pipe shall be carried out by the Contractor in accordance with the drawings and requirements laid down elsewhere. Trenches shall be dug true to line and grades. Back fill for trenches shall be filled in layer not exceeding 150mm. Each layer shall be properly rammed and consolidated before laying the next layer.

The Contractor shall restore all surface, road ways, side walks, kerbs wall or the works cut by excavation to their original condition to the satisfaction of the Engineer-in -Charge.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Cables shall be laid in existing HDPE pipes laid connecting Manhole chamber to Manhole chamber provided bridge each Lighting Pole location. HDPE pipe shall be directly laid in ground at depth of 600 mm ground level.

TECHNICAL SPECIFICATIONS FOR ACCESS CONTROL

- Software

- System Overview

- The Integrated Security Management System (ISMS) shall be a modular, networked access control system capable of handling large proprietary corporations with multiple remote sites, alarm monitoring, video imaging, badging, paging, guard tour. The system shall allow for easy expansion or modification of inputs, outputs, and remote control stations.
- The system control at the central computer location shall be under a single software program control, shall provide full integration of all components, and shall be alterable at any time, depending upon the facility requirements. Reconfiguration shall be accomplished online through system programming, without hardware changes.
- The software program shall be a true 32-bit, 3-tier client/server, ODBC compliant application based on Microsoft tools and standards. The software program shall operate in one of the following environments; Windows 2003 Server, Windows Vista Business, Windows XP Professional SP2, Windows 2000 Professional or Server using Service Pack 4.
- The system shall support multiple communication servers on a LAN/WAN, to provide distributed networking capabilities, which significantly improve system performance.
- The database architecture shall be MSDE 2000 as standard with the capability to utilize Microsoft SQL Server 2005; SQL Server 2005 Express Edition or SQL Server 2000.
- The system shall have the capability to communicate with the control panels via LAN/WAN connections utilizing industry standard communication protocol.
- The software program shall use Abstract Devices (ADV) for representing hardware devices in the system. The ADVs shall be used in Floor Plans to provide the user interface to control and monitor the system, and shall also be used in the Data Trees to organize, display, and control system information.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- The system shall support both manual and automatic responses to alarms entering the system. Each alarm shall be capable of initiating a number of different actions, such as activation of remote devices, door control, and activation of WAV files.
- The system shall provide both supervised and non-supervised alarm point monitoring. Upon recognition of an alarm, the system shall be capable of arming or disarming alarm points both manually and automatically, by time of day, and by day of week.
- Access control functions shall include validation based on time of day, day of week, holiday scheduling, site code and card number verification, automatic or manual retrieval of cardholder photographs, and access validation based on positive verification of card, card and PIN, card or pin, pin only and Site Code only.
- Alarm events with defined priorities shall be able to pop-up automatically in an Alarm event window for operator attention. The pop-up shall display the name of the event (reader, alarm point, cardholder or system alarm), time, date, site, account, if a card event the card number, type of event and cardholder name. An event counter shall also display the number of times the event was reported to the Alarm event monitor prior to Acknowledgement or Clearing the event. Event instructions shall be made available by double clicking on the event.
- The Alarm event window shall allow the operator to initiate a physical response to the event as well as a written response. Responses shall include but not be limited to: acknowledge, clear, open a pre-programmed floor plan, energize, de-energize, pulse, time pulse, add comment, shunt or un-shunt.
- Assigned passwords shall be possible to define the levels of system operation for each individual operator. System operation for individual operators shall include, but not be limited to, restricted time periods for login, available accounts and default language selection at login. Operator actions range from no view or control rights to basic monitoring including the ability to block the viewing of card and or personal identification numbers, to full control of the system including programming.
- The system programming shall be user friendly, and capable of being accomplished by personnel with no prior computer experience. A quick start wizard shall allow the operator to easily program a system including basic time zones, access panels (IP connection, Modem Pools or direct connections to an RS-232 port), card activation to a general-purpose access area and deactivation date. The software shall utilize drop boxes for all previously entered system-required data. The programming shall be MENU driven and include online "Help" or "Tutorial" information, as well as online data entry examples. The Help shall be available by using the F1 key. When using the

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

F1 help access, the help menu will provide detailed information relative to the operation that the user is performing without the need to key in additional search parameters. An operation Tutorial shall also be provided with the access control software. The contents of the Tutorial shall include, but not be limited to: Floor plan setup and control, Visitor management integration, and Intrusion integration and operation.

- After installation, the Customer shall be able to perform hardware configuration changes. These hardware configuration changes shall include, but not be limited to, door open time, door contact shunt time, point and reader names, when and where a cardholder is valid, and the ability to add or modify card databases as desired; For the intrusion system, any function that can be programmed from a physical keypad shall also be available from the system's virtual keypad, without the services of the Contractor or Manufacturer.
- Equipment repair shall be able to be accomplished on site, by module replacement, utilizing spare components.

Basic System Capabilities

The following functional capabilities are considered essential for the system described in this specification. The capabilities are to be considered standard, without the need for add-on software or hardware.

• **General**

1. All databases will have the ability to ADD, DELETE, REPORT, VIEW or EDIT information.
2. Provide storage of all system transactions in a retrievable file.
3. Log all events by time and date with reference to GMT.
4. Provide capability to store all or selected system transactions to a disk file.
5. Provide ability for CUSTOMER to make system configuration changes such as, but not limited to door open time, door contact shunt time, point and reader names, when and where a cardholder is valid, and the ability to add or modify card databases at any time.
6. Support "Global Anti-passback", allowing cardholder to enter/exit any card reader on the same RS485 drop line.
7. Duress feature where when a PIN is used in conjunction with a card read, the number of digits are selected at the keypad where the PIN number is a value of one different from the normal PIN.
8. Provide mode of system operation that stores system commands that were not accepted by the hardware.
9. Provide mode of system operation that requires the operator to enter a response to an event when acknowledging it from the alarm view window.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

10. Provide mode of system operation that allows acknowledged alarms to be automatically cleared.
11. Provide mode of system operation where un-acknowledged events will cause the computer to continuously emit a pulsating beep until all un-acknowledged alarms are acknowledged. A momentary silence feature shall allow the beeping to cease for up to 60 seconds. The silence feature shall also provide a visual count down to when the beeping will begin again.
12. Provide mode of system operation where when an acknowledged, but not cleared event will be reissued requiring acknowledgement when the event changes to an alarm or trouble state.
13. Provide mode of system operation that does not allow the operator to clear an alarm prior to it being restored to normal.
14. Provide ability for manual operator control of system output relays. The manual functions shall include the ability to energize, de-energize, return to time zone, or pulse the output relay. The pulse time shall be a programmable setting.
15. Provide ability for manual operator control of system doors. The manual functions shall include the ability to Lock, Un-Lock, Shunt, Un-Shunt and Return to Time Zone.
16. Provide ability to automatically display stored "video image" of cardholder
17. The cardholder "video image" pop-up shall be activated based on a priority level set to the cardholder or reader. Information in the pop-up shall include, but not be limited to the cardholder's primary image a live video pop-up showing the person who initiated the pop-up, entrance name, time, date, cardholder name, and status. User shall be able to display up to 40 note fields. The size of the pop-up(s) shall be adjustable by the operator.
18. Support multiple card reader technology including Proximity, Wiegand effect, Biometrics, Magnetic stripe, Bar Code, Keypad, Card/keypad (PIN), High-speed long range Vehicle ID, Smart Card
19. Provide a means for scheduled automatic backups of any or all database system files. A means to restore these files from a simple menu shall exist.
20. Provide the ability to address up to 2 serial communication ports, where each port can be configured for either hardwired or dial-up. When configured for dial-up, any one port can support multiple dial-up locations.
21. Communication from the access control server to the remote control panels shall be selectable. Communication options shall be via RS-485 converter, dial-up, leased line from a defined communication port or by LAN/WAN using an IP address for direct connection to the remote RS-485 converter via network interface card. When using IP addressing it shall be un-acceptable to use a communication port converter device on the communication server side of the transmission. A minimum of 64 such IP connections shall be allowed.
22. All commands and updates to the panels shall be verified and shall automatically retry if communications have failed.
23. Provide the ability to select ACK/NAK communication feature by communications port for either dial-up or hardwire.
24. Provide a system scheduler that shall automatically:
 - a. Call remote locations to retrieve history transactions and update panel information, including time and date.
 - b. Activate or deactivate cards locally or at remote dial-up sites.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

- c. Initiate a pre-programmed command event/action.
 - d. Synchronize system to controller time.
25. Provide the ability to initiate an alarm based on a transaction state. A transaction state shall be defined as but not limited to Normal, Alarm, Trouble, Ajar, Trace, Not Found, Anti-Passback Violation, PIN Violation, Time Zone Violation, Site Code Violation and System Alarms including Panel Com, Panel Power Failure, Modem Pool, Guard Tour, and Tamper.
26. A host grant mode of operation shall exist that requires the host computer to grant accesses to “valid” cards. An alternate host grant mode shall allow the card access information to be downloaded along with unlocking the door for “valid” cards.

• **Card Database**

- i. Provide a simple card and card holder database import utility. The utility shall be password protected and accessible only to administrators of the access control system. Information that can be imported shall include but not be limited to: First Name, Last Name, card number, activation date, de-activation date, status, up to 40 note fields and photo images. A simple CSV (comma separated value) file shall be used for the importing of data and image file names.
- ii. Cardholder information shall include unique card number up to 15 digits and optional Personal Identification Number.
- iii. Allow multiple cards per cardholder.
- iv. Allow for up to 32 access levels to be assigned to a card, or a single “precision” access level. When using “precision” access levels it shall be possible to create a unique access level per card using an existing access level as a baseline template. This customized card access level shall have both beginning and ending dates.
- v. Provide 40 user definable fields.
- vi. Each card holder note filed shall allow the option to be entered as free form data or structured data. Structured data shall be by use of a template or drop list. The template and drop list shall be created by the operator. The capacity of the template shall allow for up to 65,000 characters.
- vii. Provide special card options that include, but are not limited to:
 - 27. Time zone reference, which defines valid time.
 - 28. Visitor use, which provides a specified activation date and expiration date (spanning years).
 - 29. Trigger control value, which can initiate a predefined procedure at the intelligent control independent from any control function from the system computer.
- viii. Provide a card “Trace” function. The Trace function shall allow normal access control, but will provide a tracking alarm at the system monitor.
- ix. Provide ability to store digital images and written signature of cardholder.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

- x. Provide the ability to priorities specific card usage from 1 to 99 with separate priority options for Anti-pass back, Trace, PIN Violation, Normal, Not Found, Expired, Host Grant, Site Code and Time Zone card activities or violations.
- xi. Allow the user the ability to assign an operator message per card event state.
- xii. Upon editing card information, the updated information shall be sent automatically to the appropriate access control panel, when hardwired, with no other user intervention. If the port is dial-up, the entry will be stored on disk and shall be updated when connection is made to the remote loop. If the scheduler is used, then card updates shall be sent based on scheduling.
- xiii. In a traditional (Wiegand) 5-digit card database, the numbers 0 and 65,535 shall not be valid card numbers as some devices transmit these numbers on an improper read.
- xiv. In a 15-digit card database, the number 0 shall not be a valid card number as some devices transmit this number on an improper read.
- xv. A card shall have the ability to be allowed to access one or selected accounts up to all available accounts.

- **Access Levels**

- i. It shall provide the ability to define specific times of access, specific readers for access, provide a template of a defined access level detail, where changes can be made to the template and saved as a new access level detail and provide an access control tree structure that allows groupings of entrances. User shall have the ability to group program all entrances on the branch or make specific changes to individual entrances.

- **Alarm Monitoring – Alarms Only View**

- i. Report alarm point activity.
- ii. Provide colour for each specific alarm point action of “Alarm”, “Normal” and “Trouble”, conditions.
- iii. Provide the ability to access the default floor plan graphic for any active alarm point by a right click option, to acknowledge any alarm, card, or reader activity based on priority and to bypass alarms in the system
- iv. Execute alarm notification in all modes of operation.
- v. Provide display of system activity with the higher priorities displayed at the top of the list with identical points stacked with a frequency count of each point’s change of state.
- vi. Provide ability for the operator to acknowledge and clear alarms from display. Prior to acknowledgment, the user shall be allowed to enter a response per alarm. The system shall offer a means to require acknowledgement of an alarm before it can be cleared.
- vii. Provide a display of the most current transactions in real time.
- viii. Provide the ability for dynamic alarm monitoring of alarm points in real time on the system computer’s video display terminal.
- ix. Provide an alarm view filter that is structured as a tree allowing the operator to select individual devices or groups of devices to be viewed.
- x. Provide a “Panel Not Responding” alarm if communication to a panel is lost.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

- xi. Provide real time printing of alarms as they occur by line printing with a dot matrix printer or provide printing of alarms, one page at a time, using typical Windows page printing.

• **Alarm Monitoring/System Control – Tree View**

- i. Provide the ability for dynamic alarm monitoring of alarm points in real time on the system computer's video display terminal
- ii. Provide colour and icon shapes for each specific alarm point action of "Alarm", "Normal" and "Trouble", and "Shunted".
- iii. Access control panels in the alarm tree, like alarm points, shall also indicate if they are in the buffered mode of operation as well as any "system" related alarm such as "Tamper" or "Primary Power Loss" or Loss of communication.
- iv. Devices connected to the communication server shall provide additional popup information as to the communication port or IP connection the device is programmed for.
- v. Provide a means to launch a Virtual keypad from an intrusion panel partition to monitor the physical keypad remotely and to administer programming changes via the Virtual keypad.

• **Operator Database**

- i. The software shall allow the assignment of operator levels to define the system components that each operator has access to view, operate, change or delete.
- ii. The ability to view, edit or delete cardholder sensitive information such as note fields, card number and PIN shall be definable by field per operator.
- iii. Define the accounts that the operator has access to.
- iv. Provide the ability to log operator actions in the history files.
- v. Provide default language to be used based on operator's login.
- vi. Provide specified time periods that the operator can log in.

• **Reports**

- i. Provide reporting capability for printing of selected system transactions from the disk files by specific time and date selection, range from time and date to time and date, or from start time to end time each day of the selected date range.
- ii. Provide feature to generate a history report for an alarm point(s) state. An alarm point state shall be defined as Normal, Alarm, Trouble, or Ajar.
- iii. Provide feature to generate a history report of system alarms. A system alarm state shall be defined by panel and include any of the following information: communication, ground fault, power, panel reset, low voltage, panel tamper, and loop communication.
- iv. Provide feature to generate a history report for a card(s) state. A card state shall be defined as Normal, Trace, Not Found, Anti-Passback Violation, PIN Violation, Time Zone Violation, Site Code Violation, or Expired card. Additional search criteria shall include cardholders that meet up to at least 3-note field restriction and filter the report with defined reader location(s).

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

- v. Provide feature to generate a history report for system operator(s) activities. The report shall include time, date, operator name the device associated with the action and the type of action performed by the operator. Activities shall include but not limited to: acknowledged and cleared transactions, door and relay control such as unlock, lock; door and input control such as shunt, un-shunt; login, logout, panel initialization, panel buffer and panel un-buffer.
- vi. Provide complete database reporting of all data programmed into the system data files.
- vii. Provide a means to define how long a card holder has been in a defined area. This report shall allow the time to be accumulated representing an attendance report. The definable filters shall include time/date range, reader(s) definition, card number, card holder and note field. The output of the report shall allow sort options to include First Name, Last Name, Event Time, and Card Number. The sorted data shall be selectable as Alpha or Numeric sorting and Ascending or Descending.
- viii. Provide feature to generate a report based on the frequency of usage of a card. The report shall allow the operator to define a time/date period, a minimum and maximum usage limit, a means to define which reader or readers should be used to filter the report and the ability to further define the type of card to be reported on based on note field selections. This report shall also provide a disposition function. The cards meeting the filtering criteria shall be acted upon based on the disposition setting. Disposition settings shall include but not be limited to: Report only, De-activate the card or Re-assign to a specified an access level. This report shall be available in the event scheduler. When defining when to run the report an option to select the number of previous days to run the report against shall be provided. As an example a scheduled weekly report for the last 14 days could generate allowing for an overlap of time if desired.
- ix. Provide a means to create report templates. Report templates shall include, but not be limited to, History and Card Holder information. The templates shall be able to be assigned to a scheduler to run automatically per the scheduler settings.

• **Tracking/Muster Report**

- i. A tracking feature shall allow the system operator to identify an area and the person(s) in that area, which shall be defined by readers representing an IN or OUT read status.
- ii. Defined areas shall provide an automatic update of how many cardholders are in the area.
- iii. A view displaying all card holders in a defined tracking or muster area shall have the ability to be sorted in columns where by clicking on the column the data in the column shall be sorted. At a minimum, the columns can be sorted by: Card Number, Status, Card Holder, Reader, and Time/Date.
- iv. A Muster area shall be defined by a reader(s) used to “muster” individuals in the event of an emergency.
- v. Reports shall be generated for all muster or tracking areas in the system.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

- vi. Tracking areas shall include “nested” areas. Nesting allows for various reports from a large area to smaller areas within the large area.
- vii. A Tracking and Muster area screen shall be continually updated with the most recent card activity, therefore minimizing the time required generating a report.
- viii. A history-priming feature shall load history activities for the defined amount of hours when the software is started. This priming feature shall be implemented in the event that the system computer is offline when a muster call is initiated, thereby allowing the implementation of the tracking and muster features of the software. The history priming time shall be operator selectable in 1-hour increments up to 99 hours.

- **Time Zones**

- 1. Time zone definitions shall include Starting time, Ending time, Days of the week, and Holiday override.
- 2. Minimum time zones that can be assigned to a panel shall be 63 and maximum unlimited.
- 3. Holidays shall be definable in two different time zones allowing different time schedule to be programmed for each holiday type.

- **Floor Plan Graphic**

- i. Provide the ability to import floor plan graphics stored in a WMF format and to associate all hardware devices (access, intrusion) to floor plan graphics allowing the user to control and monitor the system.
- ii. Provide the ability to link floor plan graphics together in a hierarchy fashion and allow multiple floor plan views to be displayed simultaneously.

- **Front End Software Specifications**

- a Databases: The software shall provide edit, add, delete, search, sort, and print options for records in selected databases.
- b Printer Output: The software shall direct user-selected activity to the Windows supported printer.
- c Monitor Display: The software shall display all system activity on a colour monitor in real time, except for remote locations configured as dial-up. The software shall allow a WAV file to be played upon all alarm conditions. The software shall provide an acknowledge function for all incoming alarm messages that are defined for alarm acknowledgment.
- d Disk Storage: The software shall store user-selected activity on the hard disk. Report options shall recall selected history information from the hard disk. The user may request report information based on selected cardholders,

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 No. of Omissions – O NIL
 No. of Insertions – I NIL

specific areas and/or specific times. The software shall allow archiving by defined dates.

English Descriptions: The software shall support descriptive names for all database entries. The card database shall include name, number, PIN, access level, status, activation, and expiration date or limited usage and 40 user-defined fields.

- ACCESS CONTROL FIELD HARDWARE DEVICES

Reader Intelligent Controller:

The security management system shall be equipped with access control field hardware required to receive alarms and administer all access granted/denied decisions. All field hardware shall meet FCC CE C-Tick requirements. The system shall include the 2-reader intelligent controller.

The IP-enabled controller is an advanced access control panel capable of providing solutions for medium to large applications. The controller provides power and flexibility with its 32-bit CPU architecture, TCP/IP protocol support, flash memory for firmware and large local card holder database.

The controller is designed to operate off-line, making access control decisions independently from a PC or other controlling device. It can also be connected to a host computer for system configuration, alarm monitoring and direct control. Connectivity to the host computer is accomplished via TCP/IP network connection.

The board combines intelligent controller and reader interface into one complete unit. It connects for two readers via Wiegand controlling two doors. The controller can support up to 62 doors via RS485 multi-drop communication where 30 downstream controllers are connected to the gateway controller. This architecture can reduce the usage on LANs by using only one TCP/IP address to 62 doors. It accommodates a card database of 55,000 cards, and a transaction buffer of 45,000 transactions. It is designed with tile mounting configuration.

Specifications

Database:

- Cardholder capacity: 55,000
- Transaction storage: 45,000
- Flash programming for firmware revision updates
- Access level: 128
- Holidays: 255
- Time zone: 127
- Card reader formats: 128 Wiegand format support

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- Credential facility codes: 8
- Dedicated tamper alarm
- Dedicated power fail alarm
- Real time clock:
 - Geographic time zone support
 - Leap year support
- Embedded web server to configure network attributes

Environment:

- Temperature: 0 to 50° C operational
-55 to 85° C storage
- Humidity: 0 to 85% RHNC

Communication:

- Ethernet port connected to TCP/IP network as master panel
- RS485 multi-drop connection for downstream panels

Onboard I/O:

- 2 Readers, expandable to 62 readers per gateway controller
- 8 Supervised inputs
- 4 Relay outputs

Operational Functionality:

- Operational modes:
 - Card only
 - Card and PIN
- Maximum site codes: 8 digit
- Anti-Passback support:
 - Local
 - Global
 - Forgiveness
- Interlocks: 256

Approvals:

- CE/FCC/C-TICK

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

Standard Read Range Smart Card Reader:

- Reader shall be read only reader
- Provide surface mounting style 13.56 MHz contactless smart card readers suitable for minimal space mounting configurations as shown on the project plans.
- Contactless smart card readers shall comply with ISO 15693, ISO 14443A (CSN), and ISO 14443B and shall read credentials that comply with these standards.
- Data security with cards shall use 64-bit authentication keys to reduce the risk of compromised data or duplicate cards. The contactless smart card reader and cards shall require matching keys in order to function together. All RF data transmission between the card and the reader shall be encrypted, using a secure algorithm. Card readers shall be provided with keys that are compatible with the cards.
- The contactless smart card reader shall provide the ability to change operational features in the field through the use of a factory-programmed command card. Additionally, firmware may be updated by flashing the reader. Command card operational programming options shall include:
 - Output configurations
 - LED & Audio configurations
 - Keypad configurations
- Contactless smart card readers shall provide the following programmable audio/visual indication:
 - An audio transducer shall provide various tone sequences to signify: access granted, access denied, power up, and diagnostics.
 - A high-intensity light bar shall provide clear visual status (red/green/amber) that is visible even in bright sunlight.
- Contactless smart card readers shall meet the following physical specifications:
 - Dimensions: 1.90" x 4.04" x .80" (4.83cm x 10.26 cm x 2.03 cm)
 - Weight: 3.2.oz (90.7 g)
 - Material: UL94 Polycarbonate
 - Three-part design with separate mounting plate, reader body, and cover.
 - Color: Black.
- Contactless smart card readers shall meet the following electrical specifications:
 - Operating voltage: 10 – 16 VDC, reverse voltage protected. Linear power supply recommended.
 - Current requirements: (average/peak) 61/178mA @ 12 VDC
- Contactless smart card readers shall meet the following certifications:
 - UL 294
 - Canada/UL 294
 - FCC Certification
 - Canada Radio Certification
 - EU and CB Scheme Electrical Safety

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

- EU – R&TTE Directive
- CE Mark (Europe)
- IP55 Rated
- C-Tick (New Zealand/Australia/Taiwan)
- Contactless smart card readers shall meet the following environmental specifications:
 - Operating temperature: -30 to 150 degrees F (-35 to 65 degrees C)
 - Operating humidity: 5% to 95% relative humidity non-condensing
 - Weatherized design suitable to withstand harsh environments
- Contactless smart card reader cabling requirements shall be:
 - Cable distance: (Wiegand): 500 feet (150m)
 - Cable type: 5-conductor #22 AWG with overall shield
 - Standard reader termination: 18" (.5m) cable pigtail
- Warranty of contactless smart card readers shall be lifetime against defects in materials and workmanship.

Electromagnetic Lock:

Single Leaf doors.

Surface Mount Electromagnetic Lock with built in magnetic read switch contractor shall consider the U , L , Z brackets based on the site conditions accordingly

The EM Lock shall have minimum with following specifications

- a. Suitable for surface mount on single leaf doors
- b. Current Draw: 500mA / 12V, 250mA / 24V
- c. Dual Voltage: 12V / 24 V
- d. Holding Force: About 600 lbs
- e. Built-in magnetic read switch and Voltage Spike Suppressor
- f. UL Listed

Double Leaf doors.

Surface Mount Electromagnetic Lock with built in magnetic read switch contractor shall consider the U, L, Z brackets based on the site conditions accordingly

The EM Lock shall have minimum with following specifications

- a. Suitable for surface mount on double leaf doors
- b. Current Draw: 1A / 12V, 500 mA / 24V
- c. Dual Voltage: 12V / 24 V
- d. Holding Force: About 600 lbs
- e. Built-in magnetic read switch and Voltage Spike Suppressor
- f. UL Listed

- Cable:

Following shall be the cables for the various components of the networked access control system

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

Reader - six conductor shielded, 18 AWG

Power - twisted pair, 18AWG

RS-485 - 24 AWG, 4,000 ft. (1,200 m) max., 2 twisted pairs' with shield (120W, 23pF)

RS-232 – 8 conductors 24 AWG, 25 ft. (7.6 m) max.

Alarm input – 2 conductor twisted pair, 30 ohms max.

TECHNICAL SPECIFICATION FOR LAN, EPABX

SECTION-I - STRUCTURED CABLING

	Technical Specification		Compliance
Power Cat 6 4 Pair Cable			
1	Type	Unshielded twisted pair cabling system, TIA / EIA 568-C.2 Category 6 Cabling system	
2	Network support	Supports ultrahigh speed data networks such as Gigabit Ethernet (1000 Base-T and 1000 Base-TX) and beyond.	
3	TIA / EIA 568-B.1	ETL Verified, UL Listed and UL channel verified- All three Certificates are mandatory	
4	IEEE 802.3ab	Zero-bit Error, ETL verified	
5	Warranty	25-year systems warranty; Warranty to cover Bandwidth of the specified and installed cabling system, and the installation costs. Site certificate must be issued by OEM	
6	Performance characteristics to be provided along with bid	Attenuation, Pair-to-pair and PS NEXT, ELFEXT and PSELFEXT, Return Loss, ACR and PS ACR for 4-connector channel	
7	Manufacturer	All passive cabling must be from same OEM (UTP and Fiber)	
8	Conductors	23 AWG solid bare copper	

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

9	Insulation	Polyethylene	
10	Approvals	UL Listed and UL Channel verified	
		ETL verified to TIA / EIA Cat 6	
11	Frequency tested up to	600 MHz minimum	
12	Packing	Box of 305 meters	
13	Impedance	100 Ohms + / - 15 ohms	
14	Performance characteristics to be provided along with bid	Attenuation, Pair-to-pair and PS NEXT, ELFEXT and PSELFEXT, Return Loss, ACR and PS ACR	
15	Delay Skew:	45ns Max	
16	Impedance:	100 ± 15 Ohms	
17	Current Rating:	1.5 A Max	
18	Conductor DC Resistance:	66.5Ω/km	
19	Voltage:	150VAC	
20	Propagation delay:	535ns/100m @250MHz	
21	Mutual Capacitance:	5.6nF/100m Nominal	
22	Insulation Resistance:	500 MΩ Minimum	
23	Dielectric Strength:	1000 V RMS	
24	Contact Resistance:	10 mΩ Max	
PowerCat 6 DataGate Jack			
1	Features and Benefits		
		<input type="checkbox"/> Patented Spring-Loaded Shutter:	
		prevents incomplete mating	
		protects from dust and contaminants	
		<input type="checkbox"/> Patented IDC V-shaped contacts that flex not fatigue	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

		when terminated	
		<input type="checkbox"/> Features pointed IDC towers to speed termination	
		and enhance cable retention	
		<input type="checkbox"/> Dual color-coding allows for 568 A/B wiring	
		Configuration	
		<input type="checkbox"/> Can be terminated using industry standard	
		punch-down tools	
		<input type="checkbox"/> RJ-11 compatible	
		<input type="checkbox"/> Molded category identification on jack face as well	
		as optional port identification icons	
		<input type="checkbox"/> USOC Wiring Sequences Available	
2	Dust Proof	RJ45 Jack should be supplied with Cap or Shutter to avoid Dust	
3	RJ45 I/O Compatibility	2a. Individual Compatible RJ45 Jack	
		2b. Pointed IDC Tower on RJ45 Jack for easy termination	
		2c. Half Plugged Patch Cord should be spitted out if not properly plugged in	
4	Mechanical Characteristics		
	Plastic Housing:	Thermoplastic UL94V-0 rated orequivalent	
	Operating Life:	Minimum 750 insertion cycles	
	Contact Material:	Copper Alloy	
	Contact Plating:	50μ" Gold/100μ" Nickel	
	Contact Force:	100g minimum	
	Plug Retention Force:	11 lbf minimum	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

5	IDC Connector		
	Plastic Housing:	Thermoplastic UL94V-0 rated or equivalent	
	Operating Life:	Minimum 20 reterminations	
	Contact Material:	Copper Alloy	
	IDC Contact Plating:	Tin/Lead Plate	
	Wire Accommodation:	22-24 AWG solid	
6	Electrical Characteristics		
	Interface Resistance:	20 milliohms	
	Initial Contact Resistance:	2.5 milliohms	
	Insulation Resistance:	>100 Megaohms	
7	Parts List:	<input type="checkbox"/> DataGate Plus Jack with Stuffer Cap	
Wall plates			
1	Features and Benefits	The stylish unloaded Synergy Wallplates were designed specifically to accept the UTP Datagate Connector. The unloaded Synergy Wallplates are available in 1, 2 and 4 port variants, in five colours, to co-ordinate with any decor and any installation size.	
2	Accommodates	Accommodates UTP, STP Datagate jacks Accommodates Molex single bezel Fibre modules Accommodates Molex media configurable modules	
3	Material	VE10 ABS	

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

24 Port loaded Patch Panel 1U Height			
	Features and benefits		
1		Available in 1U 24 Port and 2U 48 Port density	
		▮ Each port features the patented spring-loaded shutter:	
		– prevents incomplete mating	
		– protects from dust and contaminants	
		▮ Patented IDC V-shaped contacts that flex not fatigue when terminated	
		▮ Features pointed IDC towers to speed termination and enhance cable retention	
		▮ Dual colour-coding allows for 568 A/B wiring configuration	
		▮ Front and rear port labelling (port sequence 1–480) as well as panel identification label	
		▮ 4 x 6 ganged jack configuration	
		▮ Individually removable patch panel ports	
		▮ Removable cable management shelf(s) ensure bend radius compliance	
		▮ Available with either ANSI and metric hardware kit	
		▮ Can be terminated using industry standard punch-down tools	
		▮ RJ45 port which is RJ-11 compatible	
		▮ Molded category identification on each port face as well as optional port identification icons	
2	Rear Cable Manager	Flat type metal with Perforated Rear Cable Manager to hold CAT6 UTP Cable with	

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

		velcro cable ties	
3	Dust Proof	RJ45 Jack should be supplied with Cap or Shutter to avoid Dust	
4	RJ45 I/O Compatibility	2a. Individual Compatiable RJ45 Jack	
		2b. Pointed IDC Tower on RJ45 Jack for easy termination	
		2c. Half Plugged Patch Cord should be spitted out if not properly plugged in	
5	Mechanical Characteristics		
	Material:	CRS (cold rolled steel)	
	Thickness:	.060" (1.52mm)	
	Coating:	Grey / Option for Black	
6	Jack Connector		
	Plastic Housing:	Thermoplastic UL94V-0 rated or equivalent	
	Operating Life:	Minimum 750 insertion cycles	
	Contact Material:	Phosphor Bronze	
	Contact Plating:	50μ" Gold/100μ" Nickel	
	Contact Force:	100g minimum	
	Plug Retention Force:	11 lbf minimum	
7	IDC Connector		
	Plastic Housing:	Thermoplastic UL94V-0 rated or equivalent	
	Operating Life:	Minimum 20 reterminations	
	Contact Material:	Phosphor Bronze	
	IDC Contact Plating:	Solder Plate (60% tin/40% lead)	
	Wire Accommodation:	22-24 AWG solid	
8	Electrical Characteristics		

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	Interface Resistance:	20 milliohms	
	Initial Contact Resistance:	2.5 milliohms	
	Insulation Resistance:	>100 Megaohms	
9	Standards	ETL Verified to ANSI/TIA-568-C.2, ISO/IEC 11801 Category 6	
PowerCat 6 Patch cord			
1	Type	PowerCat 6 U/UTP End-to-End Solution and are designed to support data networks for 10/100BASE-T and 1000BASE-T applications.	
2	Conductor size:	24 AWG stranded copper wire	
3	Nom. O.D.:	5.9mm	
4	Sheath:	LSOH	
5	Bend radius:	4X O.D.	
6	Boots	Transparent Plug with anti-snag slip on boots	
7	RJ45 Plug Standard	ISO/IEC 60606-7-4 and FCC 47 Part 68	
8	Sheath Standards	Fire Propagation compliant with CSA FTI, IEC 60332-1, IEC 61034	
9	Operating temperature range:	-20°C to 60°C	
10	MIN operating life	: 750 insertion cycles	
11	RJ45 plug and boot material:	Clear polycarbonate	
12	Contact material:	0.35mm thick copper alloy	
13	Contact plating:	Selective gold	
14	RJ45 plug dimensions compliant with:	ISO/IEC 60603-7-4 and FCC 47 Part 68	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

15	Commercial Standards	ISO/IEC 11801:2002/Amd 2:2010 Cat 6-, TIA-568-C.2 Cat 6	
16		ETL Verified	
17	Fire Propagation Tests:	LSOH Sheath: CSA FT1, IEC 60332-1, IEC 61034	
18	Standard length available	0.5mt to 10 mts	

PART II ACTIVE COMPONENT

OEM Eligibility Terms and Conditions: -

S.No	Criteria	
1	The OEM should be in Gartner magic quadrant for LAN and WLAN in leaders quadrant in last 3 years	
2	All Switches should be from same OEM to have single TAC for Active components	
3	The OEM should have done at least 3 WLAN deployments with more than 1000 Aps.	
4	OEM should have hardware spare depots at least 24 number in India covering major cities.	
5	OEM should have presence in India at least from last 10 years and making no losses in Networking business in last 5 financial years.	
6	OEM should not be ready for sale or under acquisition or acquired recently (3-Years minimum), as companies strategies/ roadmap will be impacted.	
	Services:	
7	OEM should offer portal based services via partner which will provide valuable information related to the collected network devices.	
8	This should be made available through the secure portal, accessible only by Log in ID with the appropriate entitlements	

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

	OR provided by the Partner.	
9	The secure web portal should assist in solving the following support challenges:	
	• Installed base management.	
	• Contract management.	
	• Proactive product alerts.	
10	The Network Solution comprising of all active components should be from single OEM	
11.	Bidder should be OEM/Authorized Partner/service provider of the OEM. In case the bidder is an Authorized Partner or Service Provider a valid Agency-Ship/Dealership Certificate (MAF specific to this tender) to quote on behalf of OEM should also be enclosed along with the technical bid	
12.	The Bidder must be a registered company in India under Companies Act 1956 or a registered firm. Registration Certificate for the same must be submitted. Bidder must also have a registered office in India.	
13.	Bidder have to submit copy of GST and PAN No. allotted by the concerned authorities.	

Core Switch: - 32-port 40G Gigabit Ethernet or 16-port 100G Gigabit Ethernet.

S.No	Specifications	
1	The Switch should support the following ports : 32-port 40G Gigabit Ethernet or 16-port 100G Gigabit Ethernet	
2	The Switch should support upto 960G SSD.	
3	The Switch should have Redundant Power Supplies	
4	The Switch should have Multicore x86 CPU Architecture	
5	The Core Switch should have 16GB of DRAM and 16GB of Flash	
6	The Switch should have a USB 2.0 slot to load system images and set configurations	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

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

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Distribution Switch: - 24 1/10G Fiber Ports with 40/100G Uplink ports.

S.No	Specifications	
1	The Switch should support the following ports : 24-port 1/10/25G Gigabit Ethernet	
2	The Switch should have 4 x 40/100G uplink ports.	
3	The Switch should have Redundant Power Supplies	
4	The Switch should have Multicore x86 CPU Architecture	
5	The Core Switch should have 16GB of DRAM and 16GB of Flash	
6	The Switch should have a USB 2.0 slot to load system images and set configurations	
7	The Switch should support AES-256 with MAC-Sec 256-bit encryption algorithm available on all models	
8	The Switch should support a modern operating system with support for model-driven programmability including NETCONF, YANG, on-box Python	
9	The switch should support Software serviceability where patches can be hot plugged into the existing switch OS without needing a full upgrade and reboot	
10	The Switch should have at least 1.6Tbps non-blocking switching bandwidth	
11	The Switch should support up to 82000 MAC Addresses, 212k IPv4 Routes, 16k QoS ACLs, 4k VLANs IDs and SVIs	
12	The switch should support routing protocols such OSPF, BGPv4, IS-ISv4.	
13	The switch should support Detection of Unidirectional Links (in case of fiber cut) and to disable them to avoid problems such as spanning-tree loops.	
14	The Switch should support Control Plan Policing (CoPP)	
15	The switch should support flexible & multiple authentication mechanism, including 802.1X, MAC authentication bypass, and web authentication using a single, consistent	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	Specifications	
	configuration.	
16	The switch should support TACACS and RADIUS authentication to facilitate centralized control of the switch and restricts unauthorized users from altering the configuration.	
17	The Switch should support Rate limiting based on source and destination IP address, source and destination MAC address, Layer 4 TCP/UDP information, or any combination of these fields, using QoS ACLs (IP ACLs or MAC ACLs), class maps, and policy maps.	
18	The Switch should support Eight egress queues per port for wired traffic and four egress queues for wireless to enable differentiated management of different traffic types across the stack for wired traffic.	

Access Switch Type-1: - Layer 2 Switch - 24 Ports with 10G Uplink

S.No	Specifications	
1.	19" Rack Mountable Switch with support for integrated redundant power supply and operating temperature of -5 ° to 45°C.	
2.	Should have 24 1Gig BaseT RJ45 ports plus 4x10G SFP+ ports from day one	
3.	Should support for minimum 128 Gbps of switching bandwidth & minimum 95 Mpps forwarding rate	
4.	Should support dedicated stacking port separate from uplink ports with 80 Gbps of stacking bandwidth to put minimum 8 switches into a single stack group.	
5.	Should support following layer 3 features Static routes, RIPv1 & v2, RIPv1, PBR, OSPFv3, PIM-SM, PIM-SSM, VRRP, IS-IS, IP-SLA, VRF, SGT, VXLAN and MACsec-128	
6.	Should support IEEE 802.3ad Link Aggregation Control Protocol (LACP) and PAgP.	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

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

Access Switch Type-2: - Layer 2 Switch - 48 Ports with 10G Uplink

S.No	Specifications	
1.	19" Rack Mountable Switch with support for integrated redundant power supply and operating temperature of -5 ° to 45°C.	
2.	Should have 48 1Gig BaseT RJ45 ports plus 4x10G SFP+ ports from day one	
3.	Should support for minimum 176 Gbps of switching bandwidth & minimum 130 Mpps forwarding rate	
4.	Should support dedicated stacking port separate from uplink ports with 80 Gbps of stacking bandwidth to put minimum 8	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	switches into a single stack group.	
5.	Should support following layer 3 features Static routes, RIPv1 & v2, RIPv6, PBR, OSPFv3, PIM-SM, PIM-SSM, VRRP, IS-IS, IP-SLA, VRF, SGT, VXLAN and MACsec-128	
6.	Should support IEEE 802.3ad Link Aggregation Control Protocol (LACP) and PAgP.	
7.	Should support 16000 MAC Address, 8000 ARP entries, 1500 IPv6 routes, 1500 ACL, 1000 Multicast routes and 1024 VLAN ID's.	
8.	It shall have IEEE 802.1s Multiple Spanning Tree Protocol and Per-VLAN Rapid Spanning Tree technology.	
9.	Should have functionality by which switch automatically attempts to reactivate a link that is disabled because of a network error.	
10.	Should have 6MB packet buffer.	
11.	Should support netflow / sflow or equivalent to support SDN technology. Switch should support NETCONF, RESTCONF, YANG, PnP Agent, PnP for automation.	
12.	Switch should have feature to protect access ports using port security, 802.1x authentication, TACACS/TACACS+, Radius and storm control	
13.	Should support telnet, Enterprise Class CLI, web GUI interface and SNMP v1/v2c/v3.	
14.	Should have 2GB DRAM and 4GB Flash memory.	
15.	Direct OEM warranty for 5 years with TAC Support	

Access Switch Type-3: - Layer 2 Switch - 24 Ports PoE with 10G Uplink

S.No	Specifications	
1.	19" Rack Mountable Switch with support for integrated redundant power supply and operating temperature of -5 ° to 45°C.	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

2.	Should have 24 1Gig BaseT RJ45 ports plus 2x10G SFP+ ports from day one with PoE budget of 370Watts. Switch should have capability of maintaining the PoE power during a switch reload.	
3.	Should support for minimum 128 Gbps of switching bandwidth & minimum 95 Mpps forwarding rate	
4.	Should support dedicated stacking port separate from uplink ports with 80 Gbps of stacking bandwidth to put minimum 8 switches into a single stack group.	
5.	Should support following layer 3 features Static routes, RIPv1 & v2, RIPv6, PBR, OSPFv3, PIM-SM, PIM-SSM, VRRP, IS-IS, IP-SLA, VRF, SGT, VXLAN and MACsec-128	
6.	Should support IEEE 802.3ad Link Aggregation Control Protocol (LACP) and PAgP.	
7.	Should support 16000 MAC Address, 8000 ARP entries, 1500 IPv6 routes, 1500 ACL, 1000 Multicast routes and 1024 VLAN ID's.	
8.	It shall have IEEE 802.1s Multiple Spanning Tree Protocol and Per-VLAN Rapid Spanning Tree technology.	
9.	Should have functionality by which switch automatically attempts to reactivate a link that is disabled because of a network error.	
10.	Should have 6MB packet buffer.	
11.	Should support netflow / sflow or equivalent to support SDN technology. Switch should support NETCONF, RESTCONF, YANG, PnP Agent, PnP for automation.	
12.	Switch should have feature to protect access ports using port security, 802.1x authentication, TACACS/TACACS+, Radius and storm control	
13.	Should support telnet, Enterprise Class CLI, web GUI interface and SNMP v1/v2c/v3.	
14.	Should have 2GB DRAM and 4GB Flash memory.	
15.	Direct OEM warranty for 5 years with TAC Support	

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Wireless Controller: -

S.No	Sepcification	
1	Must be compliant with IEEE CAPWAP or equivalent for controller-based WLANs.	
2	Should have at least 2 x 10 Gigabit Ethernet interface.	
3	Should support both centralized as well as distributed traffic forwarding architecture with L3 roaming support from day 1. Should have IPv6 ready from day one.	
4	Controller should have hot-swappable internal redundant power supplies.	
5	Controller should support minimum 20000 concurrent devices.	
6	WLAN controller should have scalability to support 1500 Access points from day 1 without any hardware change. Controller should be provided with 500AP lic. From Day-1.	
7	Should be rack-mountable. Required accessories for rack mounting to be provided.	
8	WLAN controller should provide Application visibility with both traffic forwarding mode i.e when traffic coming to controller and when traffic moving locally from Ap to connected access switch. Admin should have option to create policies to allow or deny access based on applications.	
9	WLC should support AP License Migration from one WLC to another	
10	Should support minimum 4000 VLANs	
11	Must support stateful switchover between active and standby controller in a sub second time frame.	
12	WLC should support L2 and L3 roaming for IPv4 and IPv6 clients	
13	WLC should support guest-access functionality for IPv6 clients.	
14	Should support IEEE 802.1p priority tag.	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	Sepcification	
15	Should ensure WLAN reliability by proactively determining and adjusting to changing RF conditions.	
16	Should provide real-time radio power adjustments based on changing environmental conditions and signal coverage adjustments.	
17	Should support automatic radio channel adjustments for intelligent channel switching and real-time interference detection.	
18	Should support client load balancing to balance the number of clients across multiple APs to optimize AP and client throughput.	
19	Should support policy based forwarding to classify data traffic based on ACLs	
20	WLC should support PMIPv6 and EoGRE tunnels on northboud interface	
21	Should support flexible DFS to prevent additional 20/40 Mhz channels from going unused	
22	Should support dynamic bandwidth selection among 20Mhz, 40 Mhz and 80Mhz channels, ensuring one access point on 20Mhz and another on 80 Mhz channel connected on the same controller at same WLAN group.	
23	Should support minimum 500 WLANs	
24	Should support dynamic VLAN assignment	
25	Should support Hot Spot 2.0	
26	To deliver optimal bandwidth usage, reliable multicast must use single session between AP and Wireless Controller.	
27	Should able to do dynamic channel bonding based on interference detected on particular channel.	
28	Must support coverage hole detection and correction that can be adjusted on a per WLAN basis.	
29	Must support RF Management with 40 MHz and 80 Mhz channels with 802.11n & 802.11ac	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	Sepcification	
30	Should provide visibility to Network airtime in order to set the airtime policy enforcement	
31	Must support dynamic Airtime allocation on per WLAN, per AP, Per AP group basis.	
32	Must be able to restrict the number of logins per user.	
33	Should support web-based authentication to provide a browser-based environment to authenticate clients that do not support the IEEE 802.1X supplicant.	
34	WLC should support web based authentication in different traffic forwarding modes i.e Central switching and Local switching when traffic move locally from AP to connected switch.	
35	Should support port-based and SSID-based IEEE 802.1X authentication.	
36	Should support MAC authentication to provide simple authentication based on a user's MAC address.	
37	WLC should be able to exclude clients based on excessive/multiple authentication failure.	
38	Shall support AES or TKIP encryption to secure the data integrity of wireless traffic	
39	Shall support the ability to classify over 20 different types of interference with in 5 to 30 seconds.	
40	Shall able to provide an air quality index for ensuring the better performance	
41	Shall able to provide real time chart showing interference per access point on per radio and per-channel basis.	
42	Should support AP location-based user access to control the locations where a wireless user can access the network	
43	Should support Public Key Infrastructure (PKI) to control access	
44	Must be able to set a maximum per-user bandwidth limit on a per-SSID basis.	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	Sepcification	
45	WLC Shall support WIDS/WIPS, and spectral analysis from day 1.	
46	WLC should detect if someone connect a Rogue Access Point in network and able to take appropriate action to contain rogue Access point.	
47	In case of Access point connected in remote locations over WAN, containment should happen even if WAN is down.	
48	WLC should detect and protect an Ad-hoc connection when a connected user forming a network with other system without an AP or try enabling bridging between two interface	
49	WLC should detect if a user try to impersonate a management frame.	
50	WLC should detect and take appropriate containment action if a smartphone user using tethering to connect other device.	
51	WLC should detect and protect if a user try to spoof mac address of valid client or AP for unauthorized access/authentication.	
52	WLC should detect if a user trying to do internet sharing through a valid system to an unauthorized device.	
53	Should support SNMPv3, SSHv2 and SSL for secure management.	
54	Should support encrypted mechanism to securely upload/download software image to and from Wireless controller.	
55	Should provide visibility between a wired and wireless network using IEEE 802.1AB Link Layer Discovery Protocol (LLDP) and sFlow/equivalent.	
56	Should support AP Plug and Play (PnP) deployment with zero-configuration capability	
57	Should support AP grouping to enable administrator to easily apply AP-based or radio-based configurations to all the APs in the same group	
58	Should support selective firmware upgrade APs, typically to a group of APs minimize the impact of up-gradation	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	Specification	
59	Should have a suitable serial console port.	
60	Should have Voice and Video Call Admission and Stream prioritization for preferential QOS	
61	Controller should support deep packet inspection for all user traffic across Layer 4-7 network to analyses information about applications usage, peak network usage times for all access points from day one with different traffic forwarding modes i.e central switching with WLC and local switching when traffic move locally from AP to connected switch.	
62	Should be able to do application visibility for application running behind HTTP proxy.	
63	Support profiling of wireless devices based on known protocols like http and dhcp to identify clients	
64	Should support visibility and control based on the type of applications	

Indoor Access Point: -

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

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S. No.	Specification	
6	Must have atleast 3 dBi Antenna gain on each radios	
7	Must support 4x4 MIMO with 3 spatial streams.	
8	Must provide dynamic dual 5 ghz radio mode for high density requirement from day 1.	
9	Must Support minimum aggregate data rate of 5 Gbps on dual 5ghz mode with 160 mhz channel support and standard 256 QAM modulation.	
10	Must support minimum of 22dbm of transmit power in both 2.4Ghz and 5Ghz radios. And should follow the local regulatory Norms.	
11	Must support AP enforced load-balance between 2.4Ghz and 5Ghz band.	
12	Must incorporate radio resource management for power, channel and performance optimization	
13	Must have -97 dB or better Receiver Sensitivity.	
14	Must support Proactive Key Caching and/or other methods for Fast Secure Roaming.	
15	Must support Management Frame Protection.	
16	Should support locally-significant certificates on the APs using a Public Key Infrastructure (PKI).	
17	Access Points must support Hardware-based encrypted user data and management traffic between controller and Access point for better security.	
18	Must support the ability to serve clients and monitor the RF environment concurrently.	
19	Same model AP that serves clients must be able to be dedicated to monitoring the RF environment.	
20	Must be plenum-rated (UL2043).	
21	Must support 16 WLANs per AP for SSID deployment flexibility.	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S. No.	Specification	
22	Access Point Must continue serving clients when link to controller is down. It should also have option to authenticate user through Radius server directly from Access Point during link unavailability to controller.	
23	Must support telnet and/or SSH login to APs directly for troubleshooting flexibility.	
24	Must support Power over Ethernet, local power(DC Power), and power injectors.	
25	802.11e and WMM	
26	Must support Reliable Multicast to Unicast conversion to maintain video quality at AP level	
27	Must support QoS and Video Call Admission Control capabilities.	
28	Access Point should 802.11 DFS certified	

Outdoor Access Point: -

S.No	Specification	
1	Access Points proposed must include radios for 2.4 GHz and 5 GHz with 802.11ac Wave 2.	
2	An access point must include a standard OEM provided Mounting brackets for mounting on Ceiling or Roof top.	
3	Access Point shall support console port that uses Standard Port (RJ-45) type connection	
4	Should have 1x RJ-45 auto-sensing 10/100/1000 Mbps LAN port and 1x Built-in Gigabit SFP port for direct fibre uplink.	
5	Must have atleast 4 dBi Antenna gain on each radios	
6	Must support 3x3 MIMO for both 802.11ac and 802.11n client	
7	Must Support data rate of 1.3 Gbps on 5ghz .	
8	Must support minimum of 29 dbm of transmit power in both	

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

S.No	Specification	
	2.4Ghz and 5Ghz radios. And should follow the local regulatory Norms.	
9	Must support AP enforced load-balance between 2.4Ghz and 5Ghz band.	
10	Must incorporate radio resource management for power, channel and performance optimization	
11	Must have -97 dB or better Receiver Sensitivity.	
12	Must support Proactive Key Caching and/or other methods for Fast Secure Roaming.	
13	Must support Management Frame Protection.	
14	Should support locally-significant certificates on the APs using a Public Key Infrastructure (PKI).	
15	Access Points must support Hardware-based encrypted user data and management traffic between controller and Access point for better security.	
16	Must support the ability to serve clients and monitor the RF environment concurrently.	
17	Same model AP that serves clients must be able to be dedicated to monitoring the RF environment.	
18	Must support 16 WLANs per AP for SSID deployment flexibility.	
19	Access Point Must continue serving clients when link to controller is down. It should also have option to authenticate user through Radius server directly from Access Point during link unavailability to controller.	
20	Must support telnet and/or SSH login to APs directly for troubleshooting flexibility.	
21	Must support Power over Ethernet, local power(AC/DC Power), and power injectors.	
22	802.11e and WMM	
23	Must support Reliable Multicast to Unicast conversion to maintain video quality at AP level	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	Specification	
24	Must support QoS and Video Call Admission Control capabilities.	
25	Access Point should 802.11 DFS certified	
26	The Access point shall be IP67 and NEMA rated	
27	The Access point shall support operating temperature of -40 to 65°C	
28	The equipment shall support up to 100 MPH sustained winds & 165 MPH wind gusts.	

AAA Solution: -

S.No	Specifications	
1	The Solution should provide a highly powerful and flexible attribute-based access control solution that combines authentication, authorization, and accounting (AAA); profiling; and guest management services on a single platform.	
2	It should allow enterprises to authenticate and authorize users and endpoints via wired, wireless, and VPN with consistent policy throughout the campus	
3	Provides complete guest lifecycle management by empowering sponsors to on-board guests	
4	Solution should be scalable enough to support 250,000 endpoints in the network. Currently needed licence for 5000 endpoints for AAA and BYOD, Profiling from day one.	
5	Delivers customizable self service portals as well as the ability to host custom web pages to ease device and guest on-boarding, automate endpoint secure access and service provisioning, and enhance the overall end-user experience inside business-defined workflows	
6	Offers comprehensive visibility of the network by automatically discovering, classifying, and controlling endpoints connected to the network to enable the appropriate services per endpoint	
7	Should capability of addresses vulnerabilities on user machines through periodic evaluation and remediation to help proactively mitigate network threats such as viruses, worms,	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	Specifications	
	and spyware	
8	Should capability to enforces security policies by blocking, isolating, and repairing noncompliant machines in a quarantine area without requiring administrator attention	
9	Offers a built-in monitoring, reporting, and troubleshooting console to assist helpdesk operators and administrators streamline operations	
10	Should capability to allows you to get finer granularity while identifying devices on your network with Active Endpoint Scanning	
11	Augments network-based profiling by targeting specific endpoints (based on policy) for specific attribute device scans, resulting in higher accuracy and comprehensive visibility of what is on your network	
12	Manages endpoint access to the network with the Endpoint Protection Service, which enables administrators to specify an endpoint and select an action - for example, move to a new VLAN, return to the original VLAN, or isolate the endpoint from the network entirely - all in a simple interface	
13	Utilizes standard RADIUS protocol for authentication, authorization, and accounting (AAA).	
14	Supports a wide range of authentication protocols, including PAP, MS-CHAP, Extensible Authentication Protocol (EAP)-MD5, Protected EAP (PEAP), EAP-Flexible Authentication via Secure Tunneling (FAST), and EAP-Transport Layer Security (TLS).	
15	Offers a rules-based, attribute-driven policy model for creating flexible and business-relevant access control policies. Provides the ability to create fine-grained policies by pulling attributes from predefined dictionaries that include information about user and endpoint identity, posture validation, authentication protocols, profiling identity, or other external attribute sources. Attributes can also be created dynamically and saved for later use. Posuture validation service not required from day one.	
16	Provides a wide range of access control mechanisms, including downloadable access control lists (dACLs), VLAN assignments, URL redirect, and Security Group Access (SGA) tagging.	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	Specifications	
17	Should have predefined device templates for a wide range of endpoints, such as IP phones, printers, IP cameras, smartphones, and tablets.	
18	It should allow Administrators to create their own device templates. These templates can be used to automatically detect, classify, and associate administrative-defined identities when endpoints connect to the network. Administrators can also associate endpoint-specific authorization policies based on device type.	
19	The Solution should have capability to collect endpoint attribute data via passive network telemetry, querying the actual endpoints, or alternatively from the infrastructure via device sensors on switches.	
20	Solution should allow end users to interact with a self-service portal for device on-boarding, providing a registration vehicle for all types of devices as well as automatic supplicant provisioning and certificate enrollment for standard PC and mobile computing platforms.	
21	Should have full guest lifecycle management, whereby guest users can access the network for a limited time, either through administrator sponsorship or by self-signing via a guest portal. Allows administrators to customize portals and policies based on specific needs of the enterprise.	
22	Should support and capability to verifies endpoint posture assessment for PCs connecting to the network. Works via either a persistent client-based agent or a temporal web agent to validate that an endpoint is conforming to a company's posture policies. Provides the ability to create powerful policies that include but are not limited to checks for the latest OS patches, antivirus and antispysware software packages with current definition file variables (version, date, etc.), registries (key, value, etc), and applications. Solution should support auto-remediation of PC clients as well as periodic reassessment to make sure the endpoint is not in violation of company policies. This functionality not require from day one.	
23	Should support and capability to allows administrators to quickly take corrective action (Quarantine, Un-Quarantine, or Shutdown) on risk-compromised endpoints within the network. This helps to reduce risk and increase security in the network.	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	Specifications	
	This functionality not require from day one.	
24	Enables administrators to centrally configure and manage profiler, posture, guest, authentication, and authorization services in a single web-based GUI console, greatly simplifying administration by providing consistency in managing all these services. Posturing services not needed from day one.	
25	Includes a built-in web console for monitoring, reporting, and troubleshooting to assist help-desk and network operators in quickly identifying and resolving issues. Offers comprehensive historical and real-time reporting for all services, logging of all activities, and real-time dashboard metrics of all users and endpoints connecting to the network.	
26	Should support consistent policy in centralized and distributed deployments that allows services to be delivered where they are needed	
27	Solution should have capability to determine whether users are accessing the network on an authorized, policy-compliant device.	
28	Solution should have capability to establish user identity, location, and access history, which can be used for compliance and reporting.	
29	Solution should have capability to assign services based on the assigned user role, group, and associated policy (job role, location, device type, and so on).	
30	Solution should have capability to grant authenticated users with access to specific segments of the network, or specific applications and services, or both, based on authentication results.	
31	Solution should have capability which allows users to add a device on a portal, where the device goes through a registration process for network access. Should allow users to mark as lost any device that you have registered in the network, and blacklist the device on the network, which prevents others from unauthorized network access when using the blacklisted device. Should have capability to reinstate a blacklisted device to its previous status in Device Portal, and regain network access without having to register the device again in the	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	Specifications	
	Devices Portal. Should also support removing any device in the enterprise network temporarily, then register the device for network access again later.	
32	The portal used for Device registration should be customizable, allowing to customize portal theme by changing text, banners, background color, and images	
33	<p>Should provide a Registered Endpoints Report which provides information about a list of endpoints that are registered through the device registration portal by a specific user for a selected period of time. The report should provide the following details</p> <ul style="list-style-type: none"> • Logged in Date and Time • Portal User (who registered the device) • MAC Address • Identity Group • Endpoint Policy • Static Assignment • Static Group Assignment • Endpoint Policy ID • NMAP Subnet Scan ID • Device Registration Status 	
34	Solution should classify a client machine, and should support client provisioning resource policies to ensure that the client machine is set up with an appropriate agent version, up-to-date compliance modules for antivirus and antispyware vendor support, and correct agent customization packages and profiles, if necessary	
35	Solution should support receiving updated endpoint profiling policies and the updated OUI database as a feed from the OEM database.	
36	Should support native supplicant profiles to enable users to bring their own devices into network. When the user logs in, based on the profile that you associate with that user's authorization requirements, solution should provide the necessary supplicant provisioning wizard needed to set up the user's personal device to access the network. This should be supported over Microsoft windows, Apple Mac and iOS and	

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

S.No	Specifications	
	Android devices.	
37	When endpoints are discovered on the network, they can be profiled dynamically based on the configured endpoint profiling policies, and assigned to the matching endpoint identity groups depending on their profiles.	
38	Should support using a simple filter that you can use to filter endpoints. The quick filter filters endpoints based on field descriptions, such as the endpoint profile, MAC address, and the static status that is assigned to endpoints when they are created in the Endpoints page.	
39	Should support an advanced filter that you can preset for use later and retrieve, along with the filtering results, The advanced filter filters endpoints based on a specific value associated with the field description. You can add or remove filters, as well as combine a set of filters into a single advanced filter.	
40	Should support importing endpoints from a comma-separated values (CSV) file in which the list of endpoints appears with the MAC address and the endpoint profiling policy details separated by a comma.	
41	Support for importing endpoints from LDAP server. Should allow to import MAC addresses and the associated profiles of endpoints securely from an LDAP server. Should support an LDAP server to import endpoints and the associated profiles, by using either the default port 389, or securely over SSL, by using the default port 636.	
42	Should support multiple Admin Group Roles and responsibilities like HelpDesk Admin, Identity Admin, Monitoring Admin, Network Device Admin, Policy Admin, RBAC Admin, Super Admin and System Admin	
43	Should support Role-based access policies which are access control policies which allow you to restrict the network access privileges for any user or group. Role-based access policies are defined when you configure specific access control policies and permissions. These admin access policies allow you to	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	Specifications	
	customize the amount and type of access on a per-user or per-group basis using specified role-based access permission settings that apply to a group or an individual user.	
44	Should support Identity source sequences which defines the order in which the solution will look for user credentials in the different databases. Solution should support the following databases: <ul style="list-style-type: none"> •Internal Users •Internal Endpoints •Active Directory •LDAP •RSA Token Servers •RADIUS •Certificate Authentication Profiles 	
45	Must be able to differentiate policy based on device type + authentication	
46	Should have Ability to authenticate at least one phone and multiple users on the same switchport without interrupting service	
47	Solution should support MAB and can further utilize identity of the endpoint to apply the proper rules for access. MacAddressBypass is typically used for devices which do not support 802.1x	
48	Solution must support Non 802.1x technology on assigned ports and 802.1x technology on open use ports	
49	Solution should provide support policy enforcement through VPN gateways	
50	Solution must allow users access to the network in a worst case scenario in case of AAA server outages or any other reasons like WAN failure.	
51	Should support authenticating Machines and users connected to the same port on the switch in a single authentication flow	
52	Should support authenticating IP phones and users connected behind IP phones on the same physical port.	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	Specifications	
53	<p>Solution should have profiling capabilities integrated into the solution in order to detect headless host. The profiling features leverage the existing infrastructure for device discovery. Should support the use of attributes from the following sources or sensors:</p> <ul style="list-style-type: none"> * Profiling using MAC OUIs * Profiling using DHCP information * Profiling using RADIUS information * Profiling using HTTP information * Profiling using DNS information * Profiling using NetFlow information * Profiling using SPAN/Mirrored traffic 	
54	Soution should support troubleshooting authentication issues by triggering session reauthentication to follow up with an attempt to reauthenticate again.	
55	Should support session termination with port shutdown option to block an infected host that sends a lot of traffic over the network.	
56	Should support the functionality to force endpoint to reacquire IP address that do not support a supplicant or client to generate a DHCP request after a vlan change.	
57	Troubleshooting & Monitoring Tools	
58	Should support tools to run SHOW command on the network device.	
59	Should support evaluation of the configuration of the device with the standard configuration.	
60	Should support TCP dump utility & also support saving a TCP dump file.	
61	Solution should support schedule reports to run and re-run at specific time or time intervals & send and receive email notifications once the reports are generated.	
62	Solution should have capability to administratate devices through TACACS+ from day one	
63	Minimum HW requirement for appliance are : 1 – Intel Xenon 2.60 GHz E5-2640 processor, minimum 64GB RAM and 4*600GB 10K RPM SAS HDD and 6 x 1G NIC	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

Network Management System: -

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

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	Specification	
9	The solution should support compliance engine, which provides the ability to specify the network configuration and perform an audit of the network devices against the configuration archive or the device configuration. The audit report identifies devices that are out of compliance. Administrator can remediate the devices that are out of compliance with the desired configuration. This engine also helps with generating reports for EoL/EoS/PCI for network devices.	
10	The solution should support customize alarms based on the operational needs. Customizable syslog based alarms provides the ability to custom create new alarms and prioritize operator response	

Internet Router: -

S.No	SPECIFICATION	
1	It should support broadband aggregation for voice, video, data, and mobility services with QoS scaling to a large number of queues per device.	
2	Router should have 8 nos. of 10/100/1000 Base-T ports. 4 nos. SFP based ports.	
3	Router should have 4 nos. SFP based ports.	
4	Router should have 4x10 Gigabit SFP+ ports from day 1	
5	Router should have minimum 8 GB RAM from day 1.	
6	Router should have DES, 3DES and AES Standards through dedicated encryption module/processor. Should support IPSec with IKEv2 and Suite-B Encryption	
7	Router shall have hot swappable 1:1 redundant internal power supply	
8	Router should have a minimum performance of 15 Mpps and 10 Gbps of bandwidth, Scalable to 20 Gbs in future.	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	SPECIFICATION	
9	Router should support static Routes, OSPFv2, OSPFv3, BGP4, MBGP, BFD, Policy based routing, IPv4 and IPv6 tunneling, MPLS LDP, MPLS L3VPN, MPLS L2VPN , MPLS TE, FRR Link & Node Protection, LDP, MPLS Static label, MPLS VRF-aware static labels, LDP - Session Protection, LDP - Graceful Restart,	
10	MPLS L2VPN Pseudo wire Redundancy with TE/FRR protection, Support for QinQ to Ethernet/VLAN Ethernet/IP interworking, MPLS VPN - Carrier Supporting Carrier (CsC), CsC with IPv4 BGP label distribution (RFC 3107)	
11	Router should support IGMP v1/v2/v3 and PIM multicast routing	
12	Should support other IP Services like GRE tunnel, IPv4 tunnel, IPv6 tunnel, Virtual Router Redundancy Protocol (VRRP), Network Address Translation (NAT), Access Control Lists (ACLs)	
13	Shall have 802.1p class of service, IP differentiated service code point (DSCP) and IP precedence,	
14	Routers should support marking, classification, policing and shaping, Hierarchical QoS for Traffic Management inspections, QoS classification with TCP Application traffic. The router shall provide up to 16k queues for deployment of per-user per-application per-port QoS.	
15	Router should support SSHv2, SNMPv2c, SNMPv3, NTPv3 and NTPv4	
16	Routers should support AAA using RADIUS and TACACS+	
17	Support for accounting of traffic flows for network planning and security purposes. Router shall provide application recognition through analysis of flows.	
18	Support for accounting of traffic flows for network planning and security purposes. Router shall provide application recognition through analysis of flows.	
19	Router should support monitoring of network traffic with application level insight with deep packet visibility into web traffic, RTP-Based VoIP traffic and cRTP	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	SPECIFICATION	
20	Router shall have traffic load balancing capability on dual WAN Links based on based on advanced criteria, such as reachability, delay, loss, jitter and bandwidth utilization.	
21	Router / Router's Operating System should be tested and certified for EAL 4 or above under Common Criteria Certification	
22	Router should be IPv6 Certified/IPv6 logo ready	
23	Router should have direct OEM TAC support and hardware replacement warranty for 5 Years.	

Next Generation Firewall: -

S.No	Specifications	
1	Industry Certifications and Evaluations	
	Firewall solution offered from OEM must be rated as 'leaders' or 'Challengers' in the latest Magic Quadrant for Enterprise Firewall published by Gartner	
	Firewall solution offered from OEM must be rated as 'leaders' or 'Challengers' in the latest Magic Quadrant for NGIPS published by Gartner	
	Firewall solution offered from OEM must be part of NGFW report published by NSS	
	Firewall solution offered from OEM must be part of BDS report published by NSS	
	Propose solution must be achieve any 3 of above criteria	
2	Hardware Architecture	
	The appliance based security platform should be capable of providing NGFW capability (firewall, application visibility, and IPS functionality) and Advance malware,URL filtering in a single appliance	
	The appliance should support atleast 8 * 10 Gigabit Ethernet ports ports from Day one and should be scalable to aditional 8 x 10G or 4 x 40G ports	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	Specifications	
	The appliance hardware should be a multicore CPU architecture with a hardened 64 bit operating system to support higher memory	
	Proposed Firewall should not be proprietary ASIC based in nature & should be open architecture based on multi-core cpu's to protect & scale against dynamic latest security threats.	
3	Performance & Scalability	
	Should support atleast 20Gbps of FW performance throughput (includes FW & Application Visibility)	
	Should support at least 15 Gbps of NGFW performance throughput (includes IPS + Application Visibility)	
	L7 Firewall and NGFW throughput difference should not be more than 70%	
	NG Firewall should support at least 15 million concurrent session	
	NG Firewall should support at least 120,000 connections per second with Application visibility	
4	High-Availability Features	
	Firewall should support Active/Standby failover	
	Firewall should support etherchannel functionality for the failover control & data interfaces for provide additional level of redundancy	
	Firewall should support redundant interfaces to provide interface level redundancy before device failover	
	Firewall should support 802.3ad Etherchannel functionality to increase the bandwidth for a segment.	
	Firewall should support VXLAN	
5	NGFW Firewall Features	
	Solution must be capable of passively gathering information about network hosts and their activities, such as operating system, services, open ports, client applications, and vulnerabilities, to assist with multiple activities, such as intrusion event data correlation, elimination of false positives,	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	Specifications	
	and policy compliance.	
	Firewall should support creating access-rules with IPv4 & IPv6 objects simultaneously	
	Firewall should support operating in routed & transparent mode	
	Should support Static, RIP, OSPF, OSPFv3 and BGP	
	Firewall should support manual NAT and Auto-NAT, static nat, dynamic nat, dynamic pat	
	Firewall should support Nat66 (IPv6-to-IPv6), Nat 64 (IPv6-to-IPv4) & Nat46 (IPv4-to-IPv6) functionality	
	Firewall should support Multicast protocols like IGMP, PIM, etc	
	Should support security policies based on security group names in source or destination fields or both	
	Should support capability to limit bandwidth on basis of apps / groups, Networks / Geo, Ports, etc	
	Should be capable of dynamically tuning IDS/IPS sensors (e.g., selecting rules, configuring policies, updating policies, etc.) with minimal human intervention.	
	Should be capable of automatically providing the appropriate inspections and protections for traffic sent over non-standard communications ports.	
	Proposed solution should have capability block BOT/CnC conention (anti-bot) from day one	
	Should be able to link Active Directory and/or LDAP usernames to IP addresses related to suspected security events.	
	Should be capable of detecting and blocking IPv6 attacks.	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	Specifications	
	Solution should support full-featured NBA capability to detect threats emerging from inside the network. This includes the ability to establish “normal” traffic baselines through flow analysis techniques (e.g., NetFlow) and the ability to detect deviations from normal baselines. If the functionality not support on the same appliance, vendor can quote separate device for the same.	
	The solution must provide IP reputation feed that comprised of several regularly updated collections of poor reputation of IP addresses determined by the proposed security vendor	
	Solution must support IP reputation intelligence feeds from third party and custom lists of IP addresses including a global blacklist.	
	Should must support URL and DNS threat intelligence feeds to protect against threats	
	Should support safe search and YouTube EDU enforcement	
	Solution must be capable of passively gathering details unique to mobile devices traffic to identify a wide variety of mobile operating systems, mobile applications and associated mobile device hardware.	
	Should support more than 4000 application layer and risk-based controls that can invoke tailored intrusion prevention system (IPS) threat detection policies to optimize security effectiveness.	
	Must be capable of providing network-based detection of malware by checking the disposition of known files in the cloud using the SHA-256 file-hash as they transit the network and capability to do dynamic analysis on-premise (if required in future) on purpose built-appliance. License not require from day one.	
	NGFW OEM must have its own threat intelligence analysis center and should use the global footprint of security deployments for more comprehensive network protection.	
	The detection engine should support capability of detecting and preventing a wide variety of threats (e.g., malware, network probes/reconnaissance, VoIP attacks, buffer overflows, P2P	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	Specifications	
	attacks, etc.).	
	Should be able to identify attacks based on Geo-location and define policy to block on the basis of Geo-location	
	The detection engine should support the capability of detecting variants of known threats, as well as new threats	
	The detection engine must incorporate multiple approaches for detecting threats, including at a minimum exploit-based signatures, vulnerability-based rules, protocol anomaly detection, and behavioral anomaly detection techniques. Identify and explain each type of detection mechanism supported.	
	Should support Open based Application ID for access to community resources and ability to easily customize security to address new and specific threats and applications quickly	
	Proposed Firewall should have URL filtering with 80+ categories and more than 280 million URL database	
6	Management	
	The management platform must be accessible via a web-based interface and ideally with no need for additional client software	
	The management platform must provide a highly customizable dashboard.	
	The management platform must be capable of integrating third party vulnerability information into threat policy adjustment routines and automated tuning workflows	
	The management platform must be capable of role-based administration, enabling different sets of views and configuration capabilities for different administrators subsequent to their authentication.	
	Should support REST API for monitoring and config programmability	
	The management platform must provide multiple report output types or formats, such as PDF, HTML, and CSV.	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	Specifications	
	The management platform must support multiple mechanisms for issuing alerts (e.g., SNMP, e-mail, SYSLOG).	
	The management platform must provide robust reporting capabilities, including a selection of pre-defined reports and the ability for complete customization and generation of new reports.	
	The management platform must risk reports like advanced malware, attacks and network	
	The management platform must include an integration mechanism, preferably in the form of open APIs and/or standard interfaces, to enable events and log data to be shared with external network and security management applications, such as Security Information and Event Managers (SIEMs), and log management tools.	

Optics: -

1. 1G 1000BaseT RJ45
2. 10G Single Mode SFP+
3. 10G Multi Mode SFP+
4. 40G Single Mode QSFP
5. 40G Multi Mode QSFP
6. 10G DAC Cable-3Mtr
7. 40G DAC Cable-3Mtr
8. 100G DAC Cable 3Mtr

PART – III – EPABX SYSTEM

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

IP Exchange Hardware: -

S.No	IP Exchange Hardware		
1	Processors	Each server shall have a minimum of one Intel 2.2Ghz 10 core CPU with 13MB cache.	
2	Storage	The server should have 6*300GB 12G SAS 10K RPM SFF HDD	
		The Optional server RAID controller should support the following configurations RAID 0, 1, 5, 6, 10 , 50 and 60 support	
		Must have an internal slot for SD card / Flash which supports booting hypervisors	
3	Memory	Should have minimum 48GB DDR4 RAM from Day-1	
		Support for advanced memory redundant technologies like Advanced error-correcting code (ECC) and memory mirroring	
4	Network	Should have 2 * 1 GbE Lan on Motherboard (LOM) for network connectivity	
		The server should offer the capability to use 10-Gbps unified network fabric which aggregates both the Ethernet and FC connectivity on a single controller using Low-latency, lossless, 10-Gbps Ethernet and industry-standard Fibre Channel over Ethernet (FCoE) fabric	
5	Management	The integrated management controller should support web user interface for server management; remote keyboard, video, and mouse (KVM); virtual media; and administration with Virtual media support for remote KVM and CD and DVD drives as if local	
		The server should support Intelligent Platform Management Interface (IPMI) 2.0 support for out-of-band management through third-party enterprise management systems	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	IP Exchange Hardware		
		The server should support Command-line interface (CLI) for server management	
6	Ports	Should have the following ports for server connectivity <ul style="list-style-type: none"> • 2 USB ports • 1 VGA video port 	
7	Others	Supports hot swappable redundant fans	
		Supports hot swappable redundant power supplies	
8	Environmental	Operating Temperature support from 41 to 104°F (5 to 40°C) and Nonoperating Temperature from -40 to 149°F (-40 to 65°C)	
		Operating Humidity from 10 to 90% noncondensing	
		Operating Altitude from 0 to 10,000 ft (0 to 3000m) and Nonoperating Altitude upto 40,000 ft (12,000m)	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

IP Exchange Software: -

S.No	Specifications	
1	The Call Control and all other components including the phones will be based on a SIP based architecture with centralized or distributed across multiple nodes across WAN for enhanced redundancy.	
2	A comprehensive IP based solutions based on a Server Gateway Architecture.	
3	Support for integrated telephony solution for Video conferencing devices, Analog & IP Phones, PSTN gateways over IP architecture.	
4	The solution should offer users the ability to use their UC clients and IP Phones outside of the enterprise (Internet) to make audio and video calls along with IM/Presence with or without VPN.	
5	The solution should allow for business to business (B2B) video calls using SIP, H.323 with other organizations without bypassing existing firewalls.	
6	The solution should offer faculty members the flexibility of using atleast 8 devices including IP Phones and Softclients, so that they can collaborate using any of the devices seamlessly.	
7	Software components of the solution should be offered and configured as highly available and fault tolerant.	
8	The solution should allow provisioning of gateways with redundant power supplies.	
9	The call control should support clustering over WAN	
10	The proposed system should be Integratable with ACD, IVR.	
11	The call control system should support IPv4 and IPv6 from day one.	
12	The system should natively support tenant partitioning so as to comply with TRAI regulations for not allowing VoIP (CUG calls) and PSTN calls to be bridged. Any third party applications to manage tenant partioning should not be quoted in the architecture.	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	Specifications	
13	The proposed call control server should provide support for standards based SIP IP Phones (Wired & Wireless), Analog Phones, Video Phones, Video Conferencing endpoints and soft clients to provide centralized management and unified dial plan.	
14	Conference Bridge—provides software conference bridge resources that can be used by IP EPABX.	
15	The system should support an inbuilt reporting tool for calls. Reports that are provided include Calls on a user basis, Calls through gateways, Simplified Call Quality.	
16	Should support signaling standards/Protocols – SIP, MGCP, H.323, Q.Sig.	
17	Audio Codec support - G.711, G.729, G.729ab, g.722, iLBC	
18	The system should provide the ability to perform tasks in bulk i.e. Add, Remove, Update users, phones, gateways, dial plan etc.	
19	The system should support creation of users and their authentication locally and via an integration with LDAP.	
20	The system should support an inbuilt reporting tool for calls. Reports that are provided include Calls on a user basis, Calls through gateways, Simplified Call Quality.	
21	The system should support call admission control to configure number of calls that can be active between locations – intercluster and intracluster.	
22	Call preservation – redundancy and automated failure – on call-processing failure. In progress PSTN calls at each of the locations should not be interrupted in the event of any WAN failure or call control server failure.	
23	Open API should be provided when required which will help to develop customized IP applications which will integrate with call processing.	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	Specifications	
24	It is required to provide Survivable Call Control functionality so that the survivable system at the remote location i.e. Media Gateway shall provide fall back call control service in case the remote site loses all connectivity to the main Call Control system placed. It is expected that the survivability call control system will provide a minimal set of essential telephony features to the end-users that could be a subset of the feature that are available from the main call control system.	
25	All the appliances in the call control system should have dual redundant and hot swappable power supply and fans for high availability.	
26	All appliances in the call control system should have hot swappable storage media to ensure high availability.	
27	Support for configuration database (contains system and device configuration information, including dial plan)	
28	Having inbuilt administration web based administration. No additional thick client for administration on the Admin PC. Should also support HTTPS for management.	
29	Access to the system should be secure for the purpose of access over IP network. The protection of signaling connection over IP by means of authentication, Integrity and encryption should be carried out using TLS.	
30	There should be provision of defining password aging, one time passwords. Provision shall be available to bar unauthorized user to connect to the system. The system should monitor and report the following types of security \ violation login Violations, authorization code violation Station security code violations etc.	
31	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 routine firmware upgrades.	
32	Role Based Account Management to define different levels of administrator access depending on specific function responsibility	

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

S.No	Specifications	
33	The system should support complete encryption capabilities with the ability to encrypt all traffic (media and call control signalling) between IP phones, softphones, call controllers, gateways and all other associated endpoints using a strong encryption algorithm (AES, IPSec and SRTP, for example).	
34	All management traffic between the remote console/session and control server should be encrypted (SSH for Direct Command Line Sessions, Interface, HTTPS (SSL) for Web Sessions, SFTP for File Transfer Etc.).	
35	Should support SSL for LDAP directory integration.	
36	All Hardware & Software with license required for providing above Security measures must be incorporated.	
37	The System should have IP capability for interfacing & Communicating with Voice, Video and Data infrastructure	
38	The architecture should support a minimum of 2500 IP phones and VC systems per Server	
39	The architecture should support single Server Clustering to provide scalability to offer support for 5,000 IP devices and 8000 users and also to provide redundancy. All the 8,000 users to be managed in a single database which is managed centrally, no multiple databases.	
40	The System should support Alternate Call Routing	
41	The System should have GUI support web based management console	
42	System backups: The management system should have the provisioning for taking manual as well as scheduling of automatic periodic backup of complete system & data.	
43	The System should support Audio message-waiting indicator (AMWI)	
44	The System should have Automated bandwidth selection	
45	Should support SNMP v2, v3	
46	It should be possible to monitor the call control system i.e. system performance, device status, device discovery, CTI applications, voice messaging ports etc.	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	Specifications	
47	Solution should provide a "presence" application for users, so that they can see the availability status of their contacts in their contact list.	
48	The common supported status for this application should be available, busy, idle, away etc.	
49	Should support the users to see other user's IP phone's on/off hook states	
50	The instant messaging application should support manual setting of user status to: Available, Away, Do Not Disturb (DND) etc.	
51	Shall provide support for open protocols like XMPP.	
52	Presence based desktop application shall allow escalation of Instant Message to Audio call and further to Video call	
53	Should support management of contact list and personal settings from Presence based desktop application	
54	Should support click to call, click to Video and click to conference features.	
55	The Soft Client should have soft phone capability and should support desktop and iPad based point to point video calls.	
56	The call control system should provide integrated video telephony features to the users so that user with IP Phone / Soft phone and video telephony end point should be able to place video calls with the same user model as audio calls.	
57	The users should be able to transfer video calls as audio calls	
58	Call-Server should provide a common control agent for signaling, configuration, and serviceability for voice or video end points.	
59	Call control system should handle codec and video capabilities of the endpoints, bandwidth negotiation to determine if video/audio call can take place.	
60	Extension mobility	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	Specifications	
61	Call forward all	
62	Message-waiting indicator (MWI)	
63	Privacy	
64	Device mobility	
65	Do not disturb	
66	Hunt groups	
67	Dial-plan partitioning	
68	Distributed call processing	
69	Deployment of devices and applications across an IP network	
70	"Clusters" of Call-Servers for scalability, redundancy, and load balancing	
71	Intercluster scalability to 100+ sites or clusters through H.323 gatekeeper	
72	Fax over IP—G.711 pass-through and Fax Relay	
73	Forced authorization codes and client matter codes (account codes)	
74	H.323 interface to selected devices	
75	Hotline and private line automated ringdown (PLAR)	
76	Interface to H.323 gatekeeper for scalability, CAC, and redundancy	
77	Language support for client user interfaces (languages specified separately)	
78	Multi-Level Precedence and Preemption (MLPP)	
79	Multilocation—dial-plan partition	
80	Multiple ISDN protocol support	
81	Multiple remote CallServer platform administration and debug utilities	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	Specifications	
82	Prepackaged alerts, monitor views, and historical reports with Real Time Monitor Tool (RTMT).	
83	Real-time and historical application performance monitoring through operating system tools and Simple Network Management Protocol (SNMP)	
84	Remote terminal service for off-net system monitoring and alerting	
85	Real-time event monitoring and presentation to common syslog	
86	Trace setting and collection utility	
87	Cluster wide trace setting tool.	
88	Trace Collection tool.	
89	Multisite (cross-WAN) capability with intersite CAC	
90	Q.SIG (International Organization for Standardization [ISO])	
91	Video calls to be placed with the same user model as audio calls.	
92	Call-Server should support new video end points.	
93	SIP Video endpoints which should inherit the functionality of audio calls which gives the user the same call model for both video and audio calls.	
94	Call-Server should have the infrastructure to handle codec and video capabilities of the endpoints, bandwidth negotiation to determine if video/audio call can take place, single point of administration, management of media devices such as gateways and MCUs.	
95	Call-Server should provide a common control agent for signaling, configuration, and serviceability for voice and video end points.	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

IP Phone Type 1: -

S.No	Specifications	
1	The phone should support atleast 1 line.	
2	It should support the following codec G.711a/μ, G.729a	
3	It should have graphical display with a minimum resolution of 128 x 32 pixels	
4	The phone should support QoS mechanism through 802.1p/q.	
5	Should have built-in high-quality full-duplex speakerphone	
6	Should include audio controls for the full-duplex speakerphone and handset.	
7	IP address Assignment by DHCP or statically configured	
8	The Phone should support the ability to provide different ringtones for internal and external calls.	
9	Should have volume control button for easy decibel-level adjustments for the speakerphone, handset and ringer.	
10	The phone should support mounting against a wall	
11	The phone should support IPv4 and IPv6 from day one.	
12	The phone should support Power over Ethernet IEEE 802.3af class 1/2/3 and should also have AC power adapter option	
13	The phone should be a SIP based Phone i.e session Initiation protocol (SIP) supported	
14	The phone should provide basic 3-way conferencing	
15	The phone should support atleast 50 entries for call history i.e. missed, received, placed etc.	
16	Should have keys for specific functionalities such as – Redial, settings, transfer, speakerphone, mute on/off, hold/resume	
17	Should have 4 MB flash memory and 30 MB or more SDRAM.	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

IP Phone Type-2

S.No	Specs	
1	The phone should support Power over Ethernet IEEE 802.3af class 1/2/3 and should also have AC power adapter option	
2	Should feature a LCD display of at least 3.5” for information such as calling party name, calling party number, and digits dialled to be displayed.	
3	The phone should have two ethernet ports of at least 10/100/1000 BASE-T Ethernet ports, one for the LAN connection and the other for connecting to PC/laptop.	
4	Corporate directory and Lightweight Directory Access Protocol (LDAP) integration.	
5	Ready access to missed, received or placed calls (plus intercom history and directories).	
6	The phone should support QoS mechanism through 802.1p/q.	
7	IP address Assignment by DHCP or statically configured	
8	Hands-free operation with full-duplex speaker-phone	
9	The phone should be a SIP based Phone i.e session Initiation protocol (SIP) supported	
10	The phone should support XML based services and applications.	
11	The phone should have a distinct LED indicator for message waiting.	
12	Should have keys for specific functionalities such as – voicemail, directories, settings, transfer, speakerphone, mute on/off, headset etc	
13	Media Encryption (SRTP) using AES	
14	Signalling Encryption (TLS) using AES	
15	Should support 802.1x	
16	Encryption of Configuration Files	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	Specs	
17	The phone should have the ability to register to call control server over an internet link with or without VPN.	
18	The phone should support IPv4 and IPv6 from day one.	
19	The phone should support at least 100 entries for call history i.e. missed, received, placed etc.	
20	It should support the following codecs: G.711a/μ-law, G.722, G.729a, iLBC	
21	The phone should have RJ9 headset port to connect any standards based headset. The phone should also have a separate headset key	
22	The phone also includes the following settings - Display contrast, Ring type, Network configuration, Call status	
23	The Phone should support the ability to provide different ringtones for internal and external calls.	
24	Should have volume control button for easy volume adjustments for the speakerphone, handset and ringer.	
25	The phone should support mounting against a wall	
26	The phone should support 4 programmable lines keys.	

IP Phone Type-3: -

S.No	Specs	
1	The phone should support Power over Ethernet IEEE 802.3af class 1/2/3 and should also have AC power adapter option	
2	Should feature a LCD display of at least 5" for information such as calling party name, calling party number, and digits dialled to be displayed.	
3	The phone should have two ethernet ports of at least 10/100/1000 BASE-T Ethernet ports, one for the LAN connection and the other for connecting to PC/laptop.	
4	Corporate directory and Lightweight Directory Access	

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

S.No	Specs	
	Protocol (LDAP) integration.	
5	Ready access to missed, received or placed calls (plus intercom history and directories).	
6	The phone should support QoS mechanism through 802.1p/q.	
7	IP address Assignment by DHCP or statically configured	
8	Hands-free operation with full-duplex speaker-phone	
9	The phone should be a SIP based Phone i.e session Initiation protocol (SIP) supported	
10	The phone should support XML based services and applications.	
11	The phone should have a distinct LED indicator for message waiting.	
12	Should have keys for specific functionalities such as – voicemail, directories, settings, transfer, speakerphone, mute on/off, headset etc	
13	Media Encryption (SRTP) using AES	
14	Signalling Encryption (TLS) using AES	
15	Should support 802.1x	
16	Encryption of Configuration Files	
17	The phone should have the ability to register to call control server over an internet link with or without VPN.	
18	The phone should support IPv4 and IPv6 from day one.	
19	The phone should support at least 100 entries for call history i.e. missed, received, placed etc.	
20	It should support the following codecs: G.711a/μ-law, G.722, G.729a, iLBC	
21	The phone should have RJ9 headset port to connect any standards based headset. The phone should also have a separate headset key	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	Specs	
22	The phone also includes the following settings - Display contrast, Ring type, Network configuration, Call status	
23	The Phone should support the ability to provide different ringtones for internal and external calls.	
24	Should have volume control button for easy volume adjustments for the speakerphone, handset and ringer.	
25	The phone should support mounting against a wall	
26	The phone should support 4 programmable lines keys.	

IP Phone Type-4: -

S.No.	Features	Specifications	
1	Video Standards:		
2		Minimum H.264 and above	
3		The system should support SIP protocol.	
4		Must support desktop sharing SIP calls	
5	Video Frame Rate		
6		Must support 1080p 30 fps	
7	Video Features:		
8		Ability to send and receive two live simultaneous video sources in a single call.	
9		Side by Side or PiP layout so that two video sources can be displayed on a single LCD screen.	
10	Video Input:		
11		Should have HDMI or DVI (Digital Video Interface) input to connect PC/ Laptop directly to the Video conferencing system and display a	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No.	Features	Specifications	
		resolution of XGA/SXGA.	
12		The user must be able to toggle between the Laptop/PC mode and the Video conferencing mode at a push of button/icon.	
13	Video Output	Must have a HD output via a HDMI/DVI output port to display the VC screen onto an external display.	
14	Video Resolution:		
15		CIF (352 x 288 pixels) VGA, 240p, 360p, 480p 720p (1280 x 720 pixels) 1080p (1920x1080 pixels)	
16	Audio:		
17		Audio System : The system should have two stereo front speakers with inbuilt microphones, wideband speakers.	
18		G.722, G.711, MPEG 4 AAC or better - which supports 20 KHz audio must be supported	
19	Other Desirable Features	Noise Reduction/Echo Cancellation, Automatic Gain control, Automatic Audio mixer	
20	Network Interfaces	1 x LAN /Ethernet--10/100/1000	
21		1 x LAN /Ethernet--10/100/1000 to connect a PC (i.e. built in switch)	
22	Bandwidth		
23	SIP/H.323/ IP Features		

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No.	Features	Specifications	
24		Must support Standard based Packet loss recovery algorithm to handle packet loss.	
25		QOS	
26		Should support URI Dialling	
27	Data Collaboration		
28		Presentation through presence of DVI/HDMI Input port	
29	Security		
30		Password protected system menu	
31		Meetings both point and point and multipoint , should be password protected and the same should be possible for SIP networks	
32		Encryption of video call: ITU-T standards based Encryption of the video call	
33		Call should be encrypted end-to-end on IP calls	
34	Camera		
35		Should be HD at least 6 megapixel camera, with privacy shutter	
36		Must support 1080P resolution. Should support Wide formats. Must support 1920 X 1080resolution	
37		60 degree horizontal Field of View	
38		35 degree vertical field of view	
39		Must have automatic Focus.	
40		The VC unit must allow the camera to be used as a document camera to capture hard copies and transmit it to the far	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No.	Features	Specifications	
		end site.	
41	Directory Services		
42		Should support Local and Global directories	
43		Should support LDAP and H.350 protocols for directory transfer.	
44	WiFi	Must support 802.11a/b/g/n	
45	Display	Must support escalation of point to point calls to Multiparty calls using the central MCU without disconnecting the call.	
46		Should be an integrated system with at least 22 to 24 inch LCD/TFT screen, 1080P resolution (16:9), HD camera and with speakers for wide band audio output. The Codec should be a part of the unit. No separate Codec's are preferred.	
47		The LCD/TFT screen should be a touch screen to provide a touch interface to the user.	

Voice Gateway: -

S.No	Specifications	
1	Should provide 3 x 10/100/1000 on board LAN/WAN interfaces	
2	Router should have minimum forwarding rate of 100 Mbps and upgradable to 300Mbps	
3	Shall support variety of Voice interfaces like FXO, FXS, BRI, Channelized PRI (E1), E&M and WAN interfaces like V.35 Sync Serial (2 Mbps), Async Serial, E1 G.703, Fast Ethernet, Gigabit Ethernet, ISDN BRI, Channelized and Clear channel E1.	

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

S.No	Specifications	
4	Should be provided with 2 port Multiflex Trunk Voice/Clear-channel Data T1/E1 Module from Day-1.	
5	It should support embedded hardware encryption acceleration, voice/ video-capable digital signal processor (DSP) slots or equivalent.	
6	The gateway should be able to support IP Phones in survivability mode.	
7	It should support embedded Voice/ video-capable digital signal processor (DSP) slots.to support 200 IP phones from Day-1.	
8	Shall support Routing protocols like RIP ver1 &2 OSPF ver2.	
9	Multicast routing protocols support: IGMPv1, v2, PIM-SM and PIM-DM, DVMRP.	
10	Shall support IPv6 features: DHCPv6, IPv6 QoS, IPv6 Multicast support, RIP and OSPFv3 for IPv6.	
11	Shall support IP Accounting features	
12	Should support cRTP to compress voice (RTP) streams	
13	Shall support the following	
14	Classification and Marking: Policy based routing, IP Precedence, DSCP, MPLS exp bits	
15	Congestion Management: RED, Priority queuing, Class based weighted fair queuing	
16	Traffic Conditioning: Committed Access Rate/Rate limiting	
17	Per VLAN QoS.	
18	Resource Reservation Protocol (RSVP)	
19	Shall support the following	
20	AAA support using Radius and/or TACACS	
21	GRE	
22	IPSec	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S.No	Specifications	
23	PAP and CHAP authentication for P-to-P links	
24	Multiple privilege level authentication for console and telnet access	
25	Time based & Dynamic ACLs.	
26	Shall have support for management thru Telnet, SSH, Secure Web based management thru HTTPS and SNMPv3 and Out of band management through Console and external modem for remote management	
27	Should provide a provision to analyze IP service levels for IP applications and services by using active traffic monitoring (the generation of traffic in a continuous, reliable, and predictable manner) for measuring network performance	
28	Should support flow-based traffic analysis of applications, hosts, performance-based measurements on application and network latency, quality of experience metrics for network-based services such as voice over IP (VoIP) / video.	
29	Should have the ability to monitor events and take informational, corrective, action when the monitored events occur or when a threshold is reached.	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

VI) HIGH MAST & POLES

GENERAL

The Road lighting & Compound lighting works shall be carried out in accordance with relevant Indian standard codes of Practices, National Building Code and CPWD general Specifications for Electrical Works - Part II (external Works). Poles detail shall be as mention in BOQ item. However the contractor/Pole manufacture shall submit the pole design as per IS standards & International standards as applicable.

OCTAGONAL POLES

Design:

The Octagonal Poles shall be designed to withstand the maximum wind speed as per IS 857. The top loading i.e. area and the weight of fixtures are to be considered to calculate maximum deflection of the same shall meet the requirement of BSEN 40-3-3:2003, pr EN-40-3-3. Structural design calculations shall be submitted to justify the pole dimensions.

Pole Shaft:

The pole shaft shall have octagonal cross section and shall be preferably continuously tapered with single longitudinal welding.

Pole shaft shall be provided with a rigid flange plate of suitable thickness with provision for fixing 4 foundation bolts. This base plate shall be fillet welded to the pole shaft at two locations i.e. from inside and outside. Structural design calculations shall be submitted to justify the flange & foundation bolt dimensions.

Door Opening:

Octagonal poles shall have of approximately 500 mm Door opening length at the elevation of 500 mm from the base plate. The door shall be vandal resistant and shall be weather proof to ensure safety of electrical connections inside the pole. The door shall be flush with locking facility. The pole shall be additionally reinforced with a welded steel section, so that the section at door is unaffected and undue bucking of the cut section is prevented.

Material of construction shall be:

Octagonal Pole shaft	HT Steel Conforming to grade S355
Pole Base Plate	Fe 410 conforming to IS 2062
Pole Foundation Bolts	EN. 8 grade
Bracket	ERW tubes as per IS 1161

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Welding:

The welding shall be carried out confirming to approve procedures duly qualified by third party inspection agency.

Pole shall be hot dip galvanized as per BS EN ISO 1461/ IS 2629 / BS 729 / IS 4759 standards with average coating thickness of 70 micron. The galvanizing shall be done in single dipping.

The poles shall be bolted on a pre-cast or cast in - situ RCC foundation on studs with nuts & washers and with a set of four foundation bolts for greater rigidity.

Manufacturing Unit:

The pole manufacturing & galvanizing unit shall be ISO 9001:2000, ISO 14001 & 18001. OSHAS certified to ensure consistent quality & environmental protection.

The manufacturing unit shall have in-house pole testing facility for validation of structural design data. The pole testing facility shall conform to BS EN 40-3-2-2000 part 3-2.

CONICAL POLES (TUBULAR)**Design:**

The Conical shall be designed to withstand the maximum wind speed as per IS 857. The top loading i.e. area and the weight of fixtures are to be considered to calculate maximum deflection of the same shall meet the requirement of BSEN 40-3-3:2003, pr EN-40-3-3. Structural design calculations shall be submitted to justify the pole dimensions.

Pole Shaft:

The pole shaft shall have Conical cross section and shall be preferably continuously tapered with single longitudinal welding.

Pole shaft shall be provided with a rigid flange plate of suitable thickness with provision for fixing 4 foundation bolts. This base plate shall be fillet welded to the pole shaft at two locations i.e. from inside and outside. Structural design calculations shall be submitted to justify the flange & foundation bolt dimensions.

Door opening:

Conical poles shall have of approximately 500 mm Door opening length at the elevation of 500 mm from the base plate. The door shall be vandal resistant and shall be weather proof to ensure safety of electrical connections inside the pole. The door shall be flush with locking facility. The pole shall be additionally reinforced

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

with a welded steel section, so that the section at door is unaffected and undue bucking of the cut section is prevented.

Material of construction shall be:

Conical Pole shaft	HT Steel Conforming to grade S355
Pole Base Plate	Fe 410 conforming to IS 2062
Pole Foundation Bolts	EN. 8 grade
Bracket	ERW tubes as per IS: 1141

Welding:

The welding shall be carried out confirming to approve procedures duly qualified by third party inspection agency.

Pole shall be hot dip galvanized as per BS EN ISO 1461 / IS 2629 / BS 729 / IS 4759 standards with average coating thickness of 70 micron. The galvanizing shall be done in single dipping.

The poles shall be bolted on a pre-cast or cast in -situ RCC foundation on studs with nuts & washers and with a set of four foundation bolts for greater rigidity.

Manufacturing Unit:

The pole manufacturing & galvanizing unit shall be ISO 9001:2000, ISO 14001 & 18001. OSHAS certified to ensure consistent quality & environmental protection.

The manufacturing unit shall have in-house pole testing facility for validation of structural design data. The pole testing facility shall conform to BS EN 40-3-2-2000 part 3-2.

HIGH MAST

The design of the high mast and its foundation shall take into account seismic activity at Delhi and also the Basic wind speed of 47 mtr/sec as per clause 5.2 of IS:875 (Part-3) 1987 with up to date amendment. The following or their corresponding equivalent reference standards for the loading of high mast shall be applicable:

<u>S No.</u>	<u>Code No</u>	<u>Title</u>
a)	IS 875 (Part –III) -1987	Code and practice for design loads for structures
b)	BS-EN 10025/ DIN 17100	Material of construction/Grade of MS Plate

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

c)	IS 1461/IS 4759 / IS-2629/BS 729	Galvanising / hot dip Galvanizing standard
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Illumination requirement

A general illumination level of 20 to 30 lux at road level / surface is desired. The contractor shall submit his drawing showing the luminaire fixing arrangement, tilt angle etc. on the high mast and illumination level achieved with such arrangement and obtain approval of Engineer-in-Charge before proceeding with the luminaire fixing work.

The flood lightings are to be designed with an overall maintenance factor of 0.70 and after taking in to account all the factors and obstructions in the area.

Choice of light sources

LED Type light fixture are to be used.

Obstruction lights

Flood light high mast tower shall be provided with One number of LED aviation obstructions light fitting and it shall meet the test specification as per ICAO Aerodrome Manual, Annexure-14, chapter 6, Table 6.3 for low intensity Type B along with the all mounting accessories for installation of fixture on TOP of Flood light high mast tower.

Flood lighting Mast

The mast shall be designed for 25 years long life. The tenderer should design the flood lighting system considering location of mast only.

Mast structure

The mast shall be continuously tapered and of polygonal cross section with a raising / lowering luminaries' carriage on top presenting good visual appearance. Provision shall be made for lightning arrester. The structure shall be suitable for wind loadings as per IS 875 part-3 1987.

Dynamic Loading

Mast shall be designed for maximum reaction arising as a result of dynamic analysis as per relevant IS codes. The design shall be such that wind excited oscillation shall be dampened as much as possible and an adequate allowance shall be made to resist stresses due to these oscillations. The tenderer shall indicate the method of dampening. On award of work, the tenderer shall furnish full calculations of the forces involved for approval. In case design is done with the help of computer, all input data, design assumptions, forces induced in each member shall be submitted including the results.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Mast Construction

The Highmast manufacturing & galvanizing unit shall be ISO 9001:2000 certified & preferably ISO 14001 certified to ensure consistent quality & environmental protection.

The mast shall be continuously tapered, constructed from steel plates/ sheets, cut and folded for polygonal section and telescopically jointed and fillet welded except the site joints which are to be push fit type. The steel used in construction of the masts shall comply with BS: 4360-50C/43C, IS 226-1975/ IS: 2062-80 of appropriate grade. Welding shall be in accordance with BS: 3135/5135/IS: 9595-80.

The mast shall be delivered in three sections (maximum) in respect of 20 M / 16 M high mast as per design and to be assembled at site by slip stress fit method. The top and bottom diameter of the mast shall be not less than 150mm & 450mm A/F respectively. There shall not be any site welding or bolted joint in the mast. The entire mast shall be hot dip galvanized internally and externally having uniform thickness of minimum 65 microns. Prior to the dispatch each joint shall be tested in work shop.

To enable clear access to the winch and other electrical equipment, inside the high mast, a vandal resistant weather proof door opening has to be provided in the mast base, with a secured heavy duty lock. The lock should not be easily accessible and special arrangements are to be made to open the door for undertaking break down/ maintenance. This opening has to be adequately reinforced with welded steel section, thereby restoring the section modules and preventing trickle.

The distance between the flange of mast and the bottom of the door is to be kept twice the width of the door. Mounting plate or brackets shall be installed within the mast to support the winch and the mast electrical equipment.

A 12mm dia. stainless steel stud should be attached to the main body of the mast structure, at a readily accessible position in the base compartment to provide lightning and cable earth points, with adequate hardware for separate connections to the earthing strip from the lightning conductor to the nearest earth station.

Lantern Carriages

A fabricated Lantern Carriage shall be provided for fixing and holding the flood light fittings and control gear boxes with stainless steel nuts, bolts & spring washers. The Lantern Carriage shall be of special design and shall be of steel tube construction, the tubes acting as conduits for wires, with holes fully protected by grummets as per IS 4923. The Lantern Carriage shall be so designed and fabricated to hold the required number of flood light fittings and the control gear boxes, and also have a perfect self balance. The lantern carriage shall be fabricated

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

in two halves and joined by bolted flanges with SS bolts and nylock type SS nuts to enable easy removal from the erected mast for replacement/ maintenance purpose. The carriage shall be supported by two/three wire ropes for better stability. The lantern carriage assembly shall not touch the lower surface of the Mast. The carriage design and fabrication shall be such that the lantern carriage will suit the lanterns and their control gear boxes to be used in the work. The inner lining of the carriage shall be provided with protective PVC arrangement, so that no damage is caused to the surface of the mast during the raising and lowering operation of the carriage. The complete Lantern Carriage shall be hot dip galvanised after fabrication. The weather proof cast aluminum junction box (IP-55) shall be provided on the Lantern Carriage assembly from which the inter - connections will be made to the designed number of floodlight fittings and lanterns on the carriage.

Foundations

Concrete foundation required for the mast shall be designed as per IS: 875 (Part-3) - 1987/ IS: 456/78 / IS: 4091-79 and with due consideration to the seismic activities in Delhi region and cost of the same shall be included in the rate for the design, manufacture, supply, installation, testing and commissioning of high mast lighting. Foundation shall be designed for safe bearing capacity of 10.0 tones per sq.mtr available at a depth of 1.50 m below ground level. Footing can be taken deeper if required from structural considerations. The foundation design of high mast structure shall be certified / vetted by a recognized Govt. Engineering College viz. IIT / NIT etc. or by a reputed structural consultant and submitted for approval / acceptance by the Engineer- in -charge. The cost for the same shall be borne by the contractor. The mast shall be 300mm above finish surface. Nothing extra shall be paid on this account.

Metal Protection

All components & accessories used in mast shall be hot dipped, galvanized internally and externally in accordance with BS: 729/ IS: 4736-68 / IS: 4759- 79/ IS: 5358-69/ IS: 4848-79.

Mechanical Arrangements

The mast shall have the facility to raise or lower the lantern carriage, at the top, for the ease of installation and maintenance. A winch located at the base of the mast, along with stainless steel wire rope (s), is used for the purpose. The steel wire rope supporting/ holding the lantern carriage is in tension at all times.

The raising and lowering system is to be robust arrangements, requiring little or no maintenance at the mast head and is to absolutely safe in operation. The system should have minimum number of moving parts and, to have least chance of parts failure.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

Pulley Arrangements (TOP)

The mast shall have purpose designed pulley of die cast aluminium alloy (LM-6) fitted with bearing with life-long lubrication (self lubricated).

The pulley shall be of large diameter appropriate to the multicore flexible cable being used. They shall be of non-corrodible material and shall run on self lubricated bearings. Arrangements shall be provided to ensure that the electric cables and steel wire ropes are separated before passing over their respective pulleys and close fittings guides shall protect the pulleys to prevent ropes and cables leaving the pulley grooves.

The axles of the pulley are made out of appropriate grade of stainless steel and are of suitable diameter, retained by stainless steel split pins and washers.

Separate ways are made internally for each wire rope and the cable. Externally a divider is fitted to separate ropes and cables, to avoid the possibility of over-wrapping of the same during wind conditions and the carriage in the lowered conditions.

Each pulley is to be protected by four close fittings sides. The cover is to be secured by a single stainless steel captive bolt and is holed to receive the safety rope.

Winch

The winch has to perform the following duties:

- Raising and lowering the luminaries carriage.
- Supporting the luminaries carriage in the raised position.
- Raising and lowering the maintenance carriage and equipment.

The winch has to be designed for an estimate operating life of 25 years, with the due allowances for the reduction in section as a result of wear and possible corrosion during the operating life.

The termination of the winch ropes shall not involve distortion of the rope structure. Also in the case of double drum the layout of the drum is spatial (two separate independently drum for anchored ropes), thereby ensuring no inter-winding of the lifting ropes. Four turns of the rope remain on the drum with the carriage in fully lowered position.

The winch is to be self-sustaining type without the need of brakes or clutches. The winch shall be provided with permanent oil bath where from the winch will be self-lubricated and required no attention in service other than recharging of the lubricant at intervals. The type of Lubricant shall be of SAE 90/140 grade.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

The winch is to be provided with a positive locking device which remains in ENGAGED condition to prevent rotation in the lower direction when the mast is in service. Raising and lowering arrangements shall be by inbuilt motorized system with all latest safety.

Steel wire Ropes

The mast is to be fitted with 6mm diameter flexible stranded stainless steel wire ropes (7/19 construction) with central core of grade AISI:316 with a factor of safety of more than 5-10 times the safe working load of the winch.

INSTALLATION OF OCTAGONAL/CONICAL & LIGHT FIXTURE

Foundation

a) Design & Approval:

The foundation shall be designed to withstand the wind velocity (not less than 47m/ sec) and maintaining the maximum deflection of the pole as specified with bracket & fixtures within limits of specified standard. The successful tenderer has to submit the design calculation & foundation drawing duly vetted / certified by recognized Govt. engineering college viz. IIT/NIT etc or reputed structural consultant and submit for approval / acceptance by the Engineer- in -charge.

b) Casting of Foundation:

Reinforced cement concrete (RCC) foundation of M 20 grade shall be casted as per item nomenclature given in the schedule of work and approved drawing. The curing shall be done sufficiently before loading the pole. The foundation shall project above ground by 200mm which shall be neatly finished with sand cement plaster.

Cable Guard pipe:

50mm (OD) ISI marked HDPE pipe as required shall be laid for of loop-in loop-out cables in concrete foundation for easy laying & relaying of cable without any change to the RCC foundation work. The end of the pipe shall be sealed after cable is laid & tested. Only one pipe will be used for laying of a single cable.

Installation of Pole

- The poles shall be installed in a workman like manner so that it is leveled, properly aligned and oriented.
- Care shall be taken in handling the pole to avoid any distortion to the supporting structure or damage to the delicate instruments & electrical parts.
- After erection of pole, bracket and all accessories, the pole should be numbered as per the direction of Engineer-in-charge and the exposed portion of concrete foundation shall be painted with black and yellow zebra pattern. The cost of the same is deemed to be included within the quoted cost.

STREET / ROAD LIGHT LUMINAIRES

- Luminaire shall be supplied in accordance with make & model number. given in the Schedule of Work.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- All light luminaries and the associated control gear shall be rated for operation at 230V, 50 Hz. A.C. supply unless otherwise specified in BOQ.

WIRING TO LIGHT FIXTURES

Each Road / Compound light fixtures shall be wired from MCB provided on loop-in-loop-out box of pole by means of a separate flexible unarmored 3 x 2.5 sq mm single core PVC insulated PVC sheathed, copper conductor cable.

POLE BRACKETS (for MS pole)

The bracket shall be suitable for installation of LED luminarie. The design of the brackets shall be submitted and got approved by Engineer- In- Charge. The brackets shall have a suitable tilt angle and shall be galvanized internally and externally by hot dip galvanizing process. Bracket shall be ERW tubes as per IS 1161.

The MS poles and brackets should be from same manufacturer to ensure proper matching and alignment of the pole and bracket.

TEST AT MANUFACTURES WORK

All routine tests specified in IS: 8623-1977 shall be carried out and test certificates produced to the Department.

TESTING AND COMMISSIONING

Commissioning checks and tests shall be included all wiring checks and checking up of connections. Relays adjustment/ setting shall be done before commissioning in addition to routine meggar test. Checks and tests shall include the following.

- Operation checks.
- Interlocking function check.
- Insulation test:** When measured with 500V meggar, the insulation resistance shall not be less than 100 mega ohms.
- Trip tests & protection gear test.
- Calibration of Astronomical Timers

L.T. CABLES & HDPE PIPE

GENERAL

L.T. Cables Work for external lighting shall be carried out as specified in clause 7.0 of this specification.

EARTHING

GENERAL

Earthing of Road & Compound Lighting poles & Feeder pillars shall be carried out in conformity with IS 3043-1987, Indian Electricity Rules and CPWD specification

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

(Internal works-2013). Specification of earthing work shall be as per clause no-----
-.

EARTH ELECTRODES

Poles shall be earth with Pipe Earth Electrode, Feeder Pillar shall be earthed with Plate Earth Electrode.

EARTHING CONDUCTOR FOR EXTERNAL LIGHTING POLES & FEEDER PILLARS

Earthing Continuity Conductor shall be 6 SWG GI Wire looping from Pole to pole. The Pole shall be earthed with GI pipe earth electrode. Feeder Pillar shall be earthed with 25 mm x 5 mm GI strip as earth conductor.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

AE-I
(EPD-4)

EE
(EPD-4)

AE (P)
(CPM (Housing))

EE(P)
(CPM (Housing))

VII) TECHNICAL SPECIFICATION FOR INTELLIGENT ADDRESSABLE FIRE DETECTION & ALARM SYSTEM

Basis of Design

An Intelligent Fire Alarm System herein after known as (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, multitasking, multi user and multi-location type.

The system shall be provided with Addressable and Analog fire alarm initiating, annunciating and control devices.

The addressable and intelligent system shall be such that smoke sensors, thermal sensors, manual pull stations etc. can be identified with point address. The system shall be capable of:

Setting smoke sensor sensitivity remotely to either high sensitivity manually or on a pre-programmed sequence e.g. occupied / unoccupied period. The IFAS shall be able to recognize normal and alarm values that reveal trouble condition, and above normal values that indicate either a pre-alarm condition or the need of maintenance.

Read-out or address at actual space temperature at thermal detector points. The operator shall also be able to adjust alarm and pre-alarm thresholds and other parameters for the smoke sensors.

Provide a maintenance / pre-alert alarm capability at smoke sensors to prevent the detectors from indicating a false alarm due to dust, dirt etc.

Provide alarm verification of individual smoke sensors. Alarm verification shall be printed on the printer at the control station's printer to enhance system maintenance and identify possible problem areas.

Provide local numeric point address and LED display of the device and current condition of the point. Local annunciation shall not interfere with annunciation from the Fire Control System.

Provide outputs that are addressable, i.e. outputs shall have point address. The operator shall be able to command such points manually or assign the points to logical point groups (Software Zones) for pre-programmed operation.

In the event of fire alarm, but not in a fault condition, the following action shall be performed automatically.

The System Alarm LED on the main fire alarm control panel shall flash

A local electric sounder shall be sounded.

The LCD display on the main fire alarm control panel shall indicate all information associated with Fire Alarm condition including the type of alarm point and its location within the premises.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Printing the information associated with the Fire Alarm Control Panel condition, along with the time and date of occurrence.

Air handling units on the affected floors shall automatically be switched OFF and simultaneously respective fire dampers shall also be closed.

Pressurization fans on the evacuation shafts i.e. Stairwells etc. will automatically be switched ON.

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 output (alarm notification appliances and/or relays) shall be activated.

The audio portion of the system shall direct the proper signal (tone or voice) to the appropriate speaker circuit.

Pre-recorded alarm messages shall be played on the public-address system.

Fire Alarm Control Panel

The Fire Alarm Control Panels shall function both as an independent standalone system element as well as an interface between the control processing unit and the fire detectors, their accessories and the controlled devices. The control panel shall be intelligent type with its own microcomputer and memory. It shall be powered with high efficiency SMPS.

The Fire Alarm Panels shall be microprocessor based and shall have necessary detector interface units (for both addressable and non-addressable sensors), alarm output modules for external hooter & lamp control output modules for various control functions through relay contacts and communication modules for interfacing with the outside world. The processor shall interact with the other modules through a common bus. The system shall store all basic system functionality and job specific data in non-volatile memory. All site specific and operating data shall survive a complete power failure intact. Password shall protect any changes to system operations.

The Fire Alarm Panels shall have the facility to process the Input Signals and control the output functions either directly or through I/O Interface Modules as per the requirements.

The Fire Alarm Panels shall continuously scan the various loops for conditions of Fire, Fault (Open circuit as well as short circuit) and provide audio-visual Alarm and Messages as the case may be. Each loop shall be capable for connecting minimum 120 addressable units (detectors and devices) with minimum 10% spare capacity for detectors.

System circuits shall be configured as follows: Addressable analog loops class 'A'; initiating devices circuits class 'A'; Notification appliance circuits Class A; Network communication A. Annunciates Communication 'A'. Any deviation in the style of wiring shall be with prior permission of the consultant.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

The Fire Alarm Panel shall be protected against any kind of short circuit, open circuit, over voltage and under voltage. In case of any abnormality, the system shall display appropriate message. The panel should have a CPU watch dog circuit to indicate trouble should the CPU fail.

The system should perform Fire Pattern Recognition. For this purpose, it shall offer the following features:

Smoke entering a detector for a short duration (e.g. cigarette smoke) shall not cause any alarm.

A fast buildup of smoke shall result in quick alarm generation.

A gradual buildup of smoke shall be detected early by reducing the pre-warning limit automatically (without disturbing the alarm level).

A slow buildup of dirt in detectors shall be recognized and the alarm level shall be suitably modified without generating any false alarms. For this purpose, the Fire Alarm Panels shall have necessary Hardware and Software filters, details of which must be submitted by the tenderer in the technical bid.

The system shall have detector sensitivity test feature, which will be a function of the smoke detectors and perform automatically every four hours.

The Fire Alarm Panels shall have the under mentioned additional features:

Logging an alarm, time and action text on printer.

Status check of disabled alarm addresses before they are restored.

Storing of alarms and the possibility of internal organization of alarms.

Offered Fire Alarm Panel shall have high degree of flexibility with:

The possibility of expanding to a bigger system with several control panels, and control and information units.

Programmable actuation of control output relays for tripping ventilators, closing of fire doors, closing of fire dampers, etc. in case of fire. The system shall also provide a manual over-riding facility to operate/de-activate the above.

Connection to addressable as well as non-addressable (Conventional) Detectors, Manual call station, etc.

The panel shall offer an event log that records a minimum of 1000 events to be displayed on a 640-character LCD or panel programming software.

For reasons of reliability and preventing inadvertent changes, the software / database shall be maintained in Non-volatile Memory. It shall be possible to reprogram the software by authorized personnel only. Fire Alarm Panel shall provide Access Protection via Password (multilevel). Hard-ware protection shall be via a security lock and key arrangement.

Offered Fire Alarm Panels shall automatically scan the whole system and confirm the user entered configuration. It shall also generate the appropriate messages.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

System should check up all the detectors periodically (by scanning) for the sensitivity of the detectors. Whenever any detector sensitivity goes down due to/soiling or dust accumulation it should provide the required biasing to bring the detector's sensitivity upto the required level. In case any detector goes below the minimum sensitivity level, it should issue a warning tone for cleaning the detector manually. Therefore, each analog detector shall be monitored for maintenance alert.

The system shall support distributed processor intelligent detectors with the following operational attributes; integral multiple differential sensors, automatic device mapping, environmental compensation, pre-alarm, dirty detector identification, automatic day/night sensitivity adjustment, normal / alarm LEDs, relay bases, sounder bases and isolator bases.

The Fire Alarm Control Panels shall be of multiplex system using distributed memory, processing and control configured in regenerative network using a Master network controller and various field panels and remote controllers. These regenerative networks shall be capable of generating critical system functions in the event of Master network controller fails or data line is severed. The network upon failure of these shall sense the missing remote controllers or field panels and regenerate itself into a system or system dependent upon the remaining hardware. Each segment that has been regenerated shall be a full operating system capable of passing individual device or zone information to or from any remote field panel for operation of appropriate output devices and events. All Fire alarm control panels will be peer to peer networked with each other.

The Fire Control Panel shall be equipped with integrated fire fighters telephone system which shall automatically dial one or more programmed fire fighter's telephone numbers and convey pre-programmed messages in the event of fire in any of the zone. The fire panel should have a Dialer Alarm Communicator Transmitter (DACT) module to transmit alarm, supervisory and trouble signal to a Central Monitoring Station (CMS). The DACT shall support dual telephone lines, 20 pps 4/2 communication and configured for Dual Tone Multi-Frequency (DTMF) or pulse modes.

Indications as mentioned hereunder shall be available on the Fire Alarm Panels.

- a) RED and AMBER high-power LED to indicate any zone on fire and fault respectively. Zone number and the area should be displayed on 3" user friendly touch screen display / 640 characters LCD display on the control panel. Nature of fault shall also be indicated on the LCD display. The main LCD panel and operator console shall be in modular form and the same should be used as a repeater panel thus enabling full featured remote operation of the fire alarm system.
- b) Mains-on (Green). In case of mains failure, SYSTEM ON BATTERY LIGHT (AMBER) should come up.
- c) Battery under voltage should be indicated by flashing RED LED with 1 KHz. broken audio signal.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Other indications as per system design.

It should have the facility of for the connection of printer.

Matrix type connected printer should provide real time recording of all the system operations. In addition to the above, it should be able to provide Hard Copy of reports, system serviceability and faults etc. on demand.

The system on demand shall provide analog detector sensitivity report. The system shall also provide history report of verification cycles per detector and the system status reports of detector analog reading both on computer and VDU as well as in the form of hard copy through the printer.

The FACP shall be UL listed / FM approved and the panel shall have the provision for connecting to Repeater Panels to meet feature requirements.

Modular system design, with a layered application design concept including an "operational layer" and a "human interface layer" to allow maximum flexibility of the system with a minimum physical size requirement. The panel should be dust and vermin proof.

The panel should support 128 service groups within the system program to allow the testing of the installed system based on the physical layout of the system, not on the wiring of the field circuits connected to the FACP.

All the metal portions of the panel shall be powder coated and earthed properly. All the loop cards and accessories specified will be housed in a single housing.

Digital Voice Command Center

1. The Digital Voice Command Center located with the FACP, shall contain all equipment required for all audio control, emergency telephone system control, signaling and supervisory functions. This shall include speaker zone indication and control, telephone circuit indication and control, digital voice units, microphone and main telephone handset.
2. Function: The Voice Command Center equipment shall perform the following functions:
 - a. Operate as a supervised multi-channel emergency voice communication system (minimum of 8 channels of digital audio).
 - b. Operate as a two-way emergency telephone system control center.
 - c. Audibly and visually annunciate the active or trouble condition of every speaker circuit and emergency telephone circuit.
 - d. Audibly and visually annunciate any trouble condition for digital tone and voice units required for normal operation of the system.
 - e. Provide all-call Emergency Paging activities through activation of a single control switch.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- f. As required, provide vectored paging control to specific audio zones via dedicated control switches.
- g. Provide a factory recorded “library” of voice messages and tones in standard WAV. File format, which may be edited and saved on a PC running a current Windows® operating system.
- h. Provide a software utility capable of off-line programming for the VCC operation and the audio message files. This utility shall support the creation of new programs as well as editing and saving existing program files. Uploading or downloading the VCC shall not inhibit the emergency operation of other nodes on the fire alarm network.
- i. Support an optional mode of operation with four analog audio outputs capable of being used with UL 864 fire-listed analog audio amplifiers and SCL controlled switching.
- j. The Digital Voice Command shall be modular in construction, and shall be capable of being field programmable without requiring the return of any components to the manufacturer and without requiring use of any external computers or other programming equipment.

The Digital Voice Command and associated equipment shall be protected against unusually high voltage surges or line transients.

the DVC shall also facilitate for provision to connect a general audio source such as CD player / FM player.

Addressable Digital Audio Amplifiers

1. The Digital Audio Amplifiers will provide Audio Power for distribution to speaker circuits.
2. Multiple audio amplifiers may be mounted in a single enclosure, either to supply incremental audio power, or to function as an automatically switched backup amplifier(s).
3. The audio amplifier shall include an integral power supply, and shall provide built-in LED indicators for the following conditions:
4. The audio amplifier shall provide the following built-in controls:
 - Amplifier Address Selection Switches
 - Signal Silence of communication loss annunciation Reset
 - Level adjustment for background music
 - Enable/Disable for Earth Fault detection
 - Switch for 2-wire/4-wire FFT riser
5. Adjustment of the correct audio level for the amplifier shall not require any special tools or test equipment.

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

6. Includes audio input and amplified output supervision, back up input, and automatic switch over function, (if primary amplifier should fail).
7. System shall be capable of backing up digital amplifiers.
8. The amplifier shall be capable of selecting 1 (one) or 2 (two) out of 8 (eight) channels on the Digital Audio Loop and further process and amplify the same to broadcast over the speaker circuit output.
9. The Digital Audio Amplifiers shall also provide means to connect to the FFT Riser, digitize the FFT audio signal and enable FFT audio communication over the Digital Audio Loop (DAL).
10. The Digital Audio Amplifier shall also have provision for Auxillary Audio input and the capacity to broadcast the output across any of the desired speaker circuits on the network.

Audio Message Generator (Prerecorded Voice)/Speaker Control:

Each initiating zone or intelligent device shall interface with an emergency voice communication system capable of transmitting a prerecorded voice message to all speakers in the building.

Actuation of any alarm initiating device shall cause a prerecorded message to sound over the speakers. The message shall be repeated. Pre- and post-message tones shall be supported.

A built-in microphone shall be provided to allow paging through speaker circuits.

System paging from emergency telephone circuits shall be supported.

The audio message generator shall have the following indicators and controls to allow for proper operator understanding and control:

Fire Fighters' Telephone System:

The Fire Alarm system shall provide a fully integrated Fire Fighters' Emergency Telephone and Communications System. A master Telephone handset shall be provided which will provide a totally independent 2-way communication between the Fire Alarm Control Panel and any of the Fire Fighters' Telephone Stations located as indicated on the plans for the building. The Fire Fighters' Telephone System shall include individual LEDs and switches per telephone station. The user shall connect a call by pressing the 'connect' switch. To terminate a call, the operator shall press the 'disconnect' switch. The system shall have the capacity to enable a common talk interface (conference) between 35 simultaneous FFT handsets. This can be limited to a maximum of seven active handsets on a single riser and five active risers simultaneously.

Programmable Electronic Sounders:

Electronic sounders shall operate on 24 VDC nominal.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Electronic sounders shall be field programmable without the use of special tools, at a sound level of at least 90 dBA measured at 10 feet from the device.

Shall be flush or surface mounted as shown on plans

DETECTORS AND ADDRESSABLE DEVICES

General Features common to all detector:

Detector shall have an integral microprocessor capable of storing fire parameters information in the detector head. Distributed intelligence shall improve response time by decreasing the data flow between detector and analog loop controller. Maximum total analog loop response time for detectors changing state shall be 5 seconds. The addressable detectors shall be designed to detect one or more characteristics of fire, light smoke or heat. The prime function of an addressable detector shall be to detect a fire in its early stages by one of its characteristic phenomena, both visual and invisible and convert the same into an electrical signal for initiating the local and remote alarm.

The addressable detectors shall be suitable for column / ceiling mounting.

The detector shall be suitable for class A (ring main) preferable or Class B (Non-ring main) wiring.

The detectors shall be plug-in type and shall have common base.

An indicator LED shall be provided on the detector which illuminates when the detector has reached a preset alarm level. The indicator shall be operated independently of the detector from the central control panel.

Provision shall be made for an output from the detector suitable for operating a remote indicator or other device with a current limitation of 4 milli-amps. The output shall be operated independently of the smoke detector from the central control panel.

Separate mounting bases shall be required which enable ready removal of detectors for maintenance. The bases shall be fitted with stainless steel terminal springs and stainless-steel terminal screws and saddles.

The construction of the detector and bases shall be in white self-extinguishing polycarbonate plastic. Full circuitry must be protected against moisture and fungus. Smoke entry points must be protected against dust and insect ingress by corrosion resistant gauze. The detectors must be unobtrusive when installed.

Data transmissions to and from the fire control panel from the detector shall be via a communications module which is factory fitted to a detector by the original detector manufacturer and forms a complete and integral part of the detector.

The detector shall be supplied complete, fully tested and each should bear the serial no. and seal of the approving laboratory/body.

The detector shall be capable of automatic electronic addressing/custom addressing with/without the use of DIP or rotary switches.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

There shall be facility on the mounting base for writing in indelible ink the address of that base. The address code shall be obscured from sight when detector is fitted to the base.

The build-up of dirt or similar contamination on the radio-active source will cause the output signal from the detector to gradually change. The control panel shall be capable of monitoring this slow change in signal and at a predetermined level indicate that the detector is in need of servicing.

A. Addressable Multi Sensor Smoke Detectors

The multi sensor or multi tech smoke detector which will have both photoelectric as well as thermal detection elements shall have inbuilt microprocessor, not microcontroller, and shall be capable of taking an independent alarm decision.

The detector Shall be capable of being addressed electronically or manually by dip, rotary or decade switches.

Each intelligent addressable smoke detector's sensitivity shall be capable of being programmed electronically as: most sensitive, more sensitive, normal, less sensitive or least sensitive.

The detector should continue to give TRUE alarms even if the loop controller on the main panel fails.

Alarm condition shall be based upon the combined input from the photoelectric, and thermal detection elements.

Each detector shall be capable of transmitting pre-alarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level.

Each detector microprocessor shall contain an environmental compensation algorithm that identifies and sets ambient "environmental thresholds approximately six times an hour.

The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches 75% and 100% of the allowable environmental compensation value.

B. Addressable Heat Detectors

Combined rate of rise/fixed temperature heat detectors shall consist of two independent thermistors, designed to automatically compensate changes in ambient conditions.

All electronic circuits must be solid state devices and virtually hermetically sealed to prevent their operations from being impaired by dust, dirt or humidity.

All circuitry must be protected against usual electrical transients and electromagnetic interference.

Reverse polarity or faulty zone wiring shall not damage the detectors.

The detector shall have serial no. and seal of approving laboratory/body.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

The response (activation) of a detector shall be clearly visible from the outside by a flashing light of sufficient brightness.

The detector shall be installed into the base by a simple push-twist mechanism to facilitate exchange for cleaning and maintenance.

The detector shall connect to the Fire Alarm Panel via fully supervised two wire (zone type) circuit stub line (class "B" wiring) or a four wire circuit (Class "A" wiring) (loop type) as specified by the consultant.

It shall be possible to test the sensitivity of detector in the field.

Plug-in Bases

The detectors of all types shall fit into a common type of standard base.

Once a base has been installed, it shall be possible to insert, remove and exchange different types of detectors by a simple push twist movement.

The standard base shall be equipped with screw less wiring terminals capable of securing wire sizes upto 1 .5 sq .mm (SWG 15) and with built in strain limits to prevent permanent terminals deformation and weakening of contact pressure.

The standard base shall be supplied with a sealing plate, preventing dirt, dust, condensation or water from the conduit reaching the wire terminals or the detector contact points.

All standard bases shall be supplied with a removable dust cover to protect the contact area during installation and construction phase of the building. It must allow the inspection and verification of the zone wiring before insertion of any detectors.

The standard base shall feature a built-in mechanism, which allows mechanical locking of any installed detector head, thus preventing unauthorized removal of tampering while maintaining.

The detector contact points shall be designed to retain the detector safety and to ensure uninterrupted contact also when exposed to continuous severe vibrations.

All electronic components of bases and modules must be solid state and virtually hermetically sealed to prevent their operations from being impaired by dust, dirt or humidity.

All circuitry must be protected against usual electrical transients and electromagnetic interference.

The standard base shall allow Snap-On insertion of an (optional) electronic module to drive remote visual alarm indicators.

Reversed polarity or faulty zone wiring shall not damage the detectors.

1. Bases shall be of the same make as that of the detector supplied.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Addressable Manual Call Station

Manual call stations shall be addressable and electrically compatible with standard range of automatic detectors so that it can be connected directly into supervised loop of the standard range of control units.

The manual call station shall be of pleasant, streamlined and flat appearance permitting its use as flush and surface mounted unit as per site conditions.

The Manual call station shall consist of the base plate insert and cover with break glass type.

The cover must be secured against unauthorized removal. Every removal of the cover must release an alarm.

All inscriptions, texts and marks must be on the manual call station front plate.

The glass must be secured in the cover against falling out.

The manual call station shall be designed for fail safe operation.

The manual pull station may have a built in LED, lighting up automatically to confirm its actuation.

Specifications:

Type: Addressable with rotary switch or dip switch or electronic addressing.

Address device: Electronics.

Alarm device: Break Glass Type / Two Stage Pull Station.

Output signal: Red.

Addressable Control Modules

For monitored control of an AHU/extinguishing system activation of door control units with the option to reset the activated control output from the control panel, with monitoring for short-circuit and interruption. Housing is designed for surface mounting of flush mounting.

With modules having multiple outputs the quantities of the modules can be considered according to the no of outputs available.

Speaker

Fire alarm addressable speaker should operate from 24V D.C. and should have a facility to be selected for steady tone and voice output. A moveable jumper provided should have a choice for high (84 dbA) or low (70 dbA) outputs. Speaker cum hooter will be dual transformer speaker capable of operating at 25 and 70.7 Vrms and will have a frequency range of 400 to 4000 Hz. The synchronized speaker should be supplied with "FIRE" (wall orientation) as the standard marking. It should be for indoor installation.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Fire Fighters Telephone Jack

The fire fighter's telephone jack would be a standard receptacle for hooking up the fire fighter's telephone handset. The fire fighter's telephone jack will be complete with an ABS plastic cover plate and would be suitable for flush / surface mounting.

Fault Isolator

The fault isolator device shall detect and isolate a short circuited segment of a fault tolerant loop.

The devices shall automatically determine a return to normal condition of the loop and restore the isolated segment.

Devices shall be placed every 20 detectors / modules / field devices to limit the number lost in the event of short circuit.

SYSTEM SOFTWARE

- (i) The software at the core computer shall be based around the industry standard multi-tasking, multi-user operating system, Microsoft Windows NT 4.0. Single user operating systems such as those based on MS-DOS and Microsoft Windows 3.11 will not be acceptable.
- (ii) Standard services supported by the core system operating system will include the following:
 - Multi-tasking Multi-user support
 - TCP/IP Network Support
 - Graphic Display Building Editor with functionality detailed in Section 5
 - Application software with functionality detailed in Section 5
- (iii) Software at the Operator Station shall comprise of:
 - Windows 7
 - Graphic Display Building Editor with functionality detailed in Section 5
 - Application software with functionality detailed in Section 5
 - TCP/IP Networking
- (iv) If other software is proposed then suppliers must be able to demonstrate full compliance with Section 5.
- (v) The networking software shall use the industry standard TCP/IP LAN protocol.
- (vi) The core computer or an alternative network connected computer shall be capable of acting as a File Server for displays and photo images. All LAN connected Operator Stations shall be able to view custom displays and photo images from the core computer.
- (vii) All system peripherals including security and access panels and printers shall be capable of being connected to the core computer via the LAN.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

Interface and Integration

The core computer shall be capable of interfacing to the following panel types. The electrical interface technique shall conform to EIA RS-422 and/or RS-232 and/or RS-485 standards:

[Fire Monitoring Controller]

It shall be possible for all serial connections to the core computer to be routed via a terminal server and the LAN rather than directly to the host computer. The system shall be capable of supporting up to 40 simultaneous network connected Operator Stations

It shall be possible to efficiently monitor dynamic, real time data from any of the above panel types. It shall also be possible to configure hardware and software points from the core computer for each of these panels using a consistent configuration data format across all panel/controller types.

Given sufficient level of system privilege, it shall be possible to view, manipulate and analyze data acquired from the various panels through a common operator interface at any one of the Operator Stations.

Operator Stations shall be capable of connecting/disconnecting to a fixed set of system core computers on a TCP/IP network.

It shall be possible to interface to different types of devices using an industry standard interface such as MODBUS or Advance DDE from Rockwell Software. This shall allow simple interfaces to proprietary devices to be developed using a standard protocol.

All controller subsystems shall have distributed intelligence. Normal Fire detection and control decisions shall be made at the local panel without reference to the host.

The alarm limits (Night alarm , Night Pre alarm , Day Alarm and Day Pre alarm) for the smoke detectors shall be resident in Fire Controller only but it shall be possible to change it from the central station by an authorized operator.

Application Software Functions

Operator Interface

General

- (i) The operator interface shall be interactive and totally graphics and/or icon based. Graphics shall be capable of supporting up to 65K colors at a minimum of 1024 x 768 pixel resolution.
- (ii) The operator interface shall be Windows based and shall employ standard windowing conventions so as to reduce required operator training.
- (iii) The operator interface software shall be capable of running in an environment defined by Windows XP or Windows NT. The operator interface shall appear identical in all environments.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- (iv) There shall be at least 1700 displays reserved for user customization. These user configured displays shall be constructed using the integrated display building functions available through the Operator Station.

Status Displays

System status displays shall be available on the main Operator Station. It shall display the following information:

Total number points in a collection of a certain type in a particular state
 Points in alarm condition pending ACKNOWLEDGE command
 Points which remain in an alarm state but which have been acknowledged
 Communication failures
 Printer status
 Operator Stations status
 Communication channels status
 Controller status
 Dead man Timer status

Administration Displays

The system shall provide the following full screen displays:

Master system menu
 Report summary
 Alarm summary
 Event summary
 Display summary
 Operator Station configuration
 Area assignment
 Holiday assignment
 History assignment
 Pushbutton assignment
 Operator assignment
 Operator email message page
 Point Detail for every configured Point
 Controller specific database configuration information

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

Pointing and Input Devices

- (i) The operator interface shall be capable of being mouse driven and simultaneously support keyboard data input. Both fixed menus and configurable function keys shall be supported to aid novice and experienced operators respectively. The interface shall also be capable of supporting a touch screen for pointing and command input.
- (ii) The operator interface shall use a toolbar for common operator commands. The operator shall be able to request display of commonly used displays from Drop-Down menus. Given sufficient level of system privilege, the operator shall be able to customize the Drop Down menus to reference new displays created with the display building tool.
- (iii) All operator interface input shall be possible using only the pointing device and QWERTY section of the keyboard.

Operator Functions

The following functions shall be performed through the operator interface:

Display and control of field equipment

Display of and point status

Acknowledge alarms on a priority basis

Initiate printing of reports

Archive and retrieve event logs

Online generation of database and color graphic displays

Monitoring of data communications channels

Configure system parameters

Multimode Window Sessions

The core computer display unit shall also be capable of supporting multiple concurrent sessions. Each session shall allow an operator to choose between the following different modes:

Master Operator Station Mode:

Normal operator access to the system

Engineering and Maintenance Mode:

System configuration or application programming

Graphics builder Mode:

Display construction using the Graphics Display Building package

It shall be possible for all modes to appear as separate Windows running simultaneously on one screen.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Applications launcher

It shall be possible to launch any Windows application from within the Operator Interface. For example, a button or menu item shall be able to be created in the FMS to launch an application such as Microsoft Word.

Operator interface as a web browser

It shall be possible to use the standard operator interface as a browser for viewing information in HTML format. This allows the operator to view information on the Internet or an Intranet without having to activate an external browser application. This enables the operator to view information in HTML while still monitoring and responding to alarms. The operator interface shall provide a mechanism to restrict access to all or particular URL addresses in order to prevent the viewing of undesirable information. The linking of operator displays to particular URL addresses shall be achieved using the Graphical Display Building Tool.

Active Document support

It shall be possible to display Active Documents (such as Microsoft Word or Microsoft Excel documents) through the operator interface by incorporating these documents directly onto displays. The linking of displays to Active Documents shall be achieved using the Graphical Display Building Tool.

Point Collection summary

There shall be an online display of selected points and their current states. It shall be possible to group points together based on common states, areas, controllers or channels and place them in a collection. The total number of all points in a collection shall be displayed along with the number of points in each possible state. An overall summary display shall be provided which shows this information about each point collection.

Operator Security

Security Levels

The system shall support at least 6 levels of operator security. The functions allowed from each security level shall be as follows:

- Level 1 : View only.
- Level 2: View only with Acknowledge - The operator shall be able to acknowledge alarms as they occur.
- Level 3 : Permit all Level 1 and 2 functions and in addition the security guard or building manager shall be permitted to control points such as disable/enable, etc.
- Level 4: Permit all Level 1 through Level 3 functions in addition to accessing master time schedules, system peripherals allocation, etc. This level shall typically be reserved for the building engineer.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- Level 5: Permit all Level 1 through Level 4 functions in addition to accessing the engineering functions such as building and linking displays, allocating keyboard push button assignments, etc. Reserved for the building supervisor.
- Level 6: This is the highest level of station security and shall allow the user unlimited access to all station functions. Typically reserved for the building manager and system administrator.

Sign-On/Sign-Off

- (i) The guard or operator shall be permitted to sign on to the system if the correct Operator ID and the Operator Password have been entered providing they are authorized for that particular Operator Station and time of day.
- (ii) After a series of unsuccessful attempts to sign-on, the Operator Station interface shall be locked for a configurable period of time.
- (iii) It shall be possible to assign operators either single or multi-user passwords. Single user passwords enable the operator to sign-on to only a single Operator Station thus preventing simultaneous sign-on by the same operator. The multi-user password would typically be used by operators with the highest sign-on security level who may require simultaneous access to more than one Operator Station.
- (iv) The operator may sign-off at any time by entering a sign-off command.
 - (v) A time-out feature shall be provided such that the operator shall be automatically signed off after a defined period of keyboard or mouse inactivity.
- (vi) It shall also be possible to restrict operator sign-on to certain Operator Stations at certain times of the day. This is to prevent operators being able to sign-on when they are not currently on shift or at their normal terminal.

Duress

It shall be possible for an operator to indicate that they are signing on under duress. The system shall recognize that the operator is signing on under duress and it shall then be able to issue a control to alert appropriate assistance.

Area Assignment

Each operator shall be assigned one or more specific areas of the building with the appropriate monitoring and control responsibility. An area shall be defined in this context as a logical entity comprising a set of points, reports, display and other system elements in the system. This in turn may represent a physical space in the building. It shall be possible to define individual tenant access by means of area

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

assignment. An operator can only view or control those points within the assigned areas.

Area assignment control shall be capable of being superimposed over security control as defined in Section 5.2.1

Command Partitioning

It shall be possible to assign to each operator a set of commands (equivalent to target output states) for each assigned area. These commands can be mapped against the output state of any given digital point in the respective area to determine whether a control command is allowed for the particular operator.

Password Authentication

- (i) Each password shall be an alphanumeric character string made up of a minimum of 5 characters and a maximum of 6 characters. The system shall provide a facility to allow all operators to change their own passwords at any time.
- (ii) When a password is changed, the system shall not permit the new password to be the same as any of a number of previous passwords used in the past three months. All passwords in the system shall be encrypted both when stored and when transmitted.

Operator Email

It shall be possible for operators to email each other using the FMS. There shall be a dedicated display in the FMS which list the new messages for the current operator. From here, an operator shall be able to open, edit, delete and send and receive messages. The operators will be able to send messages to other people also, providing they have access to that email address.

Time Schedules

One thousand time schedules shall be provided by the system.

The time schedule facility shall allow the scheduling of Point control on both a periodic and one-off basis. All time schedules shall be configurable via the Operator Station.

The available time schedule type shall as a minimum be:

- a. One shot - to be executed only once then deleted
- b. Daily - to be executed every day
- c. Workday - to be executed Monday to Friday
- d. Weekend - to be executed on Saturday and Sunday
- e. Holiday - to be executed on holidays

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- f. Individual days - to be executed on individual days (e.g. Monday)

Holiday Assignment

The system shall be capable of defining up to thirty (30) days of holidays up to one year in advance. The holidays so defined shall be taken into account by other system functions such as time schedules.

Event Initiated Programs

Physical and software outputs or groups of outputs, shall be assignable through configurable algorithms to an input point. When an input changes state the outputs assigned shall be activated as specified by their physical or configured output modes.

When alarm events of individual or groups of points are suppressed by event initiated programs, any occurrence of such alarm events during the suppress mode shall not be annunciated, reported or journalized.

Grouping of Points

The system shall provide a means by which a number of alarm inputs, outputs, doors, etc. can be grouped together by the building manager so that monitoring or control can be performed for a group.

Event Management

Online Logging

- a. It shall be possible to log an event such that it shall be journalized in the event file and optionally printed on the event printer.
- b. Events shall consist of alarms, changes of state in a monitored status point, card holder movements, changes in system status and operator actions.
- c. All journalized events shall be recorded as necessary to include event description, condition, message, time of occurrence, operator responsible and any other information or tags.
- d. It shall be possible for these events to be retrieved online and shown on the screen or printed on the printer by using the reporting system. If events are viewed on the screen, it shall be possible to pause the real time view and prevent events from scrolling off the screen as new events occur.

Events Archiving and Retrieval

- a. It shall be possible to have an on-line event file as large as the disk capacity can accommodate. Given the disk space, it shall be capable of storing more than 1,000,000 (one million) events on file, with 100,000 events being provided by the base system defined in Section 2.1.
- b. The event file shall store events in a current online buffer. When the buffer is full an alarm will be raised advising the operator to save the file to an external

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

media. The current online buffer contents will then be transferred to an archive buffer to await archiving to an external media. The current online buffer shall, without interruption, continue to store current events.

- c. Another file area shall be available to hold archived event files ready for playback. These are event files previously archived to external media. Operators shall be able to restore previously archived files via the operator interface and a dedicated display.
- d. The events file system shall be fully integrated with the standard reporting system. The system shall be able to reference the restored playback file if a report is requested containing a time search window covered by the current playback file.

Alarm Management

Alarm Types

Each monitored point in the system shall be able to assigned one of four alarm types to individual states. The meaning of the priorities shall be as follows:

Priority Action

Journal

Changes of state shall be journalized to the Alarm/Event Log and optionally printed on the Alarm/Event printer.

Low

Change of state will generate a Low priority alarm which will appear on the Alarm Summary. Optionally, the alarm may be printed on the Alarm/Event printer or generate an audible tone.

High

Change of state will generate a High priority alarm which will appear on the Alarm Summary. Optionally, the alarm may be printed on the Alarm/Event printer or generate an audible tone.

Urgent

This is the highest priority. Change of state will generate an Urgent priority alarm which will appear on the Alarm Summary. Optionally, the alarm may be printed on the Alarm/Event printer or generate an audible tone.

Within each of the four alarm types there shall be 15 sub-priorities available.

It shall be possible to configure a time such that if a low priority alarm is not acknowledged within this time then the alarm's priority is elevated to high priority and if a high priority alarm is not acknowledged within a configured time, its priority is elevated to urgent priority.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

It shall be possible to associate additional messages to be logged into a message summary in the event of an alarm condition.

When an alarm is acknowledged, it shall be possible to automatically issue a reset to a controller to indicate the alarm is acknowledged and to attempt to reset the alarm point.

Alarm Annunciation

Alarms shall be annunciated by:

Most recent, highest priority alarm message appearing on dedicated alarm line on operator interface.

Alarm message appearing on alarm summary display.

Available Tone - based on a "*.wav" file for each alarm priority

Alarm message printed on the alarm printer

Alarm indicator flashing on the operator interface

Alarms shall be annunciated at the station even if there is no operator currently signed-on. This feature shall be available on network connected Operator Stations as long as the computer running the Operator Station software remains logically connected to the network. If the Operator Station is minimized in the Windows environment, then the Operator Station icon will indicate an alarm. An audible tone shall be able to be generated and this tone shall be specified by a "*.wav" file for each alarm priority.

Points shall be annunciated whilst in alarm. If a point is set to alarm inhibited the point shall no longer cause annunciation. If a point goes into an alarm state whilst inhibited and then is still in the alarm state when the point is set to alarm enabled, the point shall immediately cause annunciation.

Dedicated Alarm Line and Alarm Indicator

A dedicated alarm line shall appear on all displays showing either the most recent or oldest (configurable), highest priority, unacknowledged alarm in the system. The line shall be clear when there are no unacknowledged alarms for the operator to process.

On occurrence of an alarm, the graphic display shall output the point identification, point type, and description on a dedicated line. If multiple alarm/change of state conditions occur, subsequent messages shall overwrite the display if they are higher priority. As subsequent alarms are displayed, the previous alarm information shall move to an unacknowledged alarm list awaiting acknowledgement by the operator.

An alarm indicator shall also appear on all displays. This indicator will flash red when there are any unacknowledged alarms pending in the system. This indicator will remain solid red if there are alarms which have not returned to normal but which have all been acknowledged. The indicator will be clear if there are no points in an alarm condition awaiting acknowledgement in the system.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Alarm Logging

As well as being logged on the printer, alarms shall be logged to an event file for future retrieval in alarm reports or archived to removable media.

Alarm Response Function Keys

The following dedicated function keys shall be provided on the keyboard for alarm action:

ACKNOWLEDGE: After moving the cursor to the point in alarm on the screen and selecting the point the operator shall be able to acknowledge an alarm by pressing this key. This action shall be logged in the event file and on the printer showing the operator ID with the message.

ALARM SUMMARY : By pressing this key at any time the operator shall be able to view a display showing all currently active alarms. The alarm messages shall be color coded showing priorities. The operator shall be able to view the alarms according to priority. It shall be possible to acknowledge alarms from this display and also go to the associated display defined for the point.

ASSOCIATED DISPLAY: After moving the cursor to the point in alarm on the screen and selecting the point the operator shall be able to bring up the display applicable to that alarm by pressing this key. Just selecting the associated display key directly will bring up the associated display for the point currently on the alarm line.

Advanced alarm management

The FMS shall be capable of advanced alarm management which includes set stages of alarm handling.

The stages shall be:-

silence alarm condition

acknowledge and action alarm condition

respond to alarm condition by using pre-defined responses

optionally reset alarm

All actions shall be recorded in the event file for retrieval and auditing purposes.

When an alarm is silenced, an instruction page for the alarm will be displayed. The alarm may then be acknowledged from this page and actioned.

Once the alarm is acknowledged and appropriate action has been taken, the operator may move to the response page to select from up to 100 user defined responses to be logged in the event file. At the same time the alarm is removed from the alarm file.

It shall be possible to enable/disable this feature on a point by point basis given the appropriate system privilege level.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Report Management

The FMS shall be capable of providing selected data in an ODBC format for the purpose of extracting data and creating custom reports. It shall be possible to access tables of data from the FMS through an ODBC compliant tool such as Crystal Reports.

It shall also be possible to incorporate the activation of custom reports created through the Crystal Reports tool through the standard FMS report subsystem. Example reports shall be provided to illustrate how to access the ODBC data in the FMS.

Reports shall be produced periodically, on demand or initiated by an event. The report detail display shall allow naming of reports, scheduling information and the destination of the report. The report destination shall be a printer, operator interface or internal file. The report output format shall be HTML (Hypertext Markup Language) or can be saved in Microsoft Word or RTF format.

The following report types shall be provided:

Alarm/Event Report

A report shall be provided to produce a summary of all events of a specified type for points occurring in a time period. The time period may be specified as an absolute start and end date and time, or as a period relative to the current time. This report shall also be able to produce a summary of all changes made by a specific operator.

Point Cross Reference Report

A report shall be provided to list information about a nominated point or group of points such as what other reports this point may be referenced in, what displays this point is included on and other related information.

Point Attribute Report

A report shall be provided to list all points specified by one of the following attribute criteria:

Out-of-service

Alarm suppressed

Abnormal input levels

In Manual mode

Nominated state

Point Change report

A report shall be provided which calculates the total number of changes of state (including none) for specified points over a given time period. The time period may be specified as an absolute start and end date and time, or as a period relative to the current time.

Alarm Duration Report

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

A report shall be provided which calculates the total amount of time a nominated point or group of points has been in an alarm condition over a given time period. The time period may be specified as an absolute start and end date and time, or as a period relative to the current time.

FIRE CONTROLLER REPORT

It shall be possible to take out reports (in HTML Format) on status of field devices (smoke detectors, Modules etc.) connected to Fire Controller based on the following criteria's (AND/OR):

Bus

Controller

Loop

Point Number

Point ID

States of field device (Normal, Pre alarm , Alarm ,Lockout , Disabled , Typemismatch, Trouble, No Response.)

Analog Value of the smoke detector.

For example:

- (1) It shall be possible to take out a report of all the smoke detectors and modules which are in trouble state in Loop 1 of Fire Controller 1.-- this report shall serve as maintenance report for Maintenance dept.
- (2) It shall also be possible to take out a report of the smoke detectors which have analog value between 70 % to 80 % in all fire controller or for individual fire controller or individual loops.

Historical Data Collection

The FMS may continuously collect and store analog and status point process variables (PV) such as historical data. The basic FMS shall contain fast, standard and extended history. Standard history consists of a value snapshot taken at a specified interval and various averages of this snapshot representing the average value over longer periods of time. Extended history is a series of snapshots.

Standard History

1-minute snapshots

6-minute averages

1-hour averages

8-hour averages

24-hour averages

Extended History

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

1-hour snapshots

8-hour snapshots

24-hour snapshots

Fast History

5 second snapshots.

The historical data can be retrieved by trend sets, operating groups, user built schematics, point detail trends, and point detail numeric history displays. Historical data can also be used in reports, application programs, or archived to off-line media for long term storage.

An operator may review history either in real-time or with an historical offset. Previous history may be selected by scrolling forwards and backwards through the history file.

Trend set displays shall be available to show historical data in the following formats:

- Single Showing plotted historical values for one point
- Dual Showing plotted historical values for up to 2 points
- Triple Showing plotted historical values for up to 3 points
- Multi Showing plotted historical values for up to 8 points
- Numeric Showing numeric historical values for up to 8 points
- X-Y Showing a graphical comparison between 2 points

For each trend set display it shall be possible for operators to configure the number of historical samples and ranges displayed. Points configured in trend sets shall be changeable online.

Operators shall be able to zoom in on information displayed on trend sets for closer inspection. Scroll bars shall be available to move the Trend set backwards and forwards across the historical records. The trend sets shall automatically access archived history files without operator configuration.

FIRE Control System

General It shall be possible to completely monitor and control fire devices for the Fire Control System from the Operator Stations. Full color displays shall be provided allowing operator to monitor the devices.

For each field device on the system the following information shall be displayed on a device detail display:

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

State of the device (for example for smoke detector : Normal , Pre alarm, Alarm, lockout, Trouble, No Response , Type Mismatch, Disabled)

Area code

Full name

Address

Alarm priority

Unless stated, the information above shall be configurable by an operator with appropriate security levels from the point detail display.

GRAPHIC DISPLAY

The Graphic Display on the operator station shall consist of following:

Smoke Detector's located on the layout

Current Analog Values of the smoke detectors

The dynamic state of the detector/modules represented by different Colours depending on the present state of the detector/module.

Movement of Mouse over the detectors/module shall indicate the point ID of the Detector/module in the message zone.

Combo-box for activating hooters/sounders manually by the authorized operator. The software shall reconfirm before activating hooters/sounders from the operator by way of user configured popup message.

The minimum proposed configuration of the Operator work station will be as under:

a.	Operator work station with PC having Intel Pentium Core i7Processor including Serial ports (RS232) and USB ports and following accessories etc. complete with software all as specified.
b.	2 Gigabytes of RAM memory
c.	500 Gigabytes of hard disk space
d.	DVD ROM
e.	21" LED colour monitor
f.	Mouse with Mouse Pad
g.	Standard Key Board
h.	Windows 8 and above Operating System
i.	Compatible Fire Alarm System Control Software
j.	Laser Printer- 1 No

Conductors

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

All cables used shall be as per makes in the tender documents. MS conduits shall be painted red to differentiate from other electrical conduits.

Wiring

The detectors in the vicinity will be looped by 2 x 1.5 sq.mm. cable as specified in Bill of Quantities. Each loop will be connected directly to the Fire Alarm Control Panel.

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No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

VIII) LIFT WORKS MACHINE ROOM LESS ELEVATORS

GENERAL AND TECHNICAL CONDITIONS

1.0 SCOPE OF WORK

These specifications cover the details of Electrical Elevator equipment to be supplied, inspection as may be necessary before dispatch, delivery at site, installation, testing, commissioning, handing over in working condition and defects liability for a period of 1 year after completion of all works.

These specifications shall be read in conjunction with the General Conditions of Contract with all correction slips as well as schedules and drawings.

2.0 GENERAL

The equipment and installation covered by these specifications and drawings shall conform to codes of practice and highest standards of workmanship and materials. This work shall be done in accordance with the provisions of the Lifts Act, and subsequent provisions, as also any state or local Act in force and latest Indian Standard 14665, 15330.

The Electrical wiring shall strictly comply with IS:732 and the entire installation shall be in accordance with the Indian Electricity Act 2003 and Indian Electricity Rules 1956 as amended to-date. The electrical works shall also conform to CPWD General Specifications for Electrical works Part - I (Internal) 2013, Part – II (External) 1994, General Specification for Electrical Works (Part-III-Lifts & Escalators) 2003 as amended up to date wherever relevant.

The Contractor shall follow all statutory requirements as well as best trade practices in the manufacture & installation of elevators. The Contractor shall arrange to obtain the approval of the Inspectorate of Lifts for commissioning of the Elevators and handover for operation after satisfactory tests.

3.0 DRAWINGS

Before commencing work, the Contractor shall prepare and submit all drawings necessary to show the general arrangement and details of elevator installation. These drawings must be approved by the Engineer-In-Charge before installation and shall become part of the contract.

The Contractor shall submit 3 copies of all working drawings showing hoist way and machine room layouts clearly indicating and specifying all connected structural, electrical and architectural works including imposed structural static / dynamic loads and electrical ratings. Within 10 days of receipt of letter of Commencement of Works the Contractor shall obtain from the Engineer-In-Charge all the information he needs to prepare his drawings and shall have any interaction with the Engineer-In-Charge to finalize all parameters and data for design. The Contractor shall be held responsible for any discrepancies, errors and omissions in

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

the drawings or particulars submitted by him even if these have been approved by the Engineer-In-Charge. On approval of these drawings by the Engineer-In-Charge (within 2 weeks of submission of full documentation), the Contractor shall submit five copies of approved working drawings incorporating corrections / comments, if any made by the Engineer-In-Charge, and shall immediately commence work.

On completion of work the Contractor shall supply four sets of CD's and four copies of the detailed wiring diagram, as fitted drawings and equipment maintenance manuals. Further, a copy of such detailed diagram shall be framed and installed in the respective machine rooms by the Contractor.

The Contractor shall carry out all the work strictly in accordance with drawings, details and instructions of the Engineer-in-Charge.

4.0 DEFECT LIABILITY PERIOD

The lift shall be 3 years defect liability period from the date of completion and handed over to the department. The contractor shall supply the guarantee/ warranty certificate to the department for the period of 3 years from the original Lift Manufacturer.

5.0 SOUND REDUCTION

The Elevator Contractor shall provide necessary sound reduction materials, such as rubber pads of suitable density to effectively isolate the machine from the machine beams and/or flooring.

Noise level inside cars and in the machine room shall be maintained at minimum levels and in any case not more than specified under PERFORMANCE PARAMETERS.

6.0 TRACTION MACHINE AND DRIVE

The tranction machine shall be Gearless type. The motor shall be controlled by a variable voltage variable frequency (V.V.V.F.) micro-processor control system which shall control and monitor every aspect of elevator operation at all stages of the car motion cycle on real time basis.

The A.C. V.V.V.F. drive system shall control A.C. voltage and frequency concurrently with the hoist motor to regulate the elevator's actual performance to match closely the ideal speed pattern to obtain maximum efficiency of operation and provide a very smooth ride.

Frequency shall range fully between zero and rated value.

The Controller shall be provided with a self diagnostic programme to keep downtime to a minimum possible.

The controller shall intelligently adjust door times in response to car calls, hall calls and "Door Open" button operation.

An Inspector's changeover switch and set of test buttons shall be provided in the controller. Operation of the Inspector's changeover switch shall make both the car

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

and landing buttons inoperative and permit the elevator to be operated in either direction from machine room for test purposes by pressing corresponding test buttons in the controller. It shall not however interfere with the emergency stop switches inside the car or on the top of the car.

7.0 SAFETY

In the addition to other specifications the Elevator shall be provided with safety devices as follows:-

- i. Safety gear on car so that in the event of rope breaking or loosening the car will be brought to rest immediately by means of grips on the guides.
- ii. The overspeeding car shall be automatically brought to a gradual stop on guide rails and power supply to the hoist motor shall be switched off.
- iii. Car gate lock so that in the event of car gate gets opened when passengers are in the car, the elevator shall be brought to rest.

8.0 CAR

i. Cabin Size

The internal **clear** dimensions of the cabin shall not be less than those specified in IS 14665-Part I and as per CPWD specifications.

ii. Car Display Panel

The Car Display panel shall be of LCD. This shall indicate the Car capacity, floor indication, direction of travel, current time and date at the minimum.

iii. Frame and Safety Device

The car frame shall consist of steel channel top and bottom securely riveted or bolted and substantially reinforced and braced so as to relieve the car enclosure of all strains when the safety device comes into action due to overspeed or when the capacity loaded car is run on the buffer springs at normal speed.

The safety device mounted on the bottom members of the frame operated by a centrifugal speed governor shall be arranged to bring the car to a gradual stop on the guide rails in the event of excessive descending speed; and provision shall be made to shut off the power supply to the motor.

iv. Doors

Provision shall be made for vertical and horizontal fine adjustment of doors.

v. Door Operators

The door operators shall be VVVF inverter controlled heavy duty A. C. motor, allowing variable opening and closing speeds, and with full synchronization of car and landing doors.

vi. Emergency Lighting

Emergency lighting with battery backup shall be provided.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

vii. Evacuation

An emergency key shall be provided on each landing to unlock the doors for evacuation and maintenance.

The doors shall be capable of being opened manually during power failure from inside the car when the car is within a landing zone.

viii. Intercom

The intercom system in the lifts shall be capable of two way communication between the lifts and the reception.

Necessary arrangements shall be provided for communication between the lift cars, respective machine room, Fire Control Room, Reception and the room of the Facility Manager.

The main control for the EPBX / Intercom shall be placed at Fire control room.

The intercom system shall be provided with a power backup of at least 30 minutes.

ix. Manual Cranking Facility

Manual cranking facility shall be provided in the machine room to facilitate evacuation of passengers in case of power failure. The manual mode shall be in addition to automatic car failure operation specified elsewhere.

x. Emergency Stop Switch

A stop switch in the machine room / top of car shall be provided for use by maintenance crew to cancel all car and landing calls for a particular elevator.

xi. Maintenance Switch

On operation of the maintenance switch located on top of the car by the maintenance crew, the car shall travel at slow speed not exceeding 0.85 m / sec by continuous operation of a button

xii. Overload Indicator

An overload indicator with buzzer shall be provided in the cabin to indicate to the passengers that the car will not start as it is overloaded.

xiii. Operating Panels, Buttons & Switches

Car operating panels, buttons and switches shall be located on the front wall panel next to the car door and as specified.

All buttons and switches shall be clearly legible with fade-proof text and figures, and shall be easily accessible, especially for disabled persons.

xiv. Other Features

All features specified in the Schedule shall be provided.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

9.0 PAINTING

All exposed metal work furnished in these specification, except as otherwise specified shall be given one shop coat of anti-corrosive primer after approved surface treatment of metal surfaces and two coats of approved enamel paint of approved shade.

10.0 TESTS AT SITE

The following tests, in addition to those mentioned in the CPWD specifications, shall be carried out to the satisfaction of the Engineer-In-Charge.

- i. The car shall be loaded until the weight on the rope is twice the combined weight of the car and the specified load. The load must be carried on for about 30 minutes, without any sign of weakness, temporary set or permanent elongation of the suspension rope strands.
- ii. The following items shall be tested :
 - a. No load current and voltage readings both on 'Up' and 'Down' Circuits.
 - b. Full load current and voltage readings both on 'Up' and 'Down' Circuits.
 - c. One and quarter load current and voltage readings both on 'Up' and 'Down' Circuits.
 - d. Stalling current and voltage and time taken to operate overload.
 - e. Overload protection.
 - f. Car and counterweight buffers with contract load and contract speed.
 - g. Manual operation of elevator at mid-way travel.
 - h. Emergency operation.
- i. Tests on completion shall also be performed to the satisfaction of Inspector of Lifts.

11.0 STATUTORY APPROVALS

All statutory approvals from commencement to commissioning of elevators shall be obtained by the Contractor from the Inspector of Lifts, Chief Fire Officer and other authorities. However the Department shall provide all necessary assistance for providing documents, drawings and certificates pertaining to other contractors, as may be required. The Department shall reimburse the statutory fees paid in connection with the approval of installation of elevators.

12.0 ADDITIONAL FEATURES REQUIRED

i. Fireman's Switch

A fireman's toggle switch shall be provided in a break glass for the specified elevator at ground floor to enable firemen to bring the elevator non-stop to ground floor from any location and to cancel hall calls until the car is operated on attendant control.

ii. Emergency Power Operation

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

The power supplies to lifts are provided from essential panel (with standby Genset).

In addition to the standby generator power, a backup UPS system shall be provided to supply power to light fixtures, fan, alarm and intercom.

iii. Anti - Nuisance

If number of calls registered is in excess of corresponding car load, all car calls shall be cancelled.

iv. Home Landing Facility

A car shall return to a pre-determined landing after the last call is answered.

v. Load Non stop

When the car load exceeds a predetermined limit the elevator shall not respond to hall calls.

vi. Separate door times

When a car responds only to hall calls or only to car calls, the door shall open for a shorter time than when responding to both car and hall calls.

vii. 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.

viii. Nudging Door Operation

When the doors remain open for more than a predetermined period a buzzer shall sound and the door shall close automatically. The door sensing device shall be rendered inoperative but the Door Open button and the safety shoe shall remain operative.

ix. 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.

x. 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.

xi. Selective floor Service

Programming for selective floors services shall be software driven.

xii. Auto Fan Off

In case no calls are registered for pre-set time, the cabin fan shall be automatically switched off.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

xiii. Automatic Rescue Device

In case of mains power failure and elevator control system failure, the elevator's own rechargeable and maintenance free battery power shall move the car to the nearest floor and the door shall open automatically for automatic rescue of passengers. A battery run-down indicator shall be provided.

Automatic Rescue Device shall be provided for all the Elevators.

xiv. Bank Separation Operation

Hall buttons & cars called by each button can be divided into several groups for independent group control operation to serve special needs or different floors.

xv. Next landing

If the elevator door do not open fully at a destination floor, the doors close & the car automatically moves to the next or nearest landing floor where the doors will open.

xvi. Safe Landing

If a car has stopped between the floors due to some equipment malfunction, the controller checks the abuse and if it is considered safe to move the car, the car will move to the nearest floor at a low speed and the doors will open.

xvii. Fireman Emergency Operation

Fireman Emergency Operation shall be provided for Elevators.

xviii. False Call Cancellation

If the number of registered car calls does not correspond to car load, all calls are cancelled to avoid unnecessary stops. If the wrong call button is pressed, it can be cancelled by quickly pressing the same button again twice.

xix. Flashing Hall Lantern

A hall lantern which corresponds to a car's service direction, flashes to indicate that the car will soon arrive.

13.0 Additional features of Elevators for Disabled Persons

1. The Elevator shall be provided with following features:

- a) Elevator control buttons at locations and height specified in IS 15330 - 2003
- b) Hall call buttons at locations and height specified in IS 15330 - 2003
- c) Hand rails shall be provided on the side walls of the Elevator at height & locations specified in IS:15330 - 2003. An international symbol of access of the disabled shall be permanently and conspicuously displayed at Elevator landing next to the Elevator entrance. Braille notations indicating the floor

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

levels shall be incorporated next to each button at the handicap COP and handicap hall call buttons.

- d) A digital voice system for announcing the car position, opening/closing of doors, direction of travel and messages shall be provided as per IS:15330 – 2003
- e) A laminated safety glass type mirror of at least half of the size shall be installed on rear panel at appropriate position as per IS : 15330 – 2003

14.0 TESTING OF LIFT INSTALLATION

TESTS AT SITE:

a) Leveling Test:

Accuracy of the floor leveling shall be tested with the lift empty, fully loaded. The lift shall be 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. In each case there shall not be any appreciable difference in these measurements for leveling at the floors when the car is empty and when it is fully loaded. 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 afterwards for signs of permanent distortion.

Counterweight safety gear should be tripped by the counterweight governor and the stopping distance noted. In this case, however 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) should 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 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. Chalk mark on the sheave or drum

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

and a stop switch 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) Lift Balance:

After the above test, some of the weight shall be removed until the remaining weights represent the figures specified by the tenderer. With this condition car at half way travel the effort required to move the lift car in either direction with the help of winding wheel shall be as nearly as can be judge by the same.

e) 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.

f) Controllers:

The operation of the contactors and interlocks shall be examined and it shall be ascertained whether all requirements laid down in the specifications have been met.

g) 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 over travels can be ascertained.

h) 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.

i) Insulation Resistance:

This shall be measured (after removing the electronic PCB's 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.

j) Earthing:

All conduits, switches, casing and similar metal work shall have earthing continuity.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

k) Ropes:

The size, number construction and fastenings of the ropes should be carefully examined and recorded.

l) 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.

Tests at Manufacturer's Works:**a) High Voltage Test:**

The dielectric or electric apparatus (excluding motors, generators and instruments which are tested in accordance with the appropriate Indian Standards wherever they exist) shall be capable of withstanding a test voltage of ten times the working voltage with a maximum of 2000 Volts when applied.

- i) between the live parts and case of frame with all circuits completed.
- ii) between main terminals or equivalent parts with all circuits open, and
- iii) between the lift parts of independent circuits.

Note : Owing to the impracticability of applying tests (ii), (iii) mentioned above on controllers and similar apparatus after controller wiring has been completed, these tests may be made at convenient stages of manufacturer.

b) i) Method of Applying High Voltage:

The test shall be made with alternating voltage of any convenient frequency, preferably between 49 to 60 cycles per second. The test voltage shall be approximately sine-wave form and during the application of voltage with peak value, as would be determined by spark gap by oscillograph or by any other approved method shall not be more than 1.45 times the rms value. The rms values of the applied voltage shall be measured by means of a volt meter used with a suitably calibrated potential transformer or by means of voltmeter used in connection with a special calibrated voltmeter winding or testing transformer by any other suitable voltmeter connected to the output side of the testing transformer.

ii) Duration of High Voltage Test:

The test shall be commenced at a voltage of about one third of the test voltage which shall be increased to the full test voltage as rapidly as is consistent with the value being indicated by the measuring instrument. The full test voltage shall be maintained for one minute. At the end of this period, the test voltage shall be rapidly diminished to one third of its full value before switching off.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

The oil buffers are examined after the above tests have been made to determine if there has been any oil leakage or distortion and to ensure that the buffers return to their normal positions.

c) Buffer Test:

A copy of the test report shall be intimated after testing at works.

Performance Test:

This test is meant for passenger lifts and is conducted to watch the performance of lift installation in terms of passenger handling capacity and waiting interval as obtained at site vis-à-vis design, data and conducted as below :

i) Waiting interval : (T)- This can be worked out by taking the average of several round trip times as observed physically and then dividing it by the number of lifts in that bank.

$$\text{ii) Handling capacity } H = \frac{300 \times Q \times 100}{T \times P}$$

Where

H = Handling capacity as the percentage of the peak population handled during 5 minutes.

P = Total population to be handled during peak morning/ evening period. (It is related to the area for which particular bank of lifts serves).

Q = Average number of passenger carried in a car.

T = Waiting interval.

iii) Service Temperature Test :

A continuous run of one hour should be made with number of starts and stops to reproduce as nearly as practical the anticipated duty in service. (The standard duty cycle is for 90 to 180 start per hour). It is very difficult in practice to carry out this test with alternate starts at full load and no load and it is necessary therefore to simulate these cycles. A suitable test for all motors except squirrel cage motors is to run the car up from the bottom landing with contract load and stop at each floor. From the top floor a non stop run is made to the lowest floor and the upward journey with stop is then repeated. The time intervals between stops and starts at the floors should be uniform and such as to give about 180 starts in one hour. At the end of this run the temperatures of the armatures and fields of the motor and generator are recorded. The temperature rise should, be within prescribed limit.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

15.0 **PERFORMANCE PARAMETERS**

The following parameters shall be achieved in the installation:

Levelling Accuracy : + 3 mm

All other parameters as per CPWD Specifications and IS shall be achieved.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

AE-I
(EPD-4)

EE
(EPD-4)

AE (P)
(CPM (Housing))

EE(P)
(CPM (Housing))

IX) SUBSTATION EQUIPMENTS & RISING MAINS

1.0 MAIN L.T. PANELS

- APPLICABLE CODES & STANDARDS

The design, manufacturing process and performance of the MV panel boards and all the equipment & instruments incorporated in the same shall comply with the latest Indian Standards issued by B.I.S. as follows :

BRIEF DESCRIPTION	REFERENCE STAND
Switch gear General Requirements	IS : 13947-1993
Factory Built Assemblies of Switch gear and Control gear and busbar trunking	IS : 8623 (Part I & Part II)
Miniature Circuit Breaker	IS : 8828
HRC Cartridge fuse	IS : 9224 (Part 2)
Current Transformers	IS : 2705
Indicating Instruments	IS : 1248
Busbar Connections and Accessories	IS : 5578, 11353
Code of Practice for Phosphating Iron & Steel	IS : 6005
PVC insulated wires	IS : 694

Note: The above are minimum standards expected. The technical specifications to follow and those given in schedule of quantities, if found to be more stringent as compared to those listed above, then the more stringent specifications shall prevail.

CONSTRUCTIONAL FEATURES

The MV Panel shall be modular in design. There shall be welding only in the main frame of the panel. The frame shall be assembled with bolts and nuts. The frame shall be assembled with Mild Steel tripod for three-dimensional flexibility in design configuration. The profiles used in the assembly of the panel shall be restricted to

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

only two designs. Each profile should have holes of standard size punched at standard pitch throughout the length of the profile. This facilitates the joining of vertical and horizontal members with three dimensional joiners of Mild Steel. The joining of these members shall be dust and vermin proof and for this Neoprene Rubber is to be used.

Doors shall be with concealed hinges and flush type locks. The doors shall be reversible in design from LHS to RHS and vice-versa. All doors shall be earthed to the profile by a yellow green 2.5 Sq. mm. wire lugged at both ends. Doors that are bolted for busbar chambers should be flush in design such that the bolt head and the door surface are in one level. Each bolt shall have plastic washers on the other side of the door such that the bolt will remain with the door on removal of the door.

All switchgears shall be mounted on clamps and fixtures such that there shall be flexibility for adjustments in X & Y axis. All partitions shall be made out of CRCA sheets. These partitions shall not be used for load bearing of switchgears. The profiles and doors shall be of 2 mm thick CRCA sheet and powder coated to RAL 7032. The partitions shall be of 1.6 mm CRCA sheet as specified above.

Modular type MV Panel to assemble low voltage switchgear and copper busbar arrangement. The switch handle shall be interlocked such that the door of enclosure cannot be opened unless the switch is in OFF position, however, mechanical interlock defeat mechanism has to be provided. All MCCB's / Switches only operating knob / handle shall only be visible other portion should be covered by suitable sheet. All rear doors shall be of hinged type with locking arrangement.

Detachable bottom plates shall be provided at the cable compartments and terminal chamber. Liberal space shall be provided in the cable compartment as well as switch compartment to facilitate termination of cables. Provision shall be made for clamping the cables in the cable compartment.

The panel shall have easily-removable and interchangeable sections. All service shall be capable of being performed with access from the front plus and a choice of any one side or rear for installation flexibility. A tool shall be required to remove the exterior panels, which access the hazardous voltage area of the unit. To ensure grounding integrity and for static protection and EMI/RFI shielding, the removable exterior panels shall be grounded to the frame by way of stranded copper wire. Hinged doors shall provide access to the main input circuit breaker, and to all output switchgears.

The unit shall be naturally convection-cooled. No fans for forced-air cooling system shall be used. The convection cooling method shall allow continuous full-load operation without activation of over-temperature circuits. Copper bus bars, sized in accordance with the NEC shall withstand 900C minimum. Both for reliability and Heat rejection shall be through screened protective sides, which prohibits entry of foreign material.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

The busbar sizes should not be less than 120% of the rated current in amps & it should be so selected that the temperature should not rise 50 C above ambient. Copper busbar shall be supported with high quality non-hygroscopic insulating material. Separate busbar compartment provided on the sides housing three phase and neutral busbar should have front bolted cover, side busbar chamber shall have standardized dimension of 300 mm. The rating of the neutral busbar shall be 100% of that of phase busbar wherever required. The busbar shall be of electrolytic grade Copper.

Power terminal blocks or bus-bar or bus-bar extensions shall be provided for each input and output feeders as per the switchgear rating and a parity-sized insulated ground conductor. All the outputs of 63A TPN & below shall be terminated to a Busbar type terminal connector at the rear side of the panel using C-rail. All the live parts of the terminations shall be provided with shrouding by transparent perplex sheet of not less than 4 mm thick. A separate housing for the Power Capacitor inside the panel shall be made. The accessories for proper fixing of the CT's shall be provided.

The frame shall be configured to accept future field augmentation of additional cubicle sections.

The panel shall be supplied along with base plinth of 100 mm. height for each modular section and shall be made of C – channel forming sectional 'Box'.

The panel shall be powder coated with mat finish. The colour of the panel shall be siemens grey (color code IS:952) and block color to the plinth.

AIR CIRCUIT BREAKERS (A.C.B.)

1. The ACBs shall comprise single units of four pole construction as per the single line diagram, having a rupturing capacity of 50kA at 415V AC for 1 second and shall be provided with door interlock.
2. The ACB shall be type tested & certified for compliance to IS13947 from Indian testing authorities – CPRI, ERDA
3. For all ratings, the ACB shall have uniform panel cut-out, preferably on left or right side of the panel for allowing maximum utilization of panel space.
4. It shall be possible to accommodate breakers up to 1600A rating in 400mm panel. The breakers shall have uniform height & depth for all the required ratings.
5. For safety of users, interlock should be provided between breaker operating mechanism & the arc chutes to prevent closing in case the arc chutes are not properly secured.
6. Draw out breakers should not close unless in distinct Service/Test/Isolated positions.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

7. All current carrying parts shall be silver plated.
8. For ease of maintenance, it should preferably be possible to replace jaw contacts & cradle terminals without disturbing the busbar links.
9. It should be possible to know the control voltage ratings for all electrical accessories without opening the panel door.
10. Circuit breaker should provide an electrical indication when all pre-requisites for closing the breaker are fulfilled.
11. A padlocking arrangement shall be provided to prevent unauthorized racking operation.
12. An interlock should be provided to prevent racking operation with panel door open.
13. It should not be possible to rack out the breaker, unless a persistent OFF command is maintained.
14. It shall not be possible to commence racking operation, with breaker ON. Additionally, it should not be possible to close the breaker during racking operation, even by a remote closing command.
15. For Draw-out breakers, an arrangement shall be provided to prevent rating mismatch between breaker and cradle.
16. The ACBs shall be CE marked.
17. The insulation material used shall conform to Glow wire test as per IEC 60695.
18. It should be possible to lock the breaker in OFF condition, by way of a key interlock.
19. The breaker as supplied should meet IP53 protection.
20. The breaker should be able to accommodate Aluminium termination as specified in IS13947 – Part 2. Any accessories required to achieve the same shall be considered in the watt-loss data specified by the manufacturer.
21. Any changes in the busbar & dropper orientation/layout in the panel shall not call for any rework on the cradle/breaker.
22. Withstand capacity shall not be lower than Icu, at least for the maximum short-time delay setting provided on the protection releases.
23. It should be possible to convert a manually spring charged breaker to motorized spring charged breaker, on site.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

24. The opening time for ACB shall not exceed 40 millisecond at any current level.
25. The ACB shall provide electrical and mechanical anti-pumping.
26. Remote tripping device (Shunt release) should be able to trip the ACB, even at voltages as low as 10%.
27. Under Voltage and closing releases should not consume power in latched condition (when not required to operate the breaker).
28. Inspection of main contacts should be possible without using any tools. The breaker shall be provided with mechanical contact wear indicator.
29. Every control connection should be uniquely identified for standardization and electrical interchangeability at site.
30. It should be possible to access racking handle & carry out setting of the release from the front & without opening the panel door.

Protection Release

1. The breaker should be equipped with micro-controller based release, offering overload, short circuit and earth fault protection with settable time delays for all protections.
2. The release should be able to communicate on MODBUS RTU protocol using RS485 port.
3. The release shall be equipped with thermal memory and Users should be able to selectively enable the feature.
4. The release should provide local LED indication for identification of type of fault, without requiring using external power supply. The fault indication should be available for a period of at least 60 hours, after tripping in the absence of main supply or battery back-up.
5. The release should provide separate electrical fault indication.
6. Critical functions like Earth Fault and Zone Selective Interlocking should be in-built and should not be provided through add-on devices.
7. The release should provide local indication of actual %age loading at any instant.
8. The release should be able to provide protection for 50% and 100% Neutral rating.
9. On-Line change of settings should be possible.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

10. It should be possible to carry out testing of release without tripping the breaker.
11. The release shall meet the EMI / EMC requirements

- **LOAD MANAGER**

The load manager shall be of 3 phase, 4 wire type and shall provide true RMS measurements of following parameters :

- Voltage – Line to Line & Average, Line to Neutral & Average, Neutral to Earth
- Current – Phase currents & Average, Neutral current
- Phase angles of V_r , V_y , V_b , I_r , I_y , I_b
- All parameters of Power for each Phase and Total
- All parameters of Energy – kVAh, kWh, kVARh
- Frequency of Supply

They shall be complete with the following functions :

- History log of Hi-lo profile with minimum 4 peaks and minimum 4 lows for Voltage, Current, Frequency, Power factor and all other parameters of power with Day, Date and Time of Occurrence.
- Shall have RS-485 Communication port.

MOULDED CASE CIRCUIT BREAKERS

The MCCBs shall comprise single units of triple pole/four pole construction as specified, shall be rated for 415 V AC.

All live parts shall be totally enclosed and shrouded with a heat resistant moulded insulating material housing. Operating mechanism shall be quick make, quick break and trip free type.

The MCCB shall be provided with the following features in microprocessor release:

Inverse-time-current tripping characteristics under sustained overload. Instantaneous tripping on short circuit MCCBs shall be of current limiting type.

The rated service breaking capacity (I_{cs}) shall not be less than the ultimate short circuit breaking capacity (I_{cu}) Variable Thermal setting shall be provided in all MCCBs with thermal magnetic Release.

All circuit breaker below 250 amps rating shall be provided with thermal magnetic release & circuit breakers of 250 amps rating and above shall be provided with Microprocessor based release.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

CURRENT TRANSFORMERS

Current transformers shall be of the Cast Resin Type.

Current transformers shall not be directly mounted on the buses. Current transformers on circuit breaker controlled circuits shall be mounted on the fixed portion of the compartment.

All current transformers shall be earthed through a separate earth link.

INDICATING INSTRUMENTS AND METERS

Digital electrical indicating instruments shall be of minimum 96 mm square size and should have red coloured readout and 1" display height.

CABLE TERMINATIONS

Suitable double compression type, brass cable glands with check nuts, rubber sealing ring and brass washers mounted on a removable gland plate shall be provided to support all cables entering the switchgear. Cable Termination will be measured under separate item in the schedule of quantities.

INTERNAL WIRING

Wiring inside the panel shall be carried out with 660/1100 V grade, single core, PVC insulated, stranded copper conductor wires. Minimum size of conductor for power circuits is 2.5 sq. mm. Not more than two connections shall be made on any one terminal. All internal wiring shall be properly ferruled at the both termination. All control cables shall be terminated with crimping types lugs with colored PVC shrouds and shall have identification labels.

TERMINAL BLOCKS

Terminal blocks shall be of heavy duty and comprising of finely threaded pairs of brass studs of at least 6 mm diameter, links between each pair of studs, washers, nuts and locknuts. The studs shall be securely locked within the mounting base to prevent their turning. Insulated barriers shall be provided between adjacent terminals.

Terminals shall be shrouded. Terminal blocks shall be adequately rated to carry the current of the associated circuit. Minimum rating of the terminal block shall be 10 A.

LABELS

Labels shall be provided for Feeder designation, feeder equipment no, Compartment designation, panel designation main label. All labels shall comprise white letters on a black background and shall be made of non-rusting metal or 3-

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

ply lamicaid or engraved PVC. Size of lettering shall be 6.0 mm. MV Danger Notice Boards shall also be provided.

EARTHING

Panel shall be provided with 2 nos 25 x 5 mm copper earth busbar running along the entire length of the board. At either end of the earth bus, one clamp type terminal with nuts, bolts and washers shall be provided for bolting the earthing conductor.

Earth bus bars shall be supported at suitable intervals. Positive connection between all the frames of equipment mounted in the switchboard and earth busbar shall be provided by using insulated copper wires/bare busbars of cross section equal to that of the bus bar or equal to half the size of circuit load current carrying conductor, whichever is smaller.

All instrument cases shall be connected to the earth busbar using 660 V grade, single core 2.5 sq.mm stranded, copper conductor.

All non-current carrying metal and hinged doors shall be earthed to the earth bar.

TESTS

Panel shall be subjected to following tests as per relevant standards:

- Mechanical operation test.
- Power frequency H. V. test for 1 minute.
- Insulation resistance at 500 V D.C. before/after 1 minute H.V. Test.

DRAWINGS AND DATA

As part of the technical bid, the tenderer shall furnish the following data:

Schedule of Technical Data completely filled in.

Technical literature and catalogues of the equipment being offered.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

TECHNICAL PARTICULARS**FOR MAIN MV PANEL and APFC PANELS**

SNO.	DESCRIPTION	PARTICULARS
1.0	M.V. SWITCHGEAR PANELS	
1.1	Rated Voltage Phases & Frequency	415 V, 3 Ph, 4 wire, 50 Hz
1.2	System Neutral Earthing	Effectively earthed
1.3	One minute power frequency voltage a) Power circuit b) Control circuit c) Aux. Circuits connected to sec. of CTs	2500 V 1500 V 2000 V
1.4	Continuous current rating of busbars under reference ambient temp.	As mentioned in Schedule of Quantities
1.5	Short circuit current	50 KA for 1 sec (Three phase Symm)
1.6	Reference ambient temperature	40 Degree Celsius
1.7	Control supply :	
a.	DC supply for breaker tripping, closing and DC ckt tapped from DC control bus	30 V DC
b.	240VAC control supply for spring motor and panel space heater tapped from 240V AC control bus	240V AC
1.8	Maximum temperature of busbars & droppers and contacts at continuous current rating under site reference ambient temperature.	90 Degree Celsius
1.9	Colour a) Interior b) Exterior	Approved shade and colour
1.10	Moulded case circuit Breakers & A.C.B.s	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

1.11	Rated Breaking Capacity (kA RMS at 415 V @ 0.25 P.F.)	As mentioned in the schedule of quantities
1.12	Releases Required a) Overload b) Short circuit c) Under voltage	As mentioned in the schedule of quantities

2.0 AUTOMATIC POWER FACTOR CORRECTION PANEL

DESIGN & SCOPE OF WORK

The Scope of work covers Design, Manufacture, Supply, Installation, Testing and Commissioning of Automatic Power Factor Correction (APFC) Panel for improvement of power factor of inductive load. The inductive load power factor as assumed of the system shall be improved from 0.7 power factor up to 0.99. The KVAR rating of the capacitor banks shall be as per schedule of quantities. It shall be able to maintain consistent high power factor. It shall be design to prevent leading power factor in the installations during low load conditions and modularity, which allows upgrading of the KVAR rating as and when required.

An automatic power factor (PF) correction relay shall be microprocessor based, with arrangement for sensing the PF of the inductive load and giving signal to the feeders of power capacitors as per the setting of PF and electronic circuit to ensure that once a capacitor gets cut off, it is not put on at least for a minute. The relay should automatically manage capacitor banks according to the reactive power required to correct the PF of the load to the PF set on the relay. The capacitors must be turned “on” and “off” to correct the PF of the load to the PF set on the relay. The relay should have automatic and manual mode of operation with an LED to indicate the operating mode. The auto/ manual function makes it possible to turn the capacitor banks “on” and “off” manually regardless of the line value measured.

operation.
TYPE: Thyristor switching module for smooth and fast switching

APFC PANEL

Particulars of the systems

- i) Operating voltage : 415 volt
- ii) Frequency : 50 Hz
- iii) System : 3 Ph.
- iv) No of wires : 4
- v) Neutral : Solidly earthed

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Fabrication

The power factor control panel shall be factory fabricated from 14 SWG CRCA sheet, totally enclosed, dust tight, vermin proof, indoor, free standing, floor mounting and fully compartmentalized cubicle construction & IP 42 protection class.

Fabrication of Panel including painting etc shall be followed as described in Main LT panel section. However, the design and construction of capacitor bank panel shall generally conform to IS 13300.

Necessary provision towards louvers covered with wire mesh and providing ventilation fan if required to be made. The busbar chamber shall be extensible on both sides. The cable alley shall be provided at the back-side.

The successful contractor shall take prior of G.A. drawing of capacitor control panel before start of fabrication of capacitor control panel.

Busbars

a) Rating of busbars

- ii) No. of busbars : 3 phase & 1 neutral
- iii) Insulating voltage : 1.1KV
- iv) Normal current : as per Design.

b) Construction of busbars

The bus-bars shall be air insulated aluminium conductor enclosed in a sheet steel chamber.

Busbar arrangements shall comply with relevant IS. Busbars connection shall be done with high tensile bolts. Busbar shall be sleeved with heat shrinkable sleeveings of red, yellow and blue colours for phases.

The cross section of busbars shall be suitable for rated current and corrected for an ambient temperature of 55 deg. C. The busbars shall be supported with FRP sheet at regular intervals.

CAPACITOR BANK

The capacitor bank shall generally conform to IS:13341-1992,13340-1993. The capacitor shall be MPP (super heavy duty type) impregnated with polyurethane compound suitable for system voltage and of ISI mark.

The capacitor units shall be indoor type, air-cooled with low viscosity impregnated paper dielectric hermitically sealed. The impregnation used shall be non-inflammable, non-oxidizing, lower freezing point type synthetic compound. Each individual cell shall be provided with pressure sensitive disconnectors / devices.

Main connections from the active element shall be brought out through porcelain bushing. Care shall be taken to solder the bushing to the cover ensure perfect hermetic sealing.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Capacitor units shall be provided with externally mounted discharge resistor to reduce the residual voltage to less than 50 volts in one minute of switching off.

Capacitor banks for each individual module shall be mounted on the back side. Removal and replacement shall be possible from the back of the panel.

Individual unit shall be provided with adequate capacity MCBs / MCCBs / ACBs, Thyristor switching module, bus bars and terminal chambers to make bank of required KVAR. Terminal chamber shall be suitable for bottom/ top cable entry. Two earth terminals shall be provided to each capacitor bank.

The installation is mostly connected with electronic equipments/ devices. Hence capacitor banks with Thyristor switching module should design to correct wave form & correct P.F. as required rapidly.

APFC PANEL COMPONENTS

Switchgears

All switchgears selection shall be at rated current and breaking capacities as per BOQ for capacitor duty and detailed specification given in the MV panel head. All MCCB shall have $I_{cs}=100\%ICU$.

Detuned Filter

- a) Detuned harmonic filter reactors shall be used along with power capacitors to mitigate harmonics amplification and to avoid electrical resonance in LV electrical networks.
- b) The complete unit shall be impregnated under vacuum and over-pressure in impregnation resin. The insulation shall be Class H.
- c) The reactors shall be made of high grade copper windings, having a three phase, iron core construction suitable for indoor use. The reactor are air cooled and the layout shall be in accordance with IEC 60289 / IS 5553.
- d) The permitted tolerance of inductance is $\pm 3\%$ of rated inductance value.
- e) Reactor tuning factor shall be 7 % (189 Hz) and the current rating of the reactor shall include the effects of harmonics and other possible over-currents.
- f) The reactor shall be fitted with a temperature sensitive micro-switch in the centre coil (normally open) for connection to trip circuits in case of high operating temperatures.

Thyristor Switching Module:

- a) Thyristor Switching Module (TSM) is used for dynamic power factor correction, i.e., for correcting power factor whose load fluctuates frequently. TSM should have fast reaction time of 5 ms and can

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

operate without inrush current. Peak Inverse withstand Voltage (PIV) shall not be less than 2200 V.

- b) There shall be two anti-parallel thyristors in each of the two phases and one shall be connected directly to capacitor/reactor.
- c) Quick discharge resistors shall be used for capacitor for faster discharge and hence faster switching. Thyristor module shall be protected by semi-conductor protection fuse (high speed fuse) of suitable rating.
- d) Thyristor module shall be provided with suitable heat sink and shall be without fan. It shall be compact design with all the firing card, thyristors, power supply module and so on in single enclosure.
- e) For ease of maintenance and monitoring, LEDs in the module should indicate the various statuses like Voltage activation, Stand-by mode, under-voltage, phase missing and over-temperature.

APFC Relay

The APFC Relay used in the APFC Panel shall be of Fourteen(14) steps, intelligent Microprocessor based type. The relay shall be flush mounting type and shall be LED / LCD display for indicating the Power factor. Relay shall sense the PF in the system and automatically switch ON/OFF the capacitor unit or stage to achieve the preset target PF.

Instrumentation

All Ammeter & Voltmeter shall be suitable for panel board mounting of size 96 mm X 96 mm in size. Scale range shall meet with the requirements and specified in the schedule of quantities. In the case of CT operated ammeters class of accuracy of CTs and protective class shall be as specified in MV panel specification.

CTs used in the work shall be in conformity with IS. The burden of the CT shall be suitable for the application.

Indication Lamps

The indication lamps used in the work shall be LED type with protection against electromagnetic interference and over voltage. The lamps shall be suitable for operation on 240 Volts. Ingress protection class of the lamp unit shall be IP : 65. The indication lamp unit shall be in conformity with IEC : 947 part 5 section 1. The dia. of the lamp shall be not more than 22mm.

Cable Entry

Terminal chamber shall be suitable for bottom/top cable entry.

EARTHING

The aluminium Earth bar shall be minimum 25X6mm size running the full length of the switch board and bolted to the supporting frame so as to make good electrical contacts. Solid bonding as per code of practice for earthing shall be connected between earth bar and each incoming and outgoing cable

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

armour clamp, gland plate or earth tag washer. Two earth terminals shall be provided to the capacitor bank. The earth terminals provided on the body of capacitor bank shall be bonded to the main capacitor bank earth bus.

OPERATION

Under auto mode the capacitors shall be switched on automatically through Thyristor switching module controlled by automatic sensing relay. In addition, there shall be indicating lamp for ON indication of each bank.

The selection of the Thyristor switching module, switches etc. shall be such that no heating takes place during the course of operation, duty cycle and their ratings shall be suitable for capacitor switching operations. Necessary cooling fan shall be provided for heat sink and general ventilation of APFC panel.

TESTS & INSPECTIONS

Acceptance tests on completed switchboards shall be as follows:

- a) A general visual check shall be carried out. This shall cover measurement of over all dimensions, location, number and type of devices, terminal boxes, location and connection of terminals etc.
- b) Checking of bill of materials as per approved drawing.
- c) Checking of operation of various feeders as per approved schematic drawings.
- d) Operation check shall be carried out for every control function as per schematic drawings by manually simulating fault conditions and operation of control switches/relays etc.
- e) Checking of inter-changeability of identical feeders.
- f) Insulation resistance test and value measurement on power and control circuits before and after high voltage withstand test.
- g) High voltage test on power and control circuit as per IS.
- h) For equipment brought from other suppliers, certified test reports of tests carried out at the manufacturers works shall be submitted. Normally all routine tests as specified in the relevant standards shall be conducted by the sub-supplier at its works and copies of routine test reports shall be furnished.

3.0 H.T. SUBSTATION EQUIPMENTS & ALLIED WORKS

11KV H.T. VACUUM CIRCUIT BREAKER SWITCHBOARD:

This specification covers the technical requirements of three phase, 11kV, front operated VCB switchboard.

Applicable Codes and Standards:

The design, manufacturing and performance of equipment shall be as per current statutory regulations and safety codes in the locality where the equipment will be

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

installed. Nothing in this specification shall be construed to relieve the vendor of this responsibility.

Unless otherwise stated, the H.T. (11 kV) Vacuum Circuit Breaker switchboard shall conform to IS: 13118 (1991) and Indian Electricity Rules and Regulations amended up to date.

CONSTRUCTIONAL FEATURES:

GENERAL

The panel board shall be compact integrated indoor, metal clad, floor mounted, free standing, sheet steel enclosed as per specifications. The panel board shall have compartmentalized design having separate compartment for Breaker, Busbar, Cable & CT, Instrument & relay. Self-threading screws shall not be used in the construction of switchboard. The panel board shall be of totally enclosed design, dust tight and vermin proof and extensible type. The degree of Protection shall be IP4X as per IEC-60529. The equipment when assembled shall form a neat and compact unit and shall be complete with all supporting frame work, mounting channels, foundation bolts etc. and shall be designed so as to ensure complete inter-changeability of components from one panel to another.

Also the panel board shall be:

- a) Provided with a metal steel frame made of structural steel channel section properly drilled for mounting the switch gear along with necessary mounting hardware (hardware shall be zinc plated and passivated);
- b) Provided with gaskets all round the perimeter of removable covers and doors
Provided with Bus Bar of adequate rating.

Provided with Base Channel of ISMC-75

Provided with Four Lifting Lugs for each shipping section.

SHEET METAL WORKS

The panel board shall be made from M.S. sheet steel 2mm thick and shall be folded and braced as necessary to provide a rigid support for all components. All panels and covers shall be properly fitted. All metal works shall be chemically treated with 7-tank process for degreasing, derusting, phosphating and epoxy powder coated for surface treatment before painting.

PAINTING

The panel board shall be painted with epoxy powder coated, of shade approved by Engineer in Charge as per IS: 5 on interior and exterior side.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

INTERLOCKS

Following minimum Interlocks shall be provided

Breaker insertion / withdrawal is possible only when breaker is in “OFF” position.

Breaker closing is prevented in intermediate position between “Service” and “Isolation”.

Door padlocking Facility.

BUSBARS

The busbar shall be made of Electrolytic Copper flats as per IS:1897. The busbar shall be insulated, covered and supported on rigid epoxy support insulators. The bus bar sizes shall be as per Current ratings.

The bus bar shall be provided with the minimum clearances in air as per applicable standards for a 11kV, 3 phase system.

Bus bar shall be adequately supported and braced to withstand the stresses due to the specified short circuit currents.

Separate supports shall be provided for each phase of the bus bars. If a common support is provided for all three phases, anti tracking barriers shall be incorporated.

Bus bar 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.

VACUUM CIRCUIT BREAKER

The Vacuum circuit breaker shall be mounted on a separate carriage arranged for horizontal / vertical isolation and horizontal withdrawal. It shall have motor operated spring charged stored energy mechanism. It shall be possible to put the Vacuum Circuit Breaker in the “Plug-in” condition or withdrawn to the ‘Test’ position.

The circuit breaker shall be provided with the necessary auxiliary contacts for indication, control, and interlocking or other purposes. Excluding the contacts already used for the circuits, four spare sets of contacts with three ‘NO’ and three ‘NC’ shall be left free in each unit.

CURRENT TRANSFORMERS

Current transformers shall be Silica filled epoxy resin insulated.

All current transformers shall be earthed through a separate earth link.

NUMERICAL TYPE RELAYS

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

The Numerical Relays in general shall comply with the following requirements:

The offered relays shall be completely numerical with Protection elements realized using software algorithm Hardware based measurement shall not be acceptable.

All the Relays shall belong to a common platform and shall be of single make.

The relay shall be provided with at least 3 nos. digital inputs and 6 nos. output contacts. The digital inputs and outputs shall be freely configurable.

It shall be possible to energise the relay from either AC or DC auxiliary supply.

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.

2 x 16 digit backlit LCD display unit

4 fixed function LEDs (for trip, Alarm, Relay available & Relay out of service)

At least 4 programmable LEDs

7 key tactile keypad for browsing and setting the relay menu

The relay shall have a front RS232 communication port for connecting to a local PC/Laptop for setting and viewing the data from the relay.

The relays shall have a RS485 rear port for connecting many relay in multidrop fashion to connect to a remote master (SCADA/DCS)

It shall be possible to provide the relay with atleast two standard communication protocols (viz, MODBUS & IEC-870-5-103) in addition to any proprietary protocols.

The relays shall have the following tools for fault diagnostics.

Fault record – The relay shall have the facility to store atleast 5 last fault records with information on cause of trip, date, time, trip values of electrical parameters.

Event record – The relay shall have the facility to store at least 75 sequence of event records with 1ms resolution.

Disturbance records – The relay shall have capacity to store at least 5 disturbance record waveforms with atleast 3s duration each.

The offered relays shall have a battery backed real time clock for providing accurate time reference.

The relay settings shall be provided with adequate password protection.

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 annunciated through a output watchdog

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

contact. The fault diagnosis information shall be displayed on the LCD and also through the communication port.

The Numerical Relays shall be provided with 1 Set of common support software compatible with both Windows 2000 / XP which will allow easy settings of relays in addition to uploading of event, fault, disturbance records and measurements. The relay settings shall also be changed from local or remote using the same software.

INDICATING INSTRUMENTS AND METERS

Digital electrical indicating instruments shall be of minimum 96 mm square size, and with a class of accuracy of 0.5 and should have approved color readout. The height of digital display shall be 1".

CABLE TERMINATIONS

HT TERMINATIONS

Indoor type Heat Shrinkable Kit shall be used for HT termination. It shall be suitable for 11 kV (E), 3 core x 240 sq. mm Aluminium conductor, XLPE insulated, PVC sheathed cable.

INTERNAL WIRING

All wiring shall be done with 600/1100 V Grade single core, PVC insulated multi stranded copper conductor wires. Minimum size of conductor for power circuits is 2.5 sq. mm. Not more than two connections shall be made on any one terminal. The connections shall be properly crimped and shall have identification labels at the ends.

EARTHING

Panel board shall be provided with a suitable size copper earth bus running along the entire length of the board. At either end of the earth bus, one clamp type terminal with nuts, bolts and washers shall be provided for bolting the earthing conductor.

Earth bus bars shall be supported at suitable intervals. Positive connection between all the frames of equipment mounted in the switchboard and earth busbar shall be provided by using insulated copper wires/bare bus bars of cross section equal to that of the busbar or equal to half the size of circuit load current carrying conductor, whichever is smaller.

All instrument cases shall be connected to the earth busbar using 660 V grade, single core 2.5sq.mm copper conductor cable.

All non current carrying metal and hinged doors shall be earthed to the earth bus bar.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

TESTS

Type test Certificates for following tests shall be submitted for the Circuit breakers

Power Frequency voltage withstand test

Partial Discharge Test

Power frequency withstand test on auxiliary and control circuit

Short circuit tests

Panel shall be subjected to following tests at the manufacturer's

Works as per relevant standards:

a) Mechanical operation test.

Power Frequency H. V. test for 1 minute.

Insulation resistance at 2500 V D.C. before/after 1 minute H.V. test.

DRAWINGS AND DATA

As part of the technical bid, tenderer shall furnish the following drawings and data:

For each Panel, overall dimensional drawing showing front view, plan, elevation and cross-section.

Schedule of Technical Data completely filled in.

Drawings giving full and complete physical and electrical details shall be submitted for approval in quadruplicate prior to fabrication. The Engineer-in-Charge will return two sets of approved drawings to the contractor. Full set of test results shall be provided to the Engineer-in-Charge in quadruplicate prior to dispatch. The switchboard shall be dispatched to project site after receiving written approval from the Engineer-in-Charge.

System	11,000 Volts, 3 phase, 3 wire, 50Hz neutral earthed.
Breaking Capacity	26.2 kA at 11 KV
Situation	Indoor
Control	Spring Operated
Sequence of Panels	Left to right (Facing the Panel) Panel No. 1 : Control of incoming supply Panel No. 2 & 3 : Control of outgoing feeders to transformers 1 & 2
General finish	Tropical
Indicating Lamps	1 – Circuit Breaker 'ON' – RED for each panel 1 – Circuit Breaker 'OFF'- GREEN

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

	-do- 1 – Breaker tripped due to abnormal condition – AMBER -do- 1 - Trip Circuit Healthy Lamp -do- 1 – Eight (8) Window Annunciation Panel with required wiring & protective devices for Incoming breaker 1 - Four (4) Window Annunciation Panel for each of the Outgoing breakers.
Vacuum CB Accessories	Mechanical as well as Electrical On / Off indicator Spring charged/ discharged indication Trip/close push button Mechanical operation counter.
Cable entry	TOP
Auxiliary supply	DC control 30V DC AC Control 230V AC, single phase, 50 Hz
Panel No.1	Control of incoming supply
Rating	800 Amp
Label reading	INCOMER, 11kV
Protection	Microprocessor based numerical relays with over load, short circuit and earth fault protections
Circuit Breaker	800 A rated vacuum circuit breaker, Power frequency withstand voltage: 28 kV, Impulse withstand voltage: 75 kV Peak
Trip Coils	30 Volts D.C.
Current Transformers:	Silica filled epoxy resin insulated, in air insulated chambers 3 – CTs 100/5 + 5 Amps, 15 VA, Class 1.5 accuracy for metering and 5 P 10 accuracy for protection
Voltage Transformer	1 No - three phase, 11 KV/110 V cast resin insulated, burden of 100 VA, Class 0.5 accuracy, complete with H.T. and L.T. fuse, circuit wiring.
Relays	Numerical type relays with O/C, S/C and Earth Fault Protection ABB RE Series / Areva Micom 122 / Siemens 7 SJ 62 1 No – Over Voltage Relay 1 No – Master Trip Relay VAJH 13
Instruments	Load Manager

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

Cable Particulars	The incomer cable is 11 kV (E), 240 sq mm Aluminum conductor XLPE insulated. Provision should be available for epoxy end sealing kit for end termination inside the cubicle itself. The cable entry will be from top.
Panel Nos. 2 & 3	Control of outgoing feeders to Transformers 1 & 2.
Rating	Each of 800 Amps rating
Label reading	Panel No.2 - Transformer 1 Panel No.3 - Transformer 2
Circuit Breakers	800 Amps rated vacuum circuit breaker.
Trip coils	30 V D C.
Current Transformer	Silica filled epoxy resin insulated, in air insulated chamber. 3-CTs of ratio 50A/5+5 Amps, 15VA, Class 0.5 accuracy for metering and accuracy class of 5 P 10 for protection.
Relays	Numerical relays with O/C, S/C and Earth Fault protection ABB RE Series / Areva Micom 122 / Siemens 7 SJ 62 1 No – Master Trip Relay VAJH 13 triple pole hand reset auxiliary check alarm relay type VAA-33
Instruments	Load Manager
Cable Particulars	The outgoing cable is 11 kV (E) type, XLPE insulated aluminium conductor. Provision should be available for epoxy end termination inside the cubicle itself. Size of cable - 3 core x 240 sq.mm. The cable entry shall be from top.
Additional equipment for the switchboard:	
Accessories	Plug and Socket (15A) for LT circuit
	Space Heater with Thermostat
	Illumination lamp in each relay / instrument panels.
Alarm Bell	One alarm bell each to be mounted for audible alarm purpose for AC/ DC failure indication.
Switch	One push button switch for the cancellation of audible alarm.
Padlock and keys	One set for each panel
Commissioning	The contractor will have to arrange for site visit(s) by the manufacturers' representative at the time of commissioning at no extra cost.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

BATTERY AND BATTERY CHARGER

Battery:

30 V Low Maintenance Tubular type Lead Acid Battery Set of 60AH capacity with 1 x 100% combined float cum boost charger unit shall be provided.

The System D.C Voltage shall be 30 V DC.

Static type Battery charger shall be used. Silicon controlled rectifiers (SCR) type battery chargers shall be provided for both boost and float chargers.

The Battery Charging Equipment should be a Self Contained Panel duly painted with anti rust primer and suitable for accommodating the Batteries in the bottom compartment of the Charger Panel and shall comprise of a Float cum Boost Charger, housed in a Sheet Steel cubicle, and constructed out of suitable angle Iron structure and Sheet Steel of 2 mm thickness for the front Panel and 1.6 mm thickness for all other panels.

The cabinet shall have IP-42 degree of protection. The Cabinet shall be treated by adopting 7 tank Process and shall be painted with colour and shade as approved by Engineer-in-Charge by adopting Powder coating process. The Battery Charging Equipment shall be suitable for a Single Phase AC Input Supply of 230 V +10%, 50Hz + 5%.

Battery Accessories:

- | | | |
|-------|---|---|
| 1 Set | : | Interconnections as required. |
| 1 No. | : | Syringe type hydrometer for specific gravity readings. |
| 1 No. | : | Pocket type Thermometer with specific gravity correction scale. |
| 1 No. | : | Cell Testing Voltmeter complete with leads. |
| 1 No. | : | Spanner. |
| 1 No. | : | Rubber Syringe. |
| 1 No. | : | Acid resisting funnel. |
| 1 No. | : | Acid resisting Jug. |

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Float cum Boost Charger:

The Float cum Boost Charger shall be of 8 Amps. DC rating and shall have Constant Voltage Operation for Floating the Batteries and also for Boost Charging the Batteries.

The Float cum Boost Charger shall comprise of AC Input and DC Output Miniature Circuit Breakers (MCBs), AC Contactor, Main Transformer, Rectifier Bridge with SCRs and Diodes, Electronic Controller for Constant Voltage operation in both Float and Boost modes, Auto/Manual Switch, Auxiliary Contactor for Automatic Changeover between Float and Boost modes with facility to override the Auto changeover, Front Panel Potentiometers, DC Digital Ammeter and Digital Voltmeter of 72 Sq.mm., Load DC Undervoltage and Overvoltage Relays, Audio Visual Alarm Annunciation Circuit for the above stated Fault Conditions and other Components as required.

Battery Charger Components :

- 1 No. : Double pole MCB for AC incoming.
- 1 No. : Pilot lamp (LED) to indicate AC mains 'ON' condition.
- 1 No. : Double wound impregnated naturally air cooled Single phase Mains transformer with class-B insulation and with primary taps at + 5% and + 10% and without secondary taps for output of 30 Volts.
- 1 Set : Single phase half controlled, full wave Rectifier bridge comprising of Silicon diodes and Silicon Controlled Rectifiers, mounted on heat sinks and complete with resistor/condensor network for surge-suppression.
- 1 Set : Filter circuit comprising of smoothing choke and condensor to Minimize the AC Ripple content in the DC output voltage.
- 1 Set : Electronic Controller to stabilise the DC output voltage within + 1% in Float mode and Boost mode for AC input voltage fluctuation of + 10% from 230 V, frequency variation of + 5% from 50 Hz and simultaneous DC load variation from 0 to 100%, with load limiting circuit and soft-start feature.
- 1 Set : Manual firing facility to operate the Float cum Boost Charger in the Manual mode, In case Auto firing fails.
- 1 No. : Auto/Manual Selector Switch for selecting mode of operation of the Charger.
- 1 No. : Auxiliary Contactor / Relay for Automatic selection of Float or Boost modes.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

- 1 No. : Single Pole Selector Switch to over ride Automatic Selection of Float/Boost modes
- 3 Nos. : Potentiometers for Auto setting of values in Float mode Boost mode Manual mode
- 1 No. : DC Digital Ammeter of 72 sq.mm to read Charger output current.
- 1 No. : DC Digital Voltmeter of 72 sq.mm with a Selector Switch to read the DC output voltage of the Charger and load.
- 1 No. : AC Digital Voltmeter of 72 sq.mm with a Selector Switch to read the Incoming Supply voltage.
- 1 : DC Digital Ammeter of 72 sq.mm to read discharge/charge currents of Battery.
- 1 No. : Pilot Lamp (LED) to indicate Charger DC On Condition.
- 1 No. : Solid State Sensing type Charger DC under voltage relay set at 25 V DC
- 1 No. : Silicon Blocking Diode to prevent Battery Backfeed for proper operation of the above relay.
- 1 No. : Double pole On/Off MCB for DC Output.
- 1 No : Solid-state current sensing relay with Milli Volt Amplifier to sense the trickle charging current going above 1.2 Amps. (20 times the normal Trickle charging current of 60 mA for the 60 AH Battery) and to enable Automatic cutting-in of the Charger in Boost mode and also To sense the falling of Charging Current in Boost mode below 1.2 Amps. through the battery and to enable Automatic change-over of the Charger to Float mode Back.
- 1 Set : Silicon Voltage Dropper Diode Circuit on the DC Loadbus, to limit the voltage across the load to the Float level voltage of 26.4 V, even though the voltage of the Float cum Boost Charger in Boost mode across the Battery may be 28.8 V (12 x 2.4V), the Circuit comprising of a fixed number of 4 Dropping Diodes and an arrangement to bypass pass the Dropping Diodes upon AC Mains failure, to ensure full voltage of the Battery to be available across the load upon AC Mains failure.
- 1 No. : Solid State Sensing type Load (Battery) DC Under voltage Relay set at 21 V DC.
- 1 No. : Solid State Sensing type Load DC Over voltage Relay set at 27 V DC.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

- 1 No. : Auxiliary Contactor / Relay for AC Mains failure Annunciation.
- 1 S : AUDIO - VISUAL ALARM ANNUNCIATION SCHEME with individual

Indicating Lamps and common audible alarm with ACCEPT/TEST/RESET Push buttons and with repetitive alarm feature in respect of following fault Conditions:

AC Mains failure

Charger DC Under Voltage

Load bus (Battery) DC Under Voltage

Load bus DC Over Voltage.

One potential free contact of each of the above fault conditions will be terminated in a separate terminal block, for remote annunciation.

4.0 11KV OIL TYPE DISTRIBUTION TRANSFORMER (INDOOR TYPE WITH ON LOAD TAP CHANGER & RTCC PANEL) (CONFIRMING TO IS 1180 PART-I LEVEL-2)

General

The transformer shall be double wound core type, oil naturally cooled suitable for Indoor installation. The transformer shall be designed and manufactured as per IS: 1180 (Part I) :2014 & IS 2026-1977 with upto date amendments and **Distribution Transformer shall conform to Energy efficiency level II** for Maximum total losses, Installed & Maintained as per IS Code of Practice IS 10028 (Part I) - 1985 with upto date amendments and having no load voltage ratio as 11000/433V. Transformer shall be provided with insulation class 'A' & Transformer enclosure protection shall be IP-55. Distribution Transformer shall be OLTC type and complete with AVR & RTCC Panel Rating of Transformer shall be as per BOQ item.

SPECIFICATION

a) Standard

Unless otherwise stated below, transformer & transformer oil, shall conform to IS 2026 & 335 respectively.

b) Climatic Conditions Affecting Operations

Minimum Temperature - 5 degree C.

Maximum Temperature + 50 degree C.

c) System of Supply

11kv 3 phase, 50 Hz system.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

d) **No Load Ratio**

11000/433 volts.

e) **KVA Rating**

Transformer shall be suitable for continuous rating as stated in BOQ and on drawings.

f) **Type**

Indoor

g) **Winding**

The transformer shall be copper wound.

h) **Core**

The magnetic core shall be made up of cold rolled grain oriented low loss steel stampings.

i) **Cooling**

Natural oil cooling by means of pressed/round tubes around transformer tank (ONAN).

j) **Frequency**

50Hz plus minus 3%

k) **Rated Voltage**

Transformer shall operate at its rated KVA at any voltage plus minus 10% of rated voltage of that particular tap.

l) **Vector Group**

Corresponding to the vector symbols Dyn-11.

m) **Connections**

H.V. side of transformer shall be provided with cable box suitable for 3 core 240Sq.mm XLPE cable. Indoor heat shrinkable termination kit shall be used for termination of HV Cable. MV side of transformer shall be suitable for Bus Trunking / Bus Duct connection arrangement.

n) **Tapping**

ON load tap changing arrangement on 11kv side. The range for circuit taps which shall be provided on HV side shall be plus 5% to minus -7.5% in steps of 2.50 %.

o) **Temperature Rise**

The transformer shall conform to the requirements of temperature rise specified in IS 2026 (Part II) 1977. Continuously rated for full load,

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

temperature rise not to exceed 50 degree C by thermometer in oil (55 degree C by resistance).

p) **Insulation Levels**

The insulation level shall be in accordance with IS : 2026 (Part III) 1977.

q) **Terminal Markings, Tappings & Connections**

The terminal marking, tappings & connections shall be in accordance with IS 2026 (Part IV) 1977.

r) **Requirement with regards to ability to withstand short circuit**

As per IS : 2026 (Part I) 1977.

s) **Impedance Voltage**

As per table 3 of IS : 2026 (Part I) 1977.

t) **Tap changing switch**

An externally hand operated on load tap changing switch with handle and a position indicating plate & locking device.

v) **Parallel Operation**

Transformer shall be suitable for parallel operation with similar unit of same rates.

FITTINGS

The followings accessories and fittings shall be provided with the transformer.

- (i). **Lifting Lugs** : The arrangement of lifting the active part of the transformer along with the cover of the tank by means of lifting lugs without disturbing the connections. Also complete transformer lifting lugs shall be provided.
- (ii). **Rollers** : The transformer to be provided with 4 Nos. rollers fitted on cross channels to facilitate the movement of transformer.
- (iii). **Oil Conservator** : The transformer to be provided with a conservator with welded end plates. It is to be bolted to the cover and can be dismantled for purposes of transport. It has to be provided with oil level gauge with marking for minimum level and an oil filling hole with a cap which can be used for filtering of oil. For draining purposes a plug is to be provided. A connection pipe between the conservator and main tank is to be provided, which projects inside the conservator.
- (iv). **Air Release Valve** : An Air release valve shall be provided on top of the tank cover to facilitate the release of the entrapped air while filling of oil.
- (v). **Breather** : The transformer shall be provided with an indicating dehydrating silicagel breather of sufficient capacity.
- (vi). **Drain Valve With Plug** : The transformer to be provided with drain valve with plug at the bottom of the tank.
- (vii). **Diagram And Rating Plate** : One diagram and rating plate indicating the details of transformer connection, diagram vector group, tap changing diagram etc.
- (viii). **Thermometer** : Dial type thermometer (100mm dia) with maximum set pointer 75 degree C.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- (ix). **Explosion Vent** : Explosion Vent or pressure relief device shall be provided of sufficient size of rapid release of any pressure that may be generated within the tank and which might result in damage to the equipment. The device shall operate at a static pressure less than the hydraulic test pressure for transformer tank.
- (x). **Filter Valve** : Filter valve on the top of the tank.
- (xi). **Bucholtz** : Oil & gas actuated relay equipment shall conform to IS 3637-1966 (amended upto date) and shall be double float type having contacts which close following oil surge or under incipient fault condition. Bucholtz relay shall have contacts for alarm and trip.
- (xii). **Winding Temperature Indicator**: Winding temperature indicator with electrical contact for alarm and trip.
- (xiii). **Oil Temperature Indicator** : Oil temperature indicator with alarm & trip contacts.
- (xiv). **Marshalling Box** : The transformer shall be provided with suitable size marshalling box to terminate the control cables of thermometer and bucholtz relay. Control cabling between bucholtz relay / Marshalling box to H.T. Panel shall be deemed to be included in quoted rate of Transformer.
- (xv). **Transformer Oil** : First filling of oil.
- (xvi). **Earthing** : Two separate earthing terminals are to be provided at the sides of the tank on both sides for earthing.

Instrumentation Manual

The successful bidder shall submit three copies of manual of complete instructions for the installations, operation, maintenance and repair, circuit diagrams, foundation and trenching details shall be provided with the transformer.

Shop Drawings

Manufacturer shall prepare and furnish shop drawings for the approval by the Engineer- in- charge before commencing fabrication/manufacture of the equipment. Shop drawings shall be based on requirement laid down in the specification. The manufacture of equipment shall be commence only after the shop drawings have been approved in writing by the Project Engineer- in-charge. Transformer shall be manufactured as per approved specification of Local Supply Authority.

Installations

- (i). The transformer shall be installed as per installation manual of the transformer supplier and conforming to Indian Standard IS 10028 (Part-II) 1981 with upto date amendments.
- (ii). The transformer is to be erected on suitable cement concrete foundation / flooring. The transformer supplied shall be lifted by all lifting lugs for the purpose of avoiding imbalance in transit.
- (iii). The transformer wheels shall be locked by suitable locking arrangement to avoid accidental movement of the transformer.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- (iv). The transformer cable end boxes shall be sealed to prevent absorption of moisture.
- (v). Dehydration at all the stages upto the handing over to the Owner shall be done by the contractor free of cost.
- (vi). The transformer neutral earthing and body earthing shall be done as shown on the drawing and shall conform to Indian Standard IS : 3043-1987 with upto date ammendmant.
- (vii). Two earths shall be provided for body earthing and two earths for neutral earthing. Copper shall be used for neutral earthing.

Factory Tests

The transformer shall be subjected to test as laid down in IS 2026 (Part-I) 1977 at the factory/manufacturing unit prior to despatch of the transformer to the site. All original test certificate shall be furnished.

Test at Site

Prior to commissioning of the transformer the following tests shall be performed.

- (i). Insulation resistance of the winding between phases and earth of H.V. and M.V. Side.
- (ii). Winding resistance of all the winding on all tap positions shall be taken.
- (iii). Di-electric strength of transformer oil shall be checked in accordance with IS 335-1963. Incase the test is not satisfactory, the oil shall be filtered till proper dielectric strength of oil is obtained. A certificate for the same shall be given to Owner.

Contractor / Manufacturer shall give sufficient advance information about the test schedule to enable the Engineer- in- charge to appoint his representative.

High Speed Resistor ON Load Tap Changer

General

High speed resistor On-Load-Tap Changer shall be provided with the transformer wherever specified. The high speed, resistor, OLTC shall be for rated voltage upto 11KV, rating current of 200 Amp, 3 phase, 7 step conforming to IS 8468-1977 complete with AVR & RTCC panel.

Type And Construction

OLTC shall be a compact unit for use with three phase distribution and substation transformer. It shall be completely self contained and designed to bolt directly to a part flange on the transformer.

The assembly comprises of :

- (a). Tank
- (b). Selector Switch
- (c). Driving Mechanism

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

- (d). Barrier Board
- (e). Local Control Gear
- (f). Control Cable Terminations
- (g). AVR & RTCC Panel

Tank

The complete tap changer shall be housed in a single tank of welded sheet steel construction. The tank shall be divided into two separate compartments to house the selector switch, Driving Mechanism and Local Control Gear. Access to the compartments shall be made easy by means of removable covers and a weatherproof door. Anti-condensation heater shall be provided in the compartment which houses driving mechanism and control gear.

Selector Switch

The three phase of the tap-changer shall be adequately spaced for full interphase insulation but mounted as a common assembly using vertical synthetic resin bonded insulating boards, each carrying a circle of fixed contacts. Insulating rods and tubes shall be used for the horizontal spacing of the phases and the fixed contacts shall be connected via the barrier board to appropriate tapplings in the transformer winding. Each phase shall have a single rotary contact support ring with sliding contact take off connection. This ring carries separately insulated spring loaded snap connected by a non inductive resistance unit accommodated on the contact carrier. One main moving contact shall be connected directly to the centre boss take off point, the second, transition moving contact shall be connected to the resistor. The three contact support rings shall be attached to the central insulating drive shaft, which rotates in self aligning ball bearings in the two outer phase boards. This centre shaft shall be of glass reinforced synthetic resin construction. Access to the selector switch shall be via removable cover on the top of the tank.

Drive Mechanism

Operation of the selector switch shaft shall be by means of a stored energy spring device having a positive snap-action for rotating the moving contacts quickly through the angle required for each tap change. The driving mechanism compartment shall be external to the oil filled switch tank. The rotary drive from the driving mechanism to the selector switch shall pass through a frictionless positive oil-tight gland. The angular movement of selector switch shaft shall be controlled by an indexing wheel which shall be positively locked by the periphery of the operating cam except during the actual time of tap-change operation. The operating cam shall be freely mounted on its shafts, rotation being imparted to it by means of tension springs attached radially between the operating camhub and the periphery of a concentric spring carrying gear wheel. The spring carrying gear wheel shall be rotated by a driving motor through cam. When the drive pin on the operating cam enters the slot in the indexing wheel the lock shall disengage but rotation shall be prevented by the locking arm pawl engaging in another slot of indexing wheel. The

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

spring carrying gear wheel continuous to rotate thus charging the springs. When sufficient energy has been stored a trip pin on the gear wheel shall lift the locking arm restraining the indexing wheel and the spring energy shall be released to move the tap selector switch one position, the cam locking coming in operation, accurately controlling the angular movement.

The operation of the selector switch shall be thus positively assured and shall be dependent only upon the quick release of the spring energy. It shall be thus independent of the motor drive. The tap changing sequence shall now complete and the driving motor shall brought to rest by the resetting of auxiliary switches and mechanical friction device. For protective purpose automatic declutching by shear pins shall be incorporated in the drive. The mechanism shall be provided with the auxiliary switches necessary for its operation. A step by step switch for position indication shall also be fitted and additional paralleling & out of step switches provided. A tap change mechanical counter, mechanical tap position indicator, mechanical end stops and electrical limit switch shall be provided. A detachable handle for hand operation shall also be provided. The fitting of this handle shall automatically disconnects the motor drive shaft by the operation of a simply spring loaded dog clutch and at the same time isolates the electrical control supply.

Barrier Board

The connections from the transformer winding shall be taken through an insulating terminal barrier board, which shall be supplied loose for clamping to the transformer port flange. Thus the transformer shall be treated and filled with oil before the tap changer is fitted. This arrangement allows the tap selector switch contacts to be inspected or the complete tap changer to be handled separately without disturbing the oil level in the transformer.

Local Control Gear

The motor reversing contactors and associated local control gear shall be housed in the same compartment as the driving mechanism with a common hinged weatherproof door. Weatherproof local control switches when required shall be mounted in an accessible position below the door.

Operating Mechanism

An impulse is received, either from a remote control panel or from a local manual operation switch, which energises the appropriate raise/lower contactor to initiate a tap changer in the required direction. The contactor when energised seals itself via its own contact and the driving motor commence to run. At a predetermined point a directional sequence switch closes, taking over the holding duties of the contactor whose original self-hold circuit shall be isolated. At the completion of the tap change the directional sequence switch opens and de-energises the driving motor. This arrangement ensures that a short period initiating pulse shall be accepted by the control gear

Control Cable Termination

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

A detachable undrilled gland plate and the terminal station for the all external connections shall be provided in the driving mechanism compartment of the tap-changer.

Automatic Voltage Regulator

Solid state Automatic Voltage Regulator shall be provided for regulation of the secondary voltage of power transformer with on load tap changer (OLTC). The band width control shall allow the dead band to be set in terms of upper (LOWER VOLTS) and lower (RAISE VOLTS) voltage limits around a particular nominal value with a specified sensitivity. AVR shall be provided with time delay control to allow the regulator to respond only to voltage fluctuations lasting for period greater than a selected time delay. Where the voltage correction requires more than one tap change, the time delay shall be reinitiated before further tap changes. Regulation shall reset automatically after voltage correction. Solid state lamps (LED) shall be provided to indicate voltage outside the preset limits & control relay operation.

RTCC Panel

RTCC Panel shall be provided to operate OLTC from Control Room located in Substation. RTCC shall be provided with main switch, a sequence selector switch. RTCC shall be provided with lower push button & raise push button, tap change in progress & complete, A.C. supply ON/OFF lamp indicator & AVR relay operated indication. Cubicle panel shall be totally enclosed, floor mounting and fabricated with a framed structure with rolled/folded sheet steel channel section of minimum 2mm thickness. All sheet steel work forming the exterior of RTCC panel shall be smoothly finished and all steel work used in construction of RTCC panel shall undergone a rigorous metal treatment process consisting of effective cleaning by hot alkaline degreasing solution followed by cold water rinsing, pickling in dilute sulphuric acid to remove scales and rust formation, a recognized phosphating process, passivating in deoxalite to retain & augment the effects of phosphating, drying with compressed air and dust free atmosphere, primer coating with two coats of highly corrosion resistant primer applied under strictly controlled conditions and finished coat of stoving synthetic enameled paint of grey colour.

5.0 CABLES (H.T. CABLES)

H.T. CABLES

The specification covers the supply, installation and delivery to site of PVC sheathed 11kV (E) grade, XLPE insulated Aluminium conductor cables.

The design, manufacture and performance of the cable should conform to the latest applicable standards of Bureau of Indian Standards i.e. as per IS: 7098 Part II.

All cables shall be XLPE type and shall comply with the following requirements.

Electrolyte Aluminum.

The conductor shall be stranded, compacted and round.

To relieve the electrical stresses, Semi conducting layer of XLPE shall be applied

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

over the conductor.

Insulation for cables shall be XLPE (Cross Linked polyethylene). The insulation shall be free of any air void and foreign material.

A semi conducting layer shall be provided over the insulation to relieve electrical stresses.

A metallic (Copper) tape shall provided over the semi conducting layer.

Different cores in a cable shall be identified by colour coding as per IS.

The Inner sheath shall be extruded type and shall be compatible with the insulation of cable. The inner sheath shall be with PVC compound type 'A', Armouring for the cables shall comprise G.I. strips/ wires.

The outer sheath shall be of an extruded layer of PVC Compound compatible with the specified ambient and operating temperature of the cables. The sheath shall be resistant to water, ultra violet radiation, fungus, termite and rodent attacks. The outer sheath shall be of black color.

Cables shall be subjected to routine and acceptance tests in accordance with IS: 7098. Test method shall conform to IS: 10810.

TERMINATION JOINTS

Terminal joints shall be carried out inside the cable end boxes fixed on the equipment. Cables shall be pencilled with layers of black ampere tapes wrapped over the conductor and the insulations then the entire joint shall be wrapped in layers of ampere tapes upto the terminals, butted and lugged. Lugs shall be fitted by the means of bolts and nuts with the terminal studs. On the glands, armour of the cable shall be fixed by means of clamps which shall be grounded. Heat shrink cable termination kit shall be used for terminations.

INSTALLATION OF CABLES

Cables in the HT Rooms of the Sub-Station shall be laid in trenches. All cables shall be bent in radius not less than 15 times the diameter of cables or as prescribed by the manufacturer whichever is higher. Cable laying shall be carried out as per CPWD specifications.

L.T. CABLES

GENERAL

L.T. Cables shall be supplied, inspected, laid tested and commissioned in accordance with drawings, specifications, relevant Indian Standards specifications and cable manufacturer's instructions. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drums. The recommendations of the cable manufacturer with regard to jointing and sealing shall be strictly followed.

MATERIALS

L.T. Cables shall be XLPE insulated and PVC sheathed aluminium conductor armoured cables conforming to IS: 7098 (Part I)-1988. Cables shall be of 1100volt and with ISI certification mark. Conductor of power cables shall be made of electrical purity aluminium conforming to IS 8130-1984. All power cables shall be FRLS type.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

INSTALLATION OF CABLES

Cables shall be laid directly in ground, pipes, masonry ducts, on cable tray, surface of wall/ceiling etc. as indicated on drawings and/or as per the direction of Engineer-in-Charge. Cable laying shall be carried out as per CPWD specifications.

INSPECTION

All cables shall be inspected at site and checked for any damage during transit.

JOINTS IN CABLES

The Contractor shall take care to see that the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilisation and avoiding of cable joints. This apportioning shall be got approved from Engineer-in-Charge before the cables are cut to lengths.

LAYING CABLES IN GROUND

Cables shall be laid by skilled experienced workmen using adequate rollers to minimize stretching of the cables. The cable drums shall be placed on jacks before unwinding the cable. With great care it shall be unrolled on over wooden rollers placed in trenches at intervals not exceeding 2 metres. Cables shall be laid at depth of 0.75 metres below ground level. A cushion of sand total of 250mm shall be provided both above and below the cable, joint boxes and other accessories. Cable shall not be laid in the same trench or along side a water main.

The cable shall be laid in excavated trench over 80mm layer of sand cushion. The relative position of the cables, laid in the same trench shall be preserved. At all changes in direction in horizontal and vertical planes, the cables shall be bent smooth with a radius of bent not less than 12 times the diameter of cables. Minimum 3 metre long loop shall be provided at both end of cable.

Distinguishing marks may be made on the cable ends for identifications of phases. Insulation, tapes of appropriate voltage and in red, yellow and blue colours shall be wrapped just below the sockets for phase identifications.

-HDPE PIPE

- a) The DWC high density polyethylene pipe having corrugation on outer wall & plain in inner wall should confirm to IS – 14930 Part – I & II amended upto date.
- b) Contractor has to arrange inspection of pipe at manufacturer's premises to carry out necessary test's contained in IS – 14930 part – I & II (compression test, impact test banding test etc.)
- c) Job includes accessories like HDPE snap fit coupler with required No. of neoprene 'O' rings in order to make water / damp proof joint.
- d) Contractor has to produce test report of anti rodant test, toxicity test of pipe from Govt. approved test house.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

PROTECTION OF CABLES

The cables shall be protected by bricks laid on the top layer of the sand for the full length of underground cable. Where more than one cables is laid in the same trench, the bricks shall cover all the cables and shall project a minimum of approximately 80mm on either side of the cables. Cable under road crossings and any other places subject to heavy traffic, shall be protected by running them through Hume Pipes of suitable size.

EXCAVATION & BACK FILL

All excavation and back fill required for the installation of the cables shall be carried out by the Contractor in accordance with the drawings and requirements laid down elsewhere. Trenches shall be dug true to line and grades. Back fill for trenches shall be filled in layer not exceeding 150mm. Each layer shall be properly rammed and consolidated before laying the next layer.

The Contractor shall restore all surface, road ways, side walks, kerbs wall or the works cut by excavation to their original condition to the satisfaction of the Engineer-in -Charge.

LAYING OF CABLES ON CABLE TRAY/SURFACE OF WALL/CEILING

Cable shall be laid on perforated / Ladder M.S. Cable tray. Cables shall be properly dressed before cable ties/clamps are fixed. Wherever cable tray is not proposed, cables shall be fixed on surface of wall or ceiling slab by suitable MS clamps/saddles. Care shall be taken to avoid crossing of cable.

CABLES ON HANGERS OR RACKS

The Contractor shall provide and install all iron hangers racks or racks with die cast cleats with all fixings, rag bolts or girder clamps or other specialist fixing as required.

Where hangers or racks are to be fixed to wall sides, ceiling and other concrete structures, the Contractor shall be responsible for cutting away, fixing and grouting in rag bolts and making good.

The hangers or racks shall be designed to leave at least 25mm clearance between the cables and the face to which it is fixed. Multiple hangers shall have two or more fixing holes. All cables shall be saddled at not more than 150mm centres. These shall be designed to keep provision of some spare capacity for future development.

CABLES TAGS

Cable tags shall be made out of 2mm thick aluminium sheets, each tag 1-1/2 inch in dia with one hole of 2.5mm dia, 6mm below the periphery. Cable designations are to be punched with letter/number punches and the tags are to be tied inside the panels beyond the glanding as well as below the glands at cable entries. Trays tags are to be tied at all bends. On straight lengths, tags shall be provided at every 5 metres.

TESTING, MANUFACTURER'S TESTS, PRE-COMMISSIONING TESTS AND COMPLETE COMMISSIONING

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

The General intent of this specification is to mention the relevant tests to be done and furnished to the Engineer-in-Charge by the Contractor. These are guidelines. However the Contractor shall carry out all such tests and complete all formalities as per relevant Indian Standard Specifications, Fire Insurance Requirements and/or Electricity Rules and Regulations as per Government Gazette and Publications.

a) Testing of Equipment:

All equipment before installing on the site work shall be tested and all such results produced to the Engineer-in-Charge. Nothing shall absolve the Contractor from re-performing any tests that the Contractor may be called upon specifically by the Engineer-in-Charge or supply company or electrical inspector. All equipment shall be tested jointly with the Engineer-in-Charge as required by various sections of the specifications and test data shall be furnished as required.

b) Pre-commissioning Tests:

All rules, regulations and requirements of Electrical, Government or Local Authorities and of Indian Standard Specifications and/or Rules and Regulations stated in Indian Electricity Act shall be strictly complied.

On completion of erection the contractor shall clean all the equipment thoroughly and inspect the entire installation for correctness and shall furnish a report of completion to the Engineer-in-Charge. Pre-commissioning tests shall commence only on approval of this report by the Engineer-in-Charge.

All tests and the certification thereof shall only be carried out by those authorized, skilled, experienced and certified permit holders of the Supervisor Category of State Government's Industries and Labour Department. No unauthorized personnel shall ever carry out any such tests as stated herein under.

- i) Mechanical Operational tests for all movable parts of switchgears, breakers, tripping devices etc.
- ii) Phase sequence tests at all the relevant points for connecting correct R, Y and B as per the supply utility sequence.
- iii) All Panels to be tested for interlocks, control tripping and breakers to be tested for sequential tripping.
- iv) Continuity tests shall be done for noting any short circuits and/or earthing of phases.
- v) Earthing tests for continuity of Earth by earth megger, on L.V. side. The earth resistance values shall not exceed 5 ohm.

6.0 RISING MAINS BUS TRUNKING SYSTEM & BUS DUCT:-

- SANDWICH TYPE BUS BAR TRUNKING SYSTEM

Scope

This specification covers the design, manufacture, tests at works and delivery at site, erecting in proper position, testing and commissioning of the Sandwich type metal enclosed Bus Duct of suitable for 3 phase 415 V, 50 Hz supply. Before fabrication of the Bus-duct the contractor shall have to submit the detailed fabrication shop drawings, three dimensional route drawings and short circuit calculations for the approval of the Engineer-in-Charge.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Codes and Standards

The design, materials, construction, manufacture and testing for Sandwich Bus Duct shall conform to IEC 60439 Part 1 & 2 standards and Codes for metal enclosed bus ducts.

Enclosure

The enclosure shall be fabricated out of 1.5 mm CRCA sheet steel.

This enclosure shall be adequately supported by cross-members as required to make the metal enclosure strong and rigid.

The enclosure shall be totally dust and vermin proof and degree of protection shall be IP 54

The Bus Duct shall be painted with Granule finished powder coated from inside and outside. The enclosure shall be coated with Siemens grey, RAL 7032. Before powder coating, the enclosure shall undergo the seven tank cleaning process.

The enclosure shall have rectangular shape of sections to confirm to latest IEC standards.

The design of the enclosure to the Bus Duct shall withstand the following:

- a) The enclosure shall be able to operate and withstand the Temperature conditions of 10 °C (winter) to 40 °C (summer).
- b) Minimum Short circuit current rating shall be 60 KA for 1 Sec.
- c) Mechanical vibration due to earth-quakes.

The Sandwich type Bus Duct system shall be manufactured in convenient section to facilitate easy transportation and installation. Each section shall be provided with suitable brackets at convenient intervals for supporting. The Cost shall include necessary bends, "T", Phase cross over chambers etc. i/c copper flexible. Nothing extra shall be paid on this account.

Expansion joints shall be provided as per the manufacturer's design and Recommendations.

Flexible connections shall be with tinned copper braided flexible at the Transformer and Switchgear end. The size of the flexible shall not be less than the cross section area of the Bus Bars.

MV Danger notice plates shall be provided on the front cover duly fixed by four screws. One danger notice plate shall be fixed at 3 m interval throughout the length of the bus duct. Nothing extra shall be paid on this account.

Terminal Enclosures and Flanges

Three phase terminal enclosures shall be provided with flanged ends and Adopter box with drilling dimensions to suit the flange at equipment terminals.

The flanges shall be provided with gaskets, nuts, bolts, etc.

Earthing

Necessary earthing arrangements as applicable shall be provided to connect to the existing earthing bus. All accessories and hardware required for the earthing arrangements shall be provided by the Contractor.

2 No's tinned Copper/aluminium earth strips of suitable size should run along with the entire length of the bus duct either integrally or outside the enclosure. These earthing strips shall be connected to the earthing grid

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Gaskets

The gasket material and thickness shall be so selected as to satisfy the operating conditions imposed by temperature, weather durability etc. Over compression of gaskets shall be avoided.

The material of the gasket shall preferably be Neoprene closed-cell sponge rubber or equivalent. Flange gaskets shall be provided at the equipment terminal connection

Hardware

The Bus Duct shall not have any through bolts. All nuts, bolts and other hardware shall be High Tensile steel. All spring washers shall be heat treated conical spring washers. SS pressure plates shall be provided at the bolted joints to ensure equal pressure.

Bus bar Conductor

Material

The material of the Bus-Bars shall be electrolytic grade Copper and should have purity more than 99.95% and Conductivity more than 97 IACS. The Oxygen contents in Copper shall not exceed 10 ppm. The Copper should be cold drawn and annealed up to 30%. All the Bus Bars should be tested as per relevant IS and latest IEC standard. The bus bar manufacturer should submit the certificate from original supplier of copper for purity and oxygen contents in Copper. These shall confirm to IS 613 of 2000 (Rev III) or the latest amendments. The size of the bus bars shall be indicated by the tenderer as part of the Technical Data. The bus bar size calculations shall be based on 1000 Amps. per sq. inch. All Phases and Neutral bus bars shall be 100% rated .

The specification and the system should be suitable to get 100% loading for horizontal and vertical installation at an ambient temperature of 40 deg C and temperature rise of bus bars shall not exceed 50 deg C Rating

The material of the conductor shall be designed to carry the rated current and short circuit current for the specified time under normal site operating conditions. Also the temperature of bus shall not exceed 250 degree centigrade while carrying the specified short circuit current for one second when a fault occurs at the operating temperature.

Bus bar Coupler

Each Bus Bar of the Bus Duct shall be joined to the adjacent section by single bolt joint clamp without drilling the bus bars. Over the joint inspection window shall be provided. Joint removing shall be a separate assembly so that the two sections shall be electrically isolated without disturbing the sections.

Insulating Material for Bus Bars

The insulating material over the Bus Bars shall be Multi layer Class “F” insulation with two layers of glass mica sheet and two layers of polyesters. The rated insulation voltage shall be 1000 volts and rated impulse withstand voltage shall be 12 KV.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Bus Duct Supports

The bus duct shall be supported from ceiling / wall using minimum 12 dia fully threaded GI rods and 50 x 50 x 6 mm GI angles using Anchor fasteners. Nothing extra shall be paid on this account.

Markings

All components of the bus duct along with the supporting structure shall be distinctly marked for erection in accordance with the erection drawings to be prepared and furnished by the Contractor

Wall/Floor Flanges

Wall/Floor flanges are required to be fitted to both sides of wall or floor while crossing the wall / floor.

Tests and Test Reports:

The following tests shall be conducted at manufactures works prior to dispatch of the bus duct assembly.

- a) One minute power frequency withstand voltage test.
- b) Megger test before and after High Voltage Test.
- c) High Voltage Test
- d) Temp Rise Test (Heat Run Test)

Test Reports shall be submitted for the tests conducted as above

BUS DUCT / BUS TRUNKING SYSTEM

GENERAL

Bus duct shall be supplied as per BOQ, specification & approved shop drawings. The Bus duct shall be of indoor type. Bus duct system shall be air cooled (self-cooled), non-segregated type and shall be suitable for continuous current rating and shall have rupturing capacity of 36MVA at 415 volts. Bus duct shall be suitable for short circuit withstand capacity of 50 kA for 1 second. Manufacturer shall submit type test certificate of similar Bus duct from recognized test lab like CPRI at Bhopal or equivalent.

CONSTRUCTION

Bus duct shall consist of three phase and neutral busbars permanently positioned. Bus duct shall conform to degree of enclosure protection IP 54 with upto date amendments. Minimum thickness of sheet steel enclosure shall be of 2mm. The busbars shall be of high conductivity electrolytic quality aluminium conforming to relevant Indian Standards and shall be of sufficient cross section. Overall busbar cross section size shall be as per table VI of CPWD General Specification for Electrical Works Part – I (Internal) -2005. The cross section of neutral busbar shall be same as that of phase busbar. Entire length of busbars shall be provided with colour coded PVC sleeves. Bus duct shall be natural cooled with inspections covers at suitable intervals. Busbars shall be supported with 12mm thick non hygroscopic insulating material at

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

every 600mm allowing busbar to expand on normal operation but restrict excessive movement under fault conditions. Expansion joints shall be provided in such a way that expansion and contraction does not have undue strain on the bus at the terminals at both ends.

The Bus duct arrangement shall have a 02 runs of common frame GI earth bar of size 32mm x 5mm for entire length suitably loop earthing of various sections. Two number of each terminals shall be provided for earthing connections. Frame earthing of Bus duct system shall be connected to two earthing terminals at Main L.T. Panels/Transformer ends.

Contractor shall submit the bus bar sizing calculation for short circuit withstand capability and maximum temperature rise indicating the de-rating factors clearly for the approval of Engineer-In-Charge.

INSTALLATION

All supporting structures required for hanging and/or supporting the complete bus duct shall be provided including related civil works. These include all types of supports, brackets, beams, channels, rods, clamps, hardware, etc to support with wall, roof, truss etc.

Bus ducts running along the wall should be supported at intervals not exceeding 1.5m. In case of branching, there should be a support on all branches at a distance of 30 cms from the point of branching. Support should not be less than 40mm X 40mm X6mm MS angle secured in an approved manner. Supports may also be formed as brackets fixed to walls where runs are along with walls. Supports shall be grouted on the walls.

In case of ceiling suspended bus ducts, supports made of 40mm X 40mm X6mm MS angle iron shall be provided. The horizontal interval between two such supports should not be more than 1200mm. However, additional supports to be given at the bends and termination points. These duct supports shall be suspended from the C.I/MS. boxes or suitable approved suspension device provided in the ceiling by means of 12 mm diameter MS rods.

Where fish plates are available, the same can be used for busduct support works. Where there is no such provision, good quality anchor fasteners of size not less than 8mm shall be used in the ceiling.

Seal-off bushings complete with wall frame and support plates shall be provided where the bus duct penetrates the building wall. The seal is to prevent free exchange of air between two portions of the bus duct part of which is indoor while the other is outdoor.

Silica-gel breather shall be provided on both portions of the bus duct between the seal of bushings.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

CONNECTIONS & TERMINATIONS

All matching flanges, seal-off bushings, gaskets, fittings, hardware and supports required for termination of the bus duct at the switchgears, transformers and other equipment shall be provided.

Flexible connections both for conductor and enclosure shall be provided.

- a) At all equipment termination to provide for misalignment up to 25 mm (1") in all directions.
- b) Between bus duct supported from building steel to prevent transmission of vibration.

The equipment terminal connections shall be readily accessible and shall provide sufficient air gap for safe isolation of equipment during testing.

If the material of bus conductor and that of the equipment terminal connectors are different then suitable bi-metallic connectors shall be furnished.

PAINTING

Unless otherwise specified, the painting process shall be as follows:-

All steel surfaces shall be thoroughly cleaned by sand blasting or chemical agents, as required, to produce a smooth surface free of scales, grease and rust etc.

The steel surfaces after cleaning shall be given on all sides proper coat of anti-corrosive primer followed by two coats of powder coating painting.

The bus duct shall be finished with two coats of grey (IS 5 shade # 632) powder coated paint.

Earth strip shall be painted with green colour enamel paint.

Where the painting is damaged during transit, installation etc., and touch up painting shall be done at site.

All metallic parts involved in the installation like supports, beams, channels, brackets, clamps, poles, hardware etc. shall be enamel painted.

TESTS

Factory Test

The routine/acceptance tests shall be witnessed at the manufacturer's works by AAI representative. Test shall be carried out as per IS.

TYPE TESTS

Bus duct shall be got manufactured by only reputed bus duct manufacturers having Government type tested by CPRI or other govt. testing laboratory on similar bus duct (s) with minimum 50KA short circuit current with stand capacity and the type test certificate shall be produced to the AAI inspector at the time of factory test.

SITE TESTS

In addition to the tests at manufacturer's premises, all relevant pre-commissioning checks and tests shall be done at site before energizing the bus duct.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

The following tests are to be particularly done before cable jointing or connecting the bus duct.

1. Physical inspection for breakages/damages/orderliness.
 2. Insulation resistance test with 500 V Megger. The insulation resistance shall not be less than 100 mega ohms.
 3. Earth continuity test.
- All test results are to be recorded and reports should be submitted to the department.

- **COMMISSIONING**

After the satisfactory installation & testing, the Bus duct shall be commissioned.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

X) SPECIFICATION LT DG SETs

GENERAL CONDITIONS

This General Specifications cover the equipments and materials for the LT DG sets and its testing and / or inspection as may be necessary before dispatch from the repetitive works, it's delivery at site, all preparatory works, assembling, installation and adjustments, commissioning, final testing, putting into operation and handing over of the complete system. Rating of DG Set & Quantity shall be as mention in BOQ item.

Works to be done by the contractor

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

- i) AVM type pad shall be used as per recommendation of manufacturers. The design of the foundation for installation of complete DG set shall be submitted duly vetted by structural engineer for approval by Engineer- In-Charge / Project Manager.
- ii) Making good all damages caused to the structure during installation and restoring the same to their original finish.
- iii) Minor building works necessary for installation of equipments, foundation trench for fuel lines & cables, making of opening in walls or in floors and restoring them to their original condition / finish and necessary grouting etc., as required.
- iv) All supports for exhaust & water pipes, sundry equipments, fittings, assemblies, accessories, hardware items, etc. as are necessary
- v) All electrical works and neutral earthing, body earthing, required for engine & alternator, main board/ control panels and control wiring including loop earthing, as are necessary.
- vi) All pipes, cable, bus duct connections etc.
- vii) POL i.e. HSD oil and lub oil for diesel engine for testing & commissioning and for trial run as per conditions of the contract.
- viii) All tools and tackles required for unloading / handling of equipments and materials at site, their assembly, erection, testing and commissioning shall be the responsibility of the contractor.
- ix) Painting of all exposed metal surfaces of equipments and components with appropriate colour.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

x) **Statutory Clearance(s)**

Approval / clearance of the complete installation shall be obtained by the contractor from CPCB / State Pollution Control Board / Local Bodies / Central Electricity Authority (CEA) / other licensing authorities, wherever required. However, application shall be made by Department and any statutory fee, as applicable, shall be paid by Owner directly to the Govt. authorities.

Carry out routine and preventive maintenance as per manufacturer's standards for a period of 24 months from the date of handing over. However, all consumables (fuel / lube oil etc.) and spare parts including filters will be supplied by the Owner.

Location: Substation Building DG Set Room.

Climatic conditions:

The output of DG set shall be under following climatic conditions to be in conformity with CPCB approved type tests:

- | | | |
|------|-------------------------------|-------------|
| i) | Outside maximum ambient temp. | : 50° C |
| ii) | Height above Mean sea level | : 1000meter |
| iii) | RH | : 50% |

DIESEL ENGINE :

Standard: The Engine shall conform to IS;10000/ISO 3046/BS; 649/BS 5514 amended upto date.

Rating: The engine shall be of standard design of the original manufacturers. It should be 4 stroke cycles, water cooled, turbo charged, diesel engine developing suitable BHP for giving a power rating as per ISO 8528-Part-1 in KVA at the load terminals of alternator at 1500 rpm after accounting for derating in engine output if any, as per the climate conditions mentioned in Para 1.3 & due to acoustic enclosure.

The engine shall be capable for delivering specified Prime Power rating output at variable loads for PF of 0.8 Lag with 10% overload available in excess of specified output for one hour after 12 hours continuous operation. The average load factor of the engine over period of 24 hours shall be 80 to 85% for prime continuous power output.

Necessary certificate indicating the compliance of the above capacity requirement for the engine model so selected along with compliance of Noise and Emission norms as per latest CPCB guidelines for DG set capacities should be furnished.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

The engine shall be fitted with following accessories subject to the design of the manufacturer:

- i) Dynamically balanced fly-wheel.
- ii) Air cleaner (dry type).
- iii) An electronic governor to maintain engine speed at all conditions of load.
- iv) Dry exhaust manifold with suitable exhaust residential grade silencer to reduce the noise level.
- v) Suitable self starter for 24V DC.
- vi) Battery charging alternator unit and voltage regulator, suitable for starting batteries, battery racks with interconnecting leads and terminals.
- vii) Necessary gear driven oil pump for lubricating oil, as well as fuel systems as per manufacturer standard.
- viii) Turbo charger.
- ix) Lubrication oil cooler.
- x) Cartridge type Lubrication oil filters.
- xi) Fuel injection: Engine should have suitable fuel injection system in order to achieve low fuel consumption.
- xii) Fuel control solenoid
- xiii) Fuel pump with engine speed adjustment.
- xiv) Engine Control Panel: fitted and having digital display for following:
 - a) Start /stop key and or switch.
 - b) Lube oil pressure indicator
 - c) Water temperature indication
 - d) RPM indication
 - e) Engine Hours indications
 - f) Battery charging indication
 - g) Low lube Oil pressure trip indication
 - h) High water temperature indication.
 - i) Over speed trip indication.
- xv) All moving parts of the engine shall be mechanically guarded in such a manner that a human finger cannot touch any moving part.
- xvi) Radiator with fan for DG cooling.
- xvii) Any other item not included / specified, but is a standard design of the manufacturer.

Governor:

Electronic governor of class A1 as per ISO 3046/ BS 5514 with actuator shall be provided as per standard design of manufacturer. Governor shall be a self-contained unit capable of monitoring speed.

The governors shall have dropping characteristics so as to ensure proper load sharing. The governing system shall be complete with all devices / switches for auto / manual operation.

The over speed trip mechanism shall also be provided to automatically shut off the supply of fuel in case the engine speed reaches 110% of rated speed.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

Frequency variation:

The engine speed shall be so maintained that frequency variation at constant load including no load shall remain within class A1 governing as per standard.

Fuel System:

It shall be fed through engine drive fuel pump. A replaceable element of fuel filter shall be suitably located to permit easy servicing.

Daily fuel tank of 8 hours fuel capacity shall be provided as per DG set Manufacturer standard design. The tank shall be fitted with breather, drain plug, transparent PVC pipe connections with valves and calibration strip, low level contacts and alarm, connecting piping works with valves etc. as per DG manufacturer standard design.

Further, the DG set tanks shall be interconnected with valves in such a way that each tank can use with either of DG set.

Lubricating oil system

It shall be so designed that when the engine starts after a long shut down lubrication failure does not occur.

The lubrication oil shall be recommended grade of engine manufacturer, marketed in India and suitable for climatic conditions of the site.

Electric Starting System:

This shall comprise of necessary set of heavy duty batteries 24V DC, and suitable starter motors and axial type gear to match with the toothed ring on the fly wheel. A timer in the control panel to protect the starter motor from excessively long cranking runs shall be suitably integrated with the engine protection system and shall be included within the scope of the work. Battery capacity shall be suitable for meeting the needs of starting system (as three attempt 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.

Battery Charger

The battery charger shall be suitable to charge required numbers of batteries at 24 Volts complete with, transformer, rectifier, charge rate selector switch, indicating ammeter and voltmeter etc. Connections between the battery charger and batteries shall be provided with suitable copper leads with lugs etc.

Turbo Charger

The turbo charger shall be suitable for being driven by waste gases from the engine and having a common shaft for the turbine and blower. It shall draw air from the air filters and shall be of suitable capacity corresponding to engine requirements. The output of the turbo charger shall be suitably routed through an inter-cooler for obtaining better efficiency.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Flywheel :

The engine shall be provided with suitable balanced flywheel to ensure and maintain the cyclic irregularity within the limits specified in BS : 5514. The combined inertia of the flywheel and alternator rotating shall be such that the angular deviation in either direction from the position of uniform rotation shall not at any time exceed limit.

Piping Work

All pipe lines, fittings and accessories requirement inside the enclosure and outside for exhaust piping shall be provided by the contractor. This shall include necessary flexible pieces in the exhaust, fuel, lub. oil and water lines as are necessary in view of the vibration isolation requirement in the installation. Piping of adequate size shall be used for lub. oil of the material as per manufacturer standard. However, only M.S. pipes for the exhaust and fuel oil lines shall be used.

The pipe work shall be inclusive of all fittings and accessories required such as bends, reducers, elbows, flanges, 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 for purposes for maintenance of unit as approved by Engineer-in-charge.

Common bed plate

Engine and alternator shall be coupled by means of rigid coupling as per manufacturer standard design and both units shall be mounted on a common bed plate together with all auxiliaries to ensure perfect alignment of engine and alternator with minimum vibrations. The bed shall have suitable anti-vibration mounting system.

Exhaust system**i) Exhaust piping:**

All M.S. Pipes for exhaust lines shall be conforming to relevant IS. The runs forming part of factory assembly on the engine flexible connections upto exhaust silencer shall be exclusive of exhaust piping item. The work includes necessary cladding of exhaust pipe work using 50mm thick glass wool / mineral wool/rock wool, density not less than 46 kg/m.sq. and aluminium cladding (0.80mm thick) for the complete portion. The exhaust pipe work includes necessary supports, Foundation etc. to avoid any load & stress on turbo charger / exhaust piping. The exhaust pipe support structure shall be got approved by engineer-in-charge before execution and with the following:

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No. of Omissions – O NIL
No. of Insertions – I NIL

- a) Exhaust system should create minimum back pressure.
- b) Number of bends should be kept minimum and smooth bends should be used to minimize back pressure.
- c) Pipe sleeve of larger dia should be used while passing the pipe through concrete wall & gap should be filled with felt lining.
- d) Exhaust piping inside the Acoustic Enclosure should be insulated with mineral / rock wool along with aluminium sheet cladding to avoid heat input to the Acoustic Enclosure.
- e) Exhaust flexible shall have its free length when it is installed considering exhaust pipe length is more than 7 meter in the proposed DG capacity, an additional bellow/provision for expansion shall be provided and deemed to be included in quoted rates.
- f) 'B' class MS pipes and long bend / elbows should be used.
- g) The exhaust outlet should be in the direction of prevailing winds and should not allow exhaust gases to enter air inlet / windows etc.
- h) When tail end is horizontal, 45 degree downward cut should be given at the end of the pipe to avoid rain water entry into exhaust piping.
- i) However, if tail end is vertical, there should be rain trap to avoid rain water entry. If rain cap is used, the distance between exhaust pipe and rain cap should be higher than diameter of pipe. Horizontal run of exhaust piping should slope downwards away from engine to the condensate trap. Silencer should be installed with drain plug at bottom.

ii) **Support to exhaust piping:**

Exhaust pipe should be supported in such a manner that load of exhaust piping is not exerted to turbo charger.

iii) **Exhaust Stack height:**

In order to dispose exhaust above building height, minimum exhaust stack height should be as below :

- a) For DG set above 1000 KVA – 30 m height or 3 M above the building height, whichever is higher.
- b) For DG Set below 1000 KVA.
Stack height in metres = $H + 0.2_ / \text{KVA}$

H – Height of nearest building in Metre.

Air System

It is preferable to provide vacuum indicator with all engine to indicate choked filter. Maximum air intake restrictions with clean and choked filters should be within

No. of Correction – C NIL
No. of Omissions – O NIL
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prescribed limit as per OEM / manufacturer recommendation for the particular model of the engine. Genset should be supplied with medium duty air cleaner.

Cooling System

- a) System should be designed for ambient temperature of 50°C.
- b) Coolant should be used mixed with additive (in suitable proportion) as per recommendation of OEM/manufacturer of proposed engine models.

ALTERNATOR (LT)

Standards: The alternator shall be in accordance with:-

- i) IS:4722 / BS:2613/1970/IEC:34. The performance of rotating electrical machine.
- ii) IS:4889 / BS:269 rules for method of declaring efficiency of electrical machine.

Technical requirement of the Synchronous Alternator (For LT DG Sets) Self excited, screen protected self regulated, brush less alternator, Horizontal foot mounted in Single bearing construction suitable for the following:

Continuous output	Rated KVA under condition described in para 1.3 (After considering deration)
Rated PF	0.8 (lag)
Rated voltage	415 volts (LT, DG Set)
Rated Frequency	50 Hz
No. of phases	3
Enclosure	SPDP (Drip proof & screen enclosure)
Degree of protection	IP -23
Ventilation	Self ventilated air cooled
Insulation Class	H or higher
Temperature Rise	With in class H limits at rated load
Voltage Regulation	± 1%
Overload duration /capacity	a) 10% for one hour after 12

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	hours of continuous operation.
	b) 50% over load for 15 second
Frequency variation	As defined by the Engine Governor
Excitation	Separately excited
Type of AVR	Electronic
Type of Bearing and	
Lubrication arrangement	Long life anti-friction bearing with Grease lubrication at one end.

Excitation:

The alternator shall be brushless type and shall be separately excited, self regulated having static excitation facility. The exciter unit should be mounted on the control panel or on the alternator assembly. The rectifier shall be suitable for operation at high ambient temperature at site.

Automatic Voltage Regulators (AVR):

In order to maintain output terminal voltage constant within the regulation limits i.e. $\pm 1\%$, Automatic voltage regulator unit shall be provided as per standard practice of manufacture

Fault tripping:

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 indicator shall also be provided.

Performance:

Voltage dip shall not exceed 20% of the rated voltage for any step load or transient load as per ISO: 8528 (Part I). The winding shall not develop hot spots 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 clause 14.1.1. of IS 4722:1992.

The performance characteristics of the alternator shall be as below:

- | | | | |
|-----|----------------------------------|---|-------------------------|
| (a) | Efficiency at full load 0.8 P.F. | - | i) not less than 93.5%. |
| (b) | Total distortion factor | - | Less than 3% |
| (c) | Operation of DG set | - | |

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No. of Insertions – I NIL

- | | | |
|-------------------|---|--|
| (i) 10% overload | - | One hour after 12 hrs of Continuous operation. |
| (ii) 50% overload | - | 15 seconds. |

Terminal Boxes:

Terminal boxes shall be suitable for U.G. cables/bus trunking. The terminal box shall be suitable to withstand the mechanical and thermal stresses developed due to any short circuit at the terminals.

Earth Terminals:

2 Nos. earth terminals on opposite side with vibration proof connections, non-ferrous hardware etc. with galvanized plate and passivated washer of minimum size 12mm dia. hole shall be provided.

Space Heaters

Alternator shall be provided with suitable space heaters to maintain the winding temperature automatically such that it does not absorb moisture during idle periods. The heater terminals shall be brought to a separate terminal box suitable for 230 volt AC supply and a permanent caution notice shall be displayed.

Power Command Controller

DG Set shall be provided with integrated Microprocessor based Power command controller alongwith each DG Set. Power command controller shall provide voltage, engine protection, alternator protection, operator interface and isochronous governing. Power command controller cumin PC 3.3 or equivalent shall be suitable for Synchronising of DG Sets. Power command controller and PLC provided in Main LT Panel shall be compatible and shall ensure Synchronising of DG Set, Load sharing on DG sets and Load management, Auto start / Auto Start of DG Set, Auto Changeover of incomer breaker of Grid supply & DG Sets beside interlocking and DG Set protections. All hardware & Software required for achieving Synchronising & Load Management shall deemed to be included in the quoted rate of DG Set of Main LT Panel.

AUTO START / AUTO STOP OPERATIONAL LOGIC OF DG SETS

System Operation:

The above-mentioned facilities provided shall afford the following operation requirement

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Auto Mode:

- a) A line voltage monitor shall monitor supply voltage on each phase. When the mains supply voltage fails completely or falls below set value (variable between 80 to 95% of the normal value) on any phase, the monitor module shall initiate start-up of diesel engine. To avoid initiation due to momentary disturbance, a time delay adjustment between 0 to 5 second shall be incorporated in start-up initiation.
- b) A three attempt starting facility shall be provided 6 seconds ON, 5 seconds OFF, 6 seconds ON, 5 seconds OFF, 6 seconds ON. If at the end of the third attempt, the engine does not start, it shall be locked out of start and a master timer shall be provided for this function. Suitable adjustment timers are to be incorporated which will make it feasible to vary independently ON-OFF setting periods from 1-10 seconds. If alternator does not build up voltage after the first or second start as may be, further starting attempt will not be made until the starting facility is reset.
- c) Once the alternator has built up voltage, the alternator circuit breaker shall close connecting the load to the alternator. The load is now supplied by the alternator.
- d) When the main supply is restored and is healthy as sensed by the line voltage monitor setting, both for under voltage and unbalance, the system shall be monitored by a suitable timer which can be set between 1 minute to 10 minutes for the load to be transferred automatically to main supply. Provision should also be made by way of selector switch for running the set atleast for 30 minutes, 10 minutes & 3 minutes after the restoration of healthy mains before the load is transferred to the mains (commercial supply).
- e) The diesel alternator set reverts to standby for next operation as per (a), (b) and (c) above.

Manual mode:

- a) In a manual mode, it shall be feasible to start-up the generator set by the operator on pressing the start push button.
- b) Three attempts starting facility shall be operative for the start-up function.
- c) Alternator circuit breakers closing 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.
- d) Engine shut down, otherwise due to faults, shall be manual by pressing a 'stop' button.

Test mode:

- a) When under 'test' mode, pressing of 'test' button shall complete the start up sequence simulation and start the engine. The simulation will be that of mains failure. Sequence I(a) and (b) shall be completed.
- b) Engine shall build up voltage but the set shall not take load by closing of alternator circuit breaker. When the load is on the mains, monitoring of

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

- performance for voltage/frequency etc. shall be feasible without supply to load.
- c) If during test mode, the power supply has failed, the load shall automatically get transferred to alternator.
 - d) Bringing the mode selector to auto position shall shut down the set as per sequence I(d) provided main supply is ON. If the mains supply is not available at that time, the alternator shall take load as in (c) above.

Engine shut down and alternator protection equipments:-

Following shut down and protection system shall be integrated in the control panel:

a) Engine:

- i) Low lubricating oil pressure shut down. This shall be inoperative during start up and acceleration period.
- ii) High coolant (water) temperature shut down.
- iii) Engine over speed shut down.

b) Alternator Protection:

- i) Over load
- ii) Short circuit
- iii) Earth fault
- iv) Over voltage

Monitoring and metering facilities:

- a) Necessary energy analyzer unit for visual monitoring of mains, alternator and load voltage, current, frequency, KWH, power factor, etc.
- b) A set of visual monitoring indication for:
 - i) Load on set
 - ii) Load on mains
 - iii) Set on test (Alternator on operation duty, Alternator on standby duty).
 - iv) Set of lamp for engine shut down for over speed, low lub. oil pressure and high coolant water temperature, overload trip of alternator, earth fault trip of alternator, engine lock out and failure to start etc. All these indications shall have an audio and visual alarm. When operator accepts the alarm, the hooter will be silenced and the fault indication will become steady until reset by operating a reset button.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

Operating Devices: A set of operation devices shall be incorporated in the front of panel as under:

- a) Master Engine Control Switch: This shall cut off in 'OFF' position DC control to the entire panel, thus preventing start-up of engine due to any cause. However, battery charger and lamp test button for testing the healthiness of indication lamps, DC volt meter/ammeter etc. shall be operative. It shall be feasible to lock the switch in OFF position for maintenance and shut down purposes.
- b) Operation selector switches OFF/AUTO/MANUAL/TEST position.
- c) Energy analyzer unit for display of various electrical parameters like voltage, current, frequency, KW, power factor etc.
- d) A set of push button, as specified.
- e) Relays, contactor, timers, circuit breakers, as required.
- f) Necessary battery charger with boost/trickle selector, DC voltmeter and DC ammeter.

Battery / Electrical System

Batteries supplied with Genset are generally dry and uncharged. First charging of uncharged batteries is very important and should be done from authorized battery charging centre. Initial charging should be done for 72-80 hours.

Batteries should be accommodated with enclosure in battery rack. Battery capacity and copper cable sizes for various engine capacities should be as per recommendation of Manufacturer. Cable size shall be of 2m length. If length is more, cable size should be selected in such a way that voltage drop does not exceed 2V.

For AMF applications, a static battery charger working on mains supply is recommended to keep the batteries charged at all times.

1.5 Sq.mm copper wire should be used for wiring between junction box and Control panel

Cable and switchgear selection: refer detailed specification in succeeding paragraphs.

Overheating due to loose thimbling /undersize cables causes most of electrical failures and hence correct size of cable and thimbles should always be used.

While terminating cables, avoid any tension on the bolts/busbars.

While terminating R,Y & B phase notations should be maintained in the alternator and control panel for easy maintenance.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

Crimped cables should be connected to alternator and control panel through cable glands.

Multi-core copper cables should be used for inter connecting the engine controls with the switchgear and other equipments.

For AMF application, multicore 1.5 sq.mm flexible stranded copper cable for control cabling should be used.

All indications shall be LED type or as recommended by the manufacturer.

It is recommended to support output cables on separate structure on ground so that weights of cables should not fall on alternator / base rail.

Alternator Termination Links

- i) For proper terminations between links and switchgear terminals, the contact area must be adequate. The situations should also be avoided as they lead to creation of heat sources at the point of termination:
 - a) Point contact arising out of improper position of links with switchgear terminals.
 - b) Gaps between bus-bars / 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.

Adequate clearance between bus-bars/links at terminals should be maintained.

FOUNDATION

Foundation should be designed considering safe bearing capacity of soil and approved structural engineers. Vibration isolators (AVMs) should be provided to reduce vibration transmission to the surrounding structure.

Foundation level should be checked diagonally as well as across the length for even flatness. The foundation should be within + 0.5 degree (angle) of any horizontal plane.

A PCC foundation (1:2:4, M-20 grade) of approximate depth of 300 mm below ground is required so as to provide leveled surface for placement of the acoustic enclosure. About 250 mm foundation height should be above ground level. The length and breadth of foundation should be at least 250 mm more than the size of the enclosure. Genset should be mounted on Anti Vibration Mountings(AVM's) inside the enclosure.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

ACCOUSTIC ENCLOSURE FOR DG SETS

General

The enclosure shall be of compact sleek design conforming to international standard to provide insertion loss of 25 dBA as per the requirement of central pollution control board norms. The enclosure shall be fabricated using high grade cold rolled cold annealed (CRCA) sheet & steel members. High density sound absorption material shall be used to reduce the sound level. Sound level shall not be more than 75 db(A) at a distance of one metre away from the set and DG Set supplier shall give an integral acoustic enclosure and the acoustic enclosure shall have approval from anyone of the agencies as listed / approved by CPCB. The enclosure shall be surface treated and powder coating painted to make it weather proof and suitable for outdoor application. The enclosure shall be provided with durable industrial locking system with doors duly gasketed.

Acoustic Insulation

High density resin bonded rock wool shall be provided on all six sides includes door, roof and base to absorb noise. The insulation shall be covered with fire proof acoustic material, light resin rock wool and shall be supported by perforated sheet. Sound attenuators/down stream silencers shall be provided at all openings for air inlet/outlet to facility free air flow but to absorb sound resulting in extremely low noise level. Detachable partitions shall be provided inside the enclosure to attain further noise attenuation of the engine.

Noise Suppressor

A suitably designed hospital type noise suppressor shall be provided to minimizes the exhaust noise of the engine. Hospital type noise suppressor shall be placed outside the acoustic enclosure.

Exhaust System

The exhaust gas shall be taken out through a specially designed flexible pipe, to prevents any back pressure on the engine.

Thermal Insulation

The exhaust system and noise suppressor shall be provided with thermal insulation by using glass wool & covering it with Aluminium sheet to prevents it from transmitting excess heat on the engine, make it safe for the operator and enhances aesthetics.

Air Circulation & Ventilation System

A suitable forced air circulation and ventilation system shall be designed to maintain safe operating temperatures inside the enclosure. This forced ventilation

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

system will be provided through axial flow blowers meeting the requirement of air required for burning of fuel as well as cooling of engine.

Painting

Enclosure shall be painted with weather proof, acid proof, heat resistant, powder coated paint shade as approved by the Engineer-in-Charge after pretreatment for degreasing, derusting, pickling, phosphating and passivation.

Compliance of norms & assistance to contactor

DG Set Supplier/ Manufacturer shall ensure that complete DG Set in acousti enclosure meets the CPCB norms related to emission exhaust and sound pollution.

DG Set Supplier / Manufacturer shall provide technical support to DG Set Erection Contractor to obtain approvals / NOC from following departments / authorities :

- i) Noise pollution from CPCB.
- ii) Emission exhaust pollution from CPCB.

DG Set Supplier / Manufacturer shall also provide technical assistance & guidance to DG Set Erection Contractor during Site Tests & Trials prior to commissioning & handing over the DG Set installation to the Owner / Department.

DG Set Supplier / Manufacturer shall depute his Engineer during Site Tests & Trials runs.

Tools / Manual / Spare List

A set of tools & tackles shall be supplied alongwith each DG Set.

Operation & Maintenance manual shall be supply alongwith each DG Set.

DG Set Supplier / Manufacturer shall submit a list of recommended spare parts with recommended quantity.

Trial Run / Running-in-Period

After successful testing of the DG set, a trial run at available load will be carried out for each DG set for 120 hrs. or 15 days whichever is earlier. 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 will be made by the successful Contractor. However, diesel shall be provided by Engineer- in- Charge. 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 set has operated without any major break down/ trouble, it shall be taken over of the DG set, after trouble free

No. of Correction –C NIL
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No. of Insertions –I NIL

operation during the trial run / running-in-period, shall be the date of acceptance / taking over.

Fuel Handling Arrangements

Scope

The scope of this section comprises supply, installation, testing and commissioning of the fuel storage and handling system arrangement as per the drawings, specifications and the BOQ.

H.S.D. Piping

The piping for HSD shall be MS ERW heavy class of TATA/JINDAL make conforming to IS 1239. The piping shall be complete with flanges to BS 10 table F, long radius seamless bends, nuts, bolts gaskets, supports etc.

H.S.D. Day Tank

The HSD day tank shall be cubicle type made out of MS plates of 5 mm thickness conforming to IS 2003 with all welded joints. The tank shall be complete with Inlet, outlet, drain and overflow nozzles and level gauge glass, level control switches (magnetic type) and 2 Nos. solenoid valves, HSD Flow meter with strainer.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

xi) TECHNICAL SPECIFICATION OF HVAC SYSTEM

I SYSTEM DESIGN DATA

1. GENERAL

Brief description on proposed HVAC system for entire DTU building phase-II Delhi.

2. BASIS OF DESIGN PROPOSED

2.1 Climate Data

Ambient Design Conditions

SUMMER

Dry bulb temperature : 43.3 deg. C

Wet bulb temperature : 23.9 deg. C

MONSOON

Dry bulb temperature : 35.0 deg. C

Wet bulb temperature : 28.3 deg. C

WINTER

Dry bulb temperature : 7.2 deg. C

Wet bulb temperature : 5.0 deg. C

2.2 Proposed inside conditions for different building are as follows.

(For Summers & Monsoon)

Admin/Academic Block : 26.0 deg. C \pm 1

Relative humidity (RH) : Not exceeding 60 \pm 5%

2.3 Fresh Air : As per ASHRAE 62.1.2007

2.4 Equipment load : As per requirement.

2.5 Light load : As per ECBC

2.6 Occupancy : As per Actual

2.7 Toilet Exhaust : 10 Airchanges/hr.

2.8 **Heat Transfer Co- Efficient (BTU / Hr. x FT² x °F) (For Academic Block)**

Wall - 0.076

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Glass (Double Glazing) U-Value	-	0.24
SHGC (Double Glazing)	-	0.23
Roof	-	0.068

2.9 **Respiration Heat (BTU / Hr.) of People**

2.9.1 Seated very light work	Sensible Heat	Latent Heat
(Lecture Halls, Office, Academic, Labs etc	(BTU/hr :	(BTU/hr) 250 200

2.10 **Other Factors**

2.10.1 1 kwh : 3410 BTU / hr.

2.10.2 Bypass Factor of 4 row coil : 0.1

2.10.3 Bypass Factor of 6 row coil : 0.05

2.10.4 Safety room sensible heat : 10%

2.10.5 Latent heat safety : 7.5%

2.10.6 Return Heat gain +
Piping gain safety : 2.5%

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

II WATER COOLED SCREW CHILLERS.

General Description:

Factory assembled single piece water-cooled liquid chiller. Contained within the unit shall be all factory wiring, piping, controls, refrigerant charge (HFC-134a), refrigeration circuits set, screw compressors, electronic expansion valves and equipment required prior to field start-up.

Quality Assurance:

Unit performance shall comply with AHRI standard 550/590. All units shall be run-tested at the factory as a standard practice. Unit components shall be capable to withstand 60°C storage without damage, failure and refrigerant loss or safety risks.

Compressor:

Unit shall be equipped with semi-hermetic mono or twin screw compressor with internal relief valve and check valve to avoid reverse rotation on shut down. The discharge shall be equipped with a muffler to reduce discharge gas pulsations. Capacity control shall be provided by a variable control slide valve capable of reducing compressor capacity down up to 20% of full load. Compressor shall start in unloaded condition. Motor shall be cooled by suction gas and protected by internal winding temperature sensors. Compressor bearings shall be designed for minimum 73000 hours at maximum operating conditions. Lubrication oil system shall include pre-filter and external filter capable of filtration up to 5 microns.

Evaporator:

Unit shall be equipped with a single evaporator having two pass water arrangement. The maximum refrigerant-side working pressure shall be 1500 kPa and the maximum waterside pressure shall be 1000 kPa. The evaporator shall be mechanically cleanable, flooded type shell-and-tube type with removable heads. Tubes shall be internally and externally grooved high efficiency tubes, seamless-copper and shall be rolled into tube sheets. Shell shall be insulated with 19mm closed-cell foam. Evaporator thermal insulation shall be factory fitted. The evaporator shall have a drain and vent in each head. Chiller shall have only one water inlet & outlet connection with Victaulic couplings to avoid vibrations transmission and accept small misalignment during installation. The evaporator shall incorporate an active refrigerant level control system to ensure optimum heat transfer performance under all load conditions. Evaporator shall be fitted with electronic auto setting water flow switch.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Condenser:

Unit shall be equipped with a single condenser having two pass water arrangement. The maximum refrigerant-side working pressure will be 1500 kPa and the maximum

waterside pressure will be 1000 kPa. The condenser shall be mechanically cleanable shell-and-tube type with removable heads. Tubes shall be internally & externally grooved, seamless-copper and shall be rolled into tube sheets. Design shall incorporate single or multiple refrigerant circuits and is fitted with oil separator that is inside the condenser. The condenser shall have a drain and vent in each head. Chiller shall have only one water inlet & outlet connection with Victaulic couplings to avoid vibrations transmission and accept small misalignment during installation.

Refrigeration Circuits:

Refrigerant circuit components shall include compressor, oil separator, high & low side pressure relief devices, refrigerant economizer, filter driers, moisture indicating sight glasses, long stroke electronic expansion device and complete operating charge of both refrigerant HFC-134a & compressor oil.

Controls:

Unit controls shall include as a minimum: microprocessor with non-volatile memory, picture guided unit/operator interface, the LOCAL/OFF/REMOTE/CCN selector and a user interface with multiple language capability. Pressure sensors shall be installed to measure suction, discharge and oil pressure. Thermistors shall be installed to measure entering and leaving temperatures (on cooler and condenser side).

Unit shall be capable of performing the following functions:

- Automatic change-over during cycling of compressors to equalize running hours and number of starts.
- EXV control, based on throttling, optimizes evaporator charging, ensuring condenser superheat and sub cooling.
- Capacity control based on leaving chilled water temperature with return fluid temperature sensing.
- Limit the chilled water temperature pull-down rate at start-up to an adjustable range of 0.1°C to 1.1°C per minute to prevent excessive demand spikes at start-up.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- Enable reset of leaving chilled water temperature according to the return water temperature or by means of a 0-10V signal.
- Provide a dual set point for the leaving chilled water temperature activated by a remote contact closure signal or by the built-in time clock.
- Enable a 2-level demand limit control (between 0 and 100%) or a maximum current drawn limit activated by a remote contact closure or by the built-in time clock.
- Control evaporator water pump and the condenser pump.
- Allow two time scheduling programs to enable unit start-up control, demand limit and set-point changes.
- Enable lead-lag control of two chillers running in series or parallel.

Diagnostics:

Display module shall be capable of displaying set points, system status including temperatures, pressures, current for each compressor, run time and percent loading in an interactive interface. The control system shall allow a quick test of machine elements (heater, EXV, solenoid valves etc.) to verify the correct operation before the chiller is started.

Safeties:

Unit is equipped with through the door fused disconnect switch that allows for short circuit protection, along with operator safety. Each circuit can be separately switched off for servicing through the door fused disconnect switch. Unit shall be equipped with all necessary components and in conjunction with the control system shall provide the unit with protection against the following:

- Reverse rotation
- Low chilled water temperature
- Low oil pressure (per compressor)
- Current imbalance
- Compressor thermal overload
- Automatic compressor unloading in case of excessive condensing temperature
- High pressure
- Electrical overload
- Loss of phase

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Electrical Characteristics:

Unit shall operate on 3-phase power supply without neutral. Control voltage shall be supplied by a factory-installed transformer. Unit shall be supplied with factory-installed electrical disconnect/isolator with integrating main fuses. Unit shall have a factory installed star/delta starter as standard to limit electrical inrush current to within 2 times the maximum unit drawn current.

CHILLER PERFORMANCE TESTS (at factory on approved AHRI test bed).

To ensure quality, guaranteed efficiency and performance in compliance with the specified conditions, two of the four package liquid chiller shall be fully tested at the factory, Readings are to be taken in the presence of the client/PWD representative (If required and all expense tickets, Hotels etc. shall be bear by client/PWD).

Before dispatch and the test certificates needs to be submitted by the contractor and clearance shall be taken from Engineer-In-Charge before dispatch of the machines.

The tests shall be conducted at the manufacturer's factory or workshop where proper testing facilities are available at 25%, 50%, 75% and 100% at constant condenser temperature and the 5th point is at 100% load at AHRI condition to verify of COP 5.75, the test results shall be submitted to the PWD upon delivery of chiller. The design ambient condition should be simulated during the chiller performance test.

Defect Liability Period: -

The chillers shall be for the defect liability period of 2 years from the date of completion of the agreement. The contractor shall furnish the warranty/ guarantee certificate for the period of 2 years from the OEM to the department.

III PUMPS**1. GENERAL**

This section comprises the supply, erection, testing and commissioning of Pumps required for chilled water circulation for primary, secondary, condenser water circuits.

2. DESIGN

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

The pump shall be capable of developing the required total head at rated capacity for continuous operation. The pump shall operate satisfactorily at any point on discharge head characteristic curve over a range of 30% to 120% capacity or capacity corresponding to 70% of the total head whichever is lower. The pump shall run smooth without undue noise, vibration.

3. **CONSTRUCTION**

Pumps shall be end suction, top discharge/Long coupled vertical inline pumps type as per IS:1520-1660, IS:9079,IS:325 with the following construction:

Sl. No. Pump Description

i)	Casing	:	Cast Iron as per IS :210; grade FG260
ii)	Impeller	:	Bronze as per IS : 318
iii)	Impeller ring	:	Bronze
iv)	Shaft	:	High Tensile steel -EN8 or SS 410
v)	Shaft sleeve	:	Bronze
vi)	Bearings	:	Heavy duty Ball/Roller Bearings.
vii)	Base Plate	:	Cast Iron
viii)	Flanges	:	Conforming to I.S.1536/1960
ix)	Seal	:	Mechanical
x)	Max. Speed	:	1500 RPM
xi)	Driver type	:	T.E.F.C.
xii)	Starter	:	As per Schedule of Equipment.

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

Impeller shall be made in one piece and securely keyed to the shaft. Measures to prevent loosening during operation including rotation in the reverse direction shall be provided.

The critical speed of the pump shall be at least 30% above the rated speed. All the pumps shall be provided with mechanical seals.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

Common base plate shall be provided for pump and motor. Suitable holes shall be provided for grouting and these shall be so located that the base can be grouted in place without disturbing the pump and the motor. Adequate space shall be provided between pump drain connection and base plate for installation of minimum 15mm dia. drain piping. Foundation bolts shall be complete with nuts and washers.

The performance curves (capacity vs. total head, efficiency, NPSH and KW requirement) ranging from 0 to maximum capacity along with pump catalogue indicating dimensional details shall be submitted by the contractor along with their technical submittals for approval of Engineer-in-charge before procurement.

Driver ratings shown are only tentative and contractor shall select their drivers at least 15% in excess of the maximum B.H.P of the pump plus transmission losses if any. Drivers shall be supplied with starters unless otherwise stated.

Pump and driver shall be mounted on a single bed-plate and directly driven through flexible coupling in case of horizontal split casing pumps.

4. **PUMP MOTOR**

Pump motor shall be an AC electric motor EFF-1 type of squirrel cage induction motor suitable for 3 phase $415 \pm 10\%$ voltage variation, 50 Hz. The drive shall be weather proof with IP-55 protection.

5. **ACCESSORIES AND FITTINGS**

The following accessories shall be provided with each pump among other standard accessories:

Coupling guard for horizontal split casing pumps.

Lubrication fittings and seal piping.

Test and/or air vent cocks.

Following valves / fittings shall be provided with each pump among other standard fittings as required (itemized separately in the schedule of quantities and prices of pumps shall not include prices of these items):

Suction and discharge shut off valves (butterfly type) and discharge dual plate check valves as specified under section "PIPING".

Suction and discharge pressure gauges not less than 100mm dia and of the appropriate rating with gauge cocks etc. suction gauge shall be of compound type.

25mm G.I. gland drain piping to be covered under drain piping item.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

6. **INSTALLATION**

Pump shall be installed as per manufacturer's recommendations. Pump-sets shall be mounted on isolation pads or any other equivalent vibration isolation fitting. Concrete floating foundation shall be made by HVAC vendor as per approved shop drawings and specifications. The isolation pads between foundation and floor (as mentioned in schedule of quantities), foundation bolts etc. shall be supplied by the contractor with in tender cost. Contractor shall ensure that the foundation bolts are correctly embedded.

Pump-sets shall preferably be factory aligned, wherever necessary, site alignment shall be done by competent person. Before the foundation bolts are grouted and the couplings are bolted, the bed plate levels and alignment results shall be submitted to the Engineer in charge.

Complete Foundation work is in the scope of HVAC vendor and made after proper approval.

7. **INSULATION**

Pumps used for chilled water service shall be insulated as specified in section-"INSULATION".

Insulation shall be applied so that the split casing is not affected. Accessories and fittings shall also be insulated as required.

8. **TESTING**

Tenderers shall submit the performance curves of the pumps supplied by them. They shall also check the capacity and total head requirements of each pump to match his own piping and equipment layout.

On completion of the entire installation, pumps shall be tested, wherever possible, for their discharge, head, flow rate, B.H.P. Where it is not possible at least the discharge, head and B.H.P. (as measured on the input side) shall be field tested. Test results shall correspond to the performance curves.

9. **PAINTING**

After complete installation and testing, pumps accessories and fittings shall be given two coats as per CPWD application/Engineer-In-Charge.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

IV INDUCED DRAFT COOLING TOWER

1. GENERAL

These specifications covers the general requirements of design, material, manufacture, inspections, testing at works, delivery, installation, performance testing and commissioning of induced draft cooling tower.

2. CODES AND STANDARDS

The design, manufacture, inspection and performance of induced draft cooling towers shall comply with all locally applicable, regulations and safety codes. The equipment shall also conform to the latest applicable Indian and/or International Standards.

3. DESIGN CRITERIA

The equipment offered shall be capable of cooling the rated quantity of water through the specified range at the design wet bulb temperature.

In multi-cell construction, each cell shall be identical with other cells of the tower in all respects. The total heat load and flow shall be equally shared amongst the number of operating cells.

The structure shall be designed for wind and other loads as per IS: 875. The tower configuration shall be such that it shall offer minimum restriction to airflow. The tower design shall be compatible with manufacture of pre-fabricated parts to achieve simple, inexpensive field erection. Noise level shall not be more than 85 Db at a distance of 5 meter.

4. CONSTRUCTION

The cooling tower shall be complete with tower, basin, basin shall have water holding capacity adequate for operation for at least 30minutes without addition of makeup water. Foundation design and mechanical equipment as described/required. The tower shall be of single or double inlet, counter flow type of construction. The tower shall be of induced draft type with fan located on top of the tower.

Complete Foundation work is in the scope of HVAC vendor, foundation shall be made after proper approval.

5. CASING

Towers shall be induced draft type and in Fiber glass Reinforced Plastic construction. The enclosure/casing shall be single mounted and preferably rectangular shaped in appearance. The material of construction of enclosure/casing shall be F.R.P. and should be strong enough to withstand wind pressure. The casing shall be finished smoothly to minimize air friction.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Filling material shall be polyvinylchloride (PVC), shall be laid in a manner to achieve high heat transfer efficiency.

Water collection sump shall also be of F.R.P. material and in single molded construction to make the sump leak proof. The tower shall be carefully designed to avoid probability of water spillage. The sump shall be complete with outlet, overflow, quick-fill and drain connections of adequate sizes.

Inlet louvers for air intake shall be provided.

6. **INLET LOUVERS**

Louvers shall be given a proper slope. Spacing of the louvers shall be so arranged that the water loss is prevented. Design of louvers shall be such that it gives uniform distribution of air with minimum pressure drop.

7. **FILL**

Fill sheets shall be of heavy gauge fire-retardant PVC and shall be shaped to offer minimum resistance having minimum thickness of 0.2mm. Film type fill shall be supported and stabilized by structural tubing elevated above the cold water basin floor to facilitate cleaning.

8. **DRIFT ELIMINATORS**

The drift eliminators shall be designed to restrict the drift loss below 0.2 percent of the circulation rate. The air pressure drop across the eliminators shall be kept to a minimum. The water collected in the eliminators shall be returned to the tower basin and shall not mix with the discharge air stream.

9. **WATER DISTRIBUTION**

The hot water shall be distributed to the fill through troughs, distribution nozzles or orifices. The water shall be equally distributed among the working cells.

10. **FAN DECK**

Fan deck shall be sturdy in construction to transmit the live loads to the frame, to support the stack and act as an access platform for the mechanical equipment and distribution system.

11. **HARDWARE**

All hardware materials such as supporting angles, channel, rods, nut bolts etc. shall be of stainless steel.

12. **FAN**

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Fan shall be of multi-blade construction with aerofoil section blades. Air velocity at the fan blade tip speed shall not exceed 65M/sec. Fan blade shall be of cast or moulded construction. These shall be of easily removable and adjustable pitch type. Blade shanks and hubs shall be suitably insulated to prevent electrolytic corrosion.

13 **FAN DRIVES**

Fan drive shall be either of direct drive type or reduction gear type. The drive shaft shall have flexible coupling at both driving and non-driving ends. The flexible coupling bushings shall be of rubber. Drive shaft shall be dynamically balanced.

14 **FAN MOTOR**

Fan motor shall be an AC electric motor of IE-3 type squirrel cage induction suitable for 3 phase $415 \pm 10\%$ voltage variation, 50 Hz. The drive shall be weather proof with IP-55 protection.

The fan motor shall be suitable for VFD operation.

Fan shall be protected with a Fan Guard. The entire assembly should be easily accessible for maintenance.

Complete performance ratings and power consumption at varying loads and outdoor wet bulb temperatures and sound power data at full load shall be furnished by the tenderer along with technical submittals for approval before execution of the work and the same shall be verified at the time of testing and commissioning the installation.

15. **ACCESSORIES**

Cooling tower shall be provided with accessories stated as under:

- a) A stainless steel pipe ladder from ground level for access to fan deck.
- b) The hot water distribution basin shall be provided with suitable cover to avoid external falling objects.
- c) Each fan shall be provided with a suitable safety guard.
- d) Gauge type thermometer on the hot water inlet to each cell.
- e) Vibration isolators between fan and tower.
- f) Foundation bolts.
- g) Bottom/Side outlets.
- h) Drain connection with valves.
- i) Ball type automatic make up connections with valves.
- j) Overflow connections.
- k) Bleed off with valve from inlet header to overflow pipe.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

16. TESTS

After completion, the equipment shall be offered for visual inspection by Engineer-in-charge. Any work or component not in accordance with the specification and approved drawings shall be replaced to the entire satisfaction of the inspection authority.

Test certificates for materials of various components of cooling tower shall be furnished. Cooling capacities of the cooling tower shall be computed from the measurement of water flow rate, temperature of entering and leaving water and ambient air wet bulb temperature. Computed result shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from the measurement of input voltage and input current. For every incremental KW of power (or part thereof) above the guaranteed power consumption of the fan penalty shall be levied. Noise level at various locations shall be measured at night, by a sound pressure level meter.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

AE-I
(EPD-4)

EE
(EPD-4)

AE (P)
(CPM (Housing))

EE(P)
(CPM (Housing))

V DOUBLE SKIN AIR HANDLING UNITS

1. SCOPE

The Scope of this section comprises the supply, erection, testing and commissioning of air handling units conforming to these Specifications & drawings and in accordance with requirements.

2. TYPE

The Air Handling Units shall be of Draw through type having pre (MERV-8) section, cooling coil section suitable for chilled water and fan sections with direct driven plenum blower as per schedule of quantities.

3. CAPACITY

The air moving and coil capacities shall be as shown in schedule of quantities.

4. CASING

The housing/ casing of the air handling unit shall be of double skin construction. The housing shall be so made that it can be delivered at site in total/ semi knock down conditions depending upon the construction. The framework shall be of extruded aluminium hollow sections. All the members shall be assembled thru mechanical joints to make a sturdy and strong framework for various sections.

Double skin panels shall be made of 0.8mm pre-plasticized / pre coated Galvanized sheet steel and 0.8mm galvanized sheet inside with insulation of 25 ± 2 mm thick CFC free PUF injected insulation of 40 kg/m³ density.

The panels shall be bolted /screwed to the framework with soft rubber gasket in between to make the joints airtight. Suitable doors with powder coated hinges and latches shall be provided for access to various panels for maintenance.

The Fan and the motor arrangement shall be mounted on to the common framework. The entire housing i.e. The Air Handling Unit shall be mounted on minimum 3 mm GI Base channel framework.

Drain pan shall be constructed of 18 gauge SS sheet with 13 mm thick closed cell nitrile insulation. The K-value shall not be more than 0.029 Kcal/hr-sq.mtr-°C/M at 10°C mean temperature. The pan shall have necessary slope to facilitate for fast removal of condensate. The coil shall be mounted on the rollers in order to facilitate easy removal of the coil from the drain pan for cleaning.

5. MOTOR AND DRIVE

5.1 Fan motor shall be totally enclosed fan cooled type in IP-55 construction suitable for AC supply of $415 \pm 10\%$ V, 3 phases, 50 Hz, IE-3, Motor shall be selected

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

for quiet operation. Drive to fan shall be provided through belt-drive arrangement. Belts shall be oil-resistant type.

The fan motor shall be suitable for VFD operation.

5.2 **FANS**

Fan shall be forward curved, DIDW type. The fan housing, impeller shall be fabricated from 1.2/1.6 mm GI sheet. Fan impeller shall be mounted on a solid steel shaft statically and dynamically balanced. Shaft shall be supported to the housing with angle iron frame and pillow block heavy duty ball bearing. Fan housing shall be made of die-formed side sheets with streamlined inlets and guide vanes to ensure smooth air-flow into the fans. Fan housing and TEFC Fan motor in IP-55 Construction shall be mounted within the fan section on a common extruded Aluminum base mounted inside the air handling unit on anti-vibration mounts.

The fan outlet shall be connected with casing with the help of fire retardant canvass.

6. **COOLING COILS**

Chilled water coils shall have 12.7 mm (1/2") to 15mm (5/8") dia. tubes minimum 0.5 mm thick with 0.15 mm aluminium fins firmly bonded to copper tubes assembled in a zinc coated steel frame. Face and surface areas shall be such as to ensure rated capacity from each unit and such that the air velocity across each coil shall not exceed 150 meters per minute. The coil shall be pitched in the unit casing for proper drainage. Each coil shall be factory tested at 21 Kg./Sq.cm air pressure under water. Tube shall be hydraulically/mechanically expanded for minimum thermal contact resistance with fins. Fins spacing shall be such that number of fins shall not be less than be 4.7per cm. length.

7. **PRE FILTERS**

Each unit shall be provided with a 50 mm thick factory assembled pre filter section containing cleanable synthetic type air filters having anodized aluminium frame. These filters shall have the efficiency of 90% down to 10 microns. The media shall be supported with HDP mesh on one side and aluminium mesh on other side. Filters face velocity shall not exceed 500 Feet per Minute. Filters shall fit so as to prevent by-pass.

8. **ISOLATORS**

Vibration isolators shall be provided with all air handling units. The fan and motor framework shall be isolated from the AHU framework by means of spring type vibration isolators. The AHU shall be mounted on 6 inch high PCC platform suitable for weight of the AHU. The platform shall be 4 inch bigger than the AHU frame size from all sides. The framework of the AHU and the P.C.C. platform shall

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

be isolated by means of neoprene mats of size 150mmx150mm in two layers with 16g G.S.S. sheet sandwiched in between.

9. **FRESH AIR INTAKES**

Exhaust/Fresh air louvers of 80 mm thick high performance (55% free area) drainable fixed louver type Aluminium frame and blades. Mullions to be sliding interlock type with integral internal drain. Jamb and mullion drains to be open on front face in order to direct water away from inside of louver. Blades to be one piece extrusions with gutters design to catch and direct water to jamb and mullion drains. Fastners to be of aluminium. Louvers to have framed 13 mm mesh removable mill finish aluminium bird screens.

Powder coated fresh air louvers constructed out of extruded aluminium complete with bird screen, filters and damper shall be provided in the clear openings in masonry walls for fresh air of the air handling units. Louvers, filters, damper, and fresh air duct shall be provided for various air handling units as called for in the schedule of quantities. Fresh air dampers shall be of the interlocking opposed blade louver type. Blades shall be made of not less than 16 gauge aluminium sheet, edges covered with felt to provide air-tight closure, and shall be rattle-free. Dampers shall be equipped with brass / nylon bushes and bush bearings. Filters shall be similar to those earlier specified for air handling units. All hardware shall be corrosion resistant brass or Stainless steel.

10. **ACCESSORIES**

Each air handling unit shall be complete with the accessories including but not restricted to the following.

- Insulated isolation valves, Y-strainer, header drain valves, unions and insulated condensate drain piping up to sump or floor drain in air handling unit room / nearest point, as described in section "Piping of Schedule of quantities". Shall be paid extra as per BOQ.
- Manual air vents at high points in the cooling coil and drain plug in the bottom of the coil.- to be included in the cost of the AHU.
- Thermometers in thermometer wells and pressure gauges in test points in chilled water supply and return lines and control as specified under section "Control and Instruments" shall be paid extra as per BOQ item.
- Structural steel base for fan and motor to be designed and manufactured by the fan supplier to ensure proper alignment of the fan and motor and structural integrity of the base to prevent vibration.
- Door switch for internal light and to disconnect the supply of blower.

11. **PAINTING**

Powder coated paint that have become marred during shipment or erection shall be cleaned off with mineral spirits, wire brushed and spot primed over the affected areas, then coated with enamel paint to match the finish over the adjoining shop-painted surfaces.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

12. NOISE CONTROL

Air Handling Units shall be selected for the lowest operating noise level of the equipment. Fan performance rating, power consumption, and sound power data with operating points clearly indicated shall be submitted by the tenders alongwith technical submittals for approval and verified at the time of testing and commissioning of the installation. The sound level within the AHU room shall be less than 65 dB.

13. CONNECTIONS

Piping installation requirements are specified in other section. The Drawings indicate the general arrangement of piping, valves, fittings, and specialties. The following are specific connection requirements:

- Arrange piping installations adjacent to units to allow unit servicing and maintenance.
- Connect piping to air-handling units with flanges enabling easy removal of the coil.
- Connect condensate drain pans using 50 mm (2-0 inch) minimum, insulated G.I. pipe and extend to nearest floor drain. Construct deep trap (depth as per detail) at connection to drain pan and install cleanouts at changes in direction.
- Duct installations and connections are specified in other sections. make final duct connections with flexible connections.
- Electrical Connections: The following requirements apply:
- Electrical power wiring is specified in section Electrical.
- Temperature control wiring and interlock wiring is specified in Section "Electrical Control systems."
- Grounding: Connect unit components to ground in accordance with the Indian Electrical Code.

14. ADJUSTING, CLEANING, AND PROTECTING

- Adjust water coil flow, with control valves to full coil flow, to indicate lpm (gpm).
- Adjust damper linkages for proper damper operation.
- Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel, fan cabinet, and coils entering air face.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

15. COMMISSIONING

- Final Checks Before Start-Up: Perform the following operations and checks before start-up:
- Remove shipping, blocking and bracing.
- Verify unit is secure on mounting and supporting devices, connections for piping, ductwork and electrical are complete. Verify proper overload protection is installed in motors, starters, and disconnects.
- Perform cleaning and adjusting specified in this Section.
- Lubricate bearings and other moving parts with factory recommended lubricants.
- Set outside-air / supply air dampers to minimum outside-air setting.
- Comb coil fins for parallel orientation.
- Install temporary throw away filters for initial run and finally install clean filters.
- Verify manual and automatic volume control, and fire dampers in connected ductwork system are in the full-open position.
- Disable automatic temperature control operators.
- Starting procedures for central-station air-handling units:
- Energize motor, verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicate RPM.
- Replace fan and motor couplings as required to achieve design conditions.
- Measure and record motor electrical values for voltage and ampere.
- Shut down and reconnect automatic temperature control operators.

16. TESTING

Cooling capacity of various Air handling units shall be computed from the measurements of air flow and dry and wet bulb temperatures of air entering and leaving the coil. Flow measurements shall be by a calibrated rotating vane anemometer and temperature measurements by accurately calibrated mercury-in-glass thermometers. Computed ratings shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current, whereas, noise level at various locations within the conditioned spaces shall be measured by a sound pressure level meter.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

VI DOUBLE SKIN UNITARY AIR HANDLING UNITS

(CEILING SUSPENDED TYPE)

1. SCOPE

The Scope of this section comprises the supply, erection, testing and commissioning of unitary (ceiling suspended) type air handling units conforming to these Specifications & drawings and in accordance with requirements.

2. TYPE

The Unitary Air Handling Units shall be of Draw through type having pre (MERV-8) section, cooling coil section suitable for chilled and fan sections with direct driven plenum/plug blower as per schedule of quantities.

3. CAPACITY

The air moving and coil capacities shall be as per scheduled BOQ.

4. CASING

The housing/ casing of the unitary air handling unit shall be of double skin construction. The framework shall be of extruded aluminium hollow sections. All the members shall be assembled thru mechanical joints to make a sturdy and strong framework for various sections.

Double skin panels shall be made of 0.8mm pre-plasticized coated Galvanized sheet steel and 0.8mm galvanized sheet inside with insulation of 25 ± 2 mm thick CFC free PUF injected insulation of 40 kg/m³ density.

The panels shall be bolted/screwed on to the framework with soft rubber gasket in between to make the joints airtight. Suitable doors with powder coated hinges and latches shall be provided for access to various panels for maintenance.

The Fan and the motor arrangement shall be mounted on to the common framework. The entire housing of unitary Air Handling Unit shall be suspended from slab.

Drain pan shall be constructed of 18 gauge SS sheet with 13 mm thick closed cell nitrile insulation. The K-value shall not be more than 0.029 Kcal/hr-sq. mtr. -°C/M at 10°C mean temperature. The pan shall have necessary slope to facilitate for fast removal of condensate. The coil shall be mounted on the rollers in order to facilitate easy removal of the coil from the drain pan for cleaning.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

5. **MOTOR AND DRIVE**

5.1 Fan. Belts shall be oil-resistant motor shall be totally enclosed fan cooled type in IP-55 construction suitable for AC supply of $415 \pm 10\%$ V, 3 phases, 50 Hz., EFF-1, Motor shall be selected for quiet operation. Drive to fan shall be provided through belt-drive arrangement type.

5.2 **FANS**

Fan shall be forward curved, DIDW type. The fan housing, impeller shall be fabricated from 1.2/1.6 mm GI sheet. Fan impeller shall be mounted on a solid steel shaft statically and dynamically balanced. Shaft shall be supported to the housing with angle iron frame and pillow block heavy duty ball bearing. Fan housing shall be made of die-formed side sheets with streamlined inlets and guide vanes to ensure smooth air-flow into the fans. Fan housing and TEFC Fan motor in IP-55 Construction shall be mounted within the fan section on a common extruded Aluminum base mounted inside the air handling unit on anti-vibration mounts.

The fan outlet shall be connected with casing with the help of fire retardant canvass.

6. **COOLING COILS**

Chilled water coils shall have 12.7 mm (1/2") to 15mm (5/8") dia. tubes minimum 0.5 thick with 0.15 mm aluminium fins firmly bonded to copper tubes assembled in a zinc coated steel frame. Face and surface areas shall be such as to ensure rated capacity from each unit and such that the air velocity across each coil shall not exceed 150meters per minute. The coil shall be pitched in the unit casing for proper drainage. Each coil shall be factory tested at 21 Kg./Sq.cm air pressure under water. Tube shall be hydraulically/mechanically expanded for minimum thermal contact resistance with fins. Fins spacing shall not less than 4.7 per centimeter length. The coil shall be 4-6 row deep. The coil shall be designed for water velocity of 0.6 to 1.8 m/sec.

7. **PRE FILTERS**

Each unit shall be provided with a 50 mm thick factory assembled pre filters containing cleanable synthetic type air filters having anodized aluminium frame. These filters shall have the efficiency of 90% down to 10 microns .The media of pre-filter shall be supported with HDP mesh on one side and aluminium mesh on other side. Filters media velocity shall not exceed 500 Feet per Minute. Filters shall fit so as to prevent by-pass.

8. **FILTER ASSEMBLY**

The housing shall be made from extruded aluminium sections. All joints shall be sealed airtight and shall be made free of all burrs and sharp edges.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

The filter loading mechanism shall be sliding type or front loading type. The locking mechanism shall be a spring loaded, toggle type mechanism with a bolt and thrust assembly which shall thrust the filter evenly against the sealing flange of the housing when it is installed.

9. **ISOLATORS**

Ceiling-suspended horizontal units mounted within the ceiling space shall be hung through neoprene in shear type vibration isolation suspensions, placed between the suspender rods of sizes as per the details drawings..

10. **ACCESSORIES**

Each air handling unit shall be complete with the accessories including but not restricted to the following.

- Insulated isolation valves, Y-strainer, header drain valves, unions and insulated condensate drain pan, drain piping upto nearest drain point, as described in section "Piping of Schedule of quantities".
- Manual air vents at high points in the cooling coil and drain plug in the bottom of the coil.- to be included in the cost of the AHU.
- Structural steel base for fan and motor to be designed and manufactured by the fan supplier to ensure proper alignment of the fan and motor and structural integrity of the base to prevent vibration.
- Door switch for internal light and to disconnect the supply of blower.

11. **PAINTING**

Powder coated paint that have become marred during shipment or erection shall be cleaned off with mineral spirits, wire brushed and spot primed over the affected areas, then coated with enamel paint to match the finish over the adjoining shop-painted surfaces.

12. **NOISE CONTROL**

Unitary Air Handling Units shall be selected for the lowest operating noise level of the equipment. Fan performance rating, power consumption, and sound power data with operating points clearly indicated shall be submitted by the tenderer during submission of technical submittals for approval and verified at the time of testing and commissioning of the installation. The sound level within one meter range shall be less than 60 dB.

13. **CONNECTIONS**

Piping installation requirements are specified in other section. The Drawings indicate the general arrangement of piping, valves, fittings, and specialties. The following are specific connection requirements:

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

- Arrange piping installations adjacent to units to allow unit servicing and maintenance.
- Connect piping to unitary air-handling units with flanges enabling easy removal of the coil.
- Connect condensate drain pans and shall be connected to nearest floor drain by extending drain piping.
- Duct installations and connections are specified in other sections. make final duct connections with flexible connections.
- Electrical Connections: The following requirements apply:
- Electrical power wiring is specified in section Electrical.
- Temperature control wiring and interlock wiring is specified in Section "Electrical Control systems."
- Grounding: Connect unit components to ground in accordance with the Indian Electrical Code.

14. **ADJUSTING, CLEANING, AND PROTECTING**

- Adjust water coil flow, with control valves to full coil flow, to indicate lpm (gpm).
- Adjust damper linkages for proper damper operation.
- Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel, fan cabinet, and coils entering air face.

15. **COMMISSIONING**

- Final Checks Before Start-Up: Perform the following operations and checks before start-up:
- Remove shipping, blocking and bracing.
- Verify unit is secure on mounting and supporting devices, connections for piping, ductwork and electrical are complete. Verify proper overload protection is installed in motors, starters, and disconnects.
- Perform cleaning and adjusting specified in this Section.
- Lubricate bearings and other moving parts with factory recommended lubricants.
- Set outside-air / supply air dampers to minimum outside-air setting.
- Comb coil fins for parallel orientation.
- Install temporary throw away filters for initial run and finally install clean filters.
- Verify manual and automatic volume control, and fire dampers in connected ductwork system are in the full-open position.
- Disable automatic temperature control operators.
- Starting procedures for central-station air-handling units:
- Energize motor, verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicate RPM.
- Replace fan and motor couplings as required to achieve design conditions.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

- Measure and record motor electrical values for voltage and ampere.
- Shut down and reconnect automatic temperature control operators.

16. **TESTING**

Cooling capacity of various Unitary Air handling units shall be computed from the measurements of air flow and dry and wet bulb temperatures of air entering and leaving the coil. Flow measurements shall be by a calibrated rotating vane anemometer and temperature measurements by accurately calibrated mercury-in-glass thermometers. Computed ratings shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current, whereas, noise level at various locations within the conditioned spaces shall be measured by a sound pressure level meter.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

VII INLINE/AXIAL/PROPELLER FAN

1. SCOPE

The Scope of this section comprises supplying, storing, erection, testing and commissioning of Inline Fan, Axial Fan & Propeller Fan, including foundation work conforming to these Specifications and in accordance with requirements of schedule of quantities.

2. INLINE FAN/AXIAL FANS

2.1 INLINE FAN

1. The Inline fans shall be cabinet/circular type meeting the site requirement and as per manufacturer standard specification.

- i) Housing shall be constructed of strong galvanized steel in riveted/welded construction.
- ii) Fan Wheel shall be backward/forward curved type, Fan Wheel shall be statically and dynamically balanced.
- iii) Shaft shall be constructed of steel.
- iv) Bearings shall be of the ball-bearing type mounted on the fan housing. Bearings shall be designed especially for quiet operation and shall be of the self-aligning, self lubrication type.
- v) Motor shall be suitable for 230 volts, 50 cycles, 1 phase power supply direct driven centrifugal impeller. Motor name plate horsepower shall exceed brake horsepower by minimum of 10%. Motor shall be designed specially for quiet operation. Drive to fan shall be direct driven.

vi) All accessories required for proper installation and commissioning.

2.2 AXIAL FLOW FAN

- i) The fans shall be of the direct driven axial type with cast aluminum airfoil propellers.
- ii) The casing shall be constructed of continuously welded steel and include integral punched inlet and outlet flanges to prevent air leakage. The casing and motor base shall be constructed from precision laser cut and formed members of heavy gauge steel to prevent vibration and rigidly support the motor. Motor support brackets shall be welded to fan casing for increased strength.
- iii) Motor shall be suitable for operation on $415 \pm 10\%$ Volt, 50 Hz, AC supply with IE-2 ratings & "H" class insulation.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- iv) Blades shall be airfoil design. Hub and blades shall be a high strength cast aluminum alloy. Blade pitch shall be manually adjustable with out removing from the fan casing. Rotors shall be statically and dynamically balanced. A tapered lock bushing shall be used to mount the propeller to the motor shaft.
- v) All the Steel casings and structural components shall be coated as per manufacturer standard.
- vi) Fan performance shall be based on tests conducted in accordance to AMCA 210 (meets BS848 part 1), licensed to bear the AMCA Air and noise label in accordance with AMCA Publication 211 and comply with the requirements of the AMCA Certified Ratings Program.
- vii) The motor assembly shall be fire rated for high temperature application (250 °C for minimum of 2 hours).
- viii) All required accessories as required as per site requirement.

2.3 PROPELLER FAN

- i) Propeller fans shall be direct – driven, three or four blade type, mounted on a steel mounting plate with orifice ring.
- ii) Mounting plate shall be of heavy gauge sheet steel construction, streamlined venturi inlet (reversed) for supply applications. The mounting plate size shall suit the fan size.
- iii) Fan blades shall be constructed of aluminium or steel. Fan hub shall be of heavy welded steel construction with blades bolted to the hub. Fan blades and hub assembly shall be statically and dynamically balanced at the factory.
- iv) Motor shall be standard (easily replaceable) single phase, permanent split capacitor or shaded pole for small sizes, totally enclosed with pre – lubricated sleeves or ball bearings, designed for quiet operation. Motor for larger fan shall be suitable for $415 \pm 10\%$ volts, 50 cycles, 3 phase, power supply. Motors shall be suitable for either horizontal or vertical services.
- v) The following accessories may be required and provided with propeller fans, as indicated in the tender specified
 - a) Wire guard on inlet sides and bird screen at the outlet.
 - b) Gravity operated louver shutters built into a steel frame.
 - c) Regulators for controlling fan speed for single phase fan motors.

2.4 INSTALLATION

- i) The Contactor shall supply all required bolts, base frame (wherever (wherever required), vibration isolators any other accessories and shall assure that the components are placed securely in proper position.
- ii) Vibration isolators shall be provided with an efficiency of not less than 80%.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

2.5 TESTING

All the fans shall be tested for performance at the factory and the following test results shall be furnished.

- i) C F M
- ii) Static pressure at the specified flow rate
- iii) KW input to motor

VIII AIR DISTRIBUTION

SHEET METAL WORK AND INSULATION:

1. GENERAL

This section comprises of supply, fabrication, installation and testing of all sheet metal ducts and supply, installation, testing and balancing of grilles, registers and diffusers, in accordance with these specifications.

2. DUCT MATERIAL

- i) All ducts shall be fabricated from galvanized steel sheet (GSS) conforming to IS-277. The steel sheet shall be hot dipped galvanized with coating of minimum 120 grams per square meter (GSM) of Zinc. All sizes tolerance shall not be negative.
- ii) The thickness of sheets for fabrication of rectangular ductwork shall be as under. The thickness required corresponding to the larger side of the rectangular section shall be applicable for all the four sides of the ducts.

	Gauge	Thickness (mm)
Ducts upto 750mm	24	0.63
751 mm and upto 1500mm	22	0.80
1501mm and upto 2250mm	20	1.00
2251mm and above	18	1.25

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Factory fabricated ducts shall have the thickness of the sheet as above and should have beading at every 300mm.

Recommended SMACNA Standard at 4 Feet Transverse Joint Reinforcement

Duct static pressure	
Sin Inches	2"
Duct Size (mm)	
0-750	E-24
751-1500	G-22
1501-2250	H-20
Above 2250	J-18

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

Note:

- SMACNA – Sheet Metal & Air Conditioning Contractor National Association Inc. “ HVAC Duct construction standard Metal & Flexible” – 1995 USA.
- In 1” static pressure i.e. comfort cooling application optional “ C&S and C&SS cleats joints can be used
- Upto 450mm duct size use C&S Cleats
- 451 mm to 750mm duct size use “ C&SS cleats.
- Over 750mm duct size use TDC Flanges with respective gauges as mentioned above.
- Alphabets B, C, D, E, F, G, H, I and J as per SMACNA 1995, transverse joint reinforcement table 1-12m (T-25b flanged) and TDC addendum.
- R means reinforcement with Zeebar Stiffener.

3. DUCT FABRICATION

All Galvanized ducts shall be **factory fabricated** from lock form grade galvanized sheet steel as per latest SMACNA specification and spell out in para 2.0. **To suite pieces** shall be fabricated **at site** as per IS: 655 latest editions. Factory fabricated duct shall be delivered at site in L shape and made in the form of box at site as per SMACNA standard.

Ducts shall be straight and smooth on all inside with neatly finished joints. All joints shall be made airtight by applying sealant during the assembly of the

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

ductwork, Sealing of the seams shall be accomplished by using approved sealant. Transverse joints shall be made using sponge rubber sulphur-free foam rubber gasketing (3mm thick and 20mm wide) All exposed ducts within conditioned spaces shall have only slip joints and no flanged joints. The internal ends of slip joints shall be made in the direction of Air flow.

Changes in dimensions and shape of ducts shall be gradual. Curved elbows, unless otherwise approved, shall have a center line radius equal to one and half times the width of the duct. Air turns shall be installed in all abrupt elbows and shall consist of curved metal blades or vanes, arranged to permit the air to make the turns without appreciable turbulence.

All ducts shall be rigid and shall be adequately supported and braced where required with standing seams to keep the ducts true to shape and to prevent buckling, vibration or breathing.

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

Volume control dampers shall be installed with duct configuration as required.

4. **DUCT INSTALLATION**

All ducts shall be installed generally as per the drawings and in strict accordance with approved shop drawings.

The contractor shall provide and neatly erect all sheet metal work as may be required to carry out the intent of these specifications. This work shall meet with the approval of the Engineer-in-charge in all its parts and details.

All necessary allowances and provisions shall be made by the contractor for beams, pipes, or other obstructions in the buildings, whether or not the same are shown on the architectural drawings. Where it becomes necessary to avoid beams or other structural work, plumbing or other pipes, and/or conduits, the ducts shall be transformed, divided or curved to one side, the required area being maintained as approved or directed by the Engineer-in-charge. The contractor shall install the

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

duct between the required points of the obstructions by any path available, subject to the approval of the Engineer-in-charge.

All duct work shall be independently supported from building elements or as required by the Engineer-in-charge. All horizontal ducts shall be rigidly and securely supported, in an approved manner, within hangers formed of GI rods and GI cleats under ducts not greater than 2 meter centers. All vertical duct work shall be supported by structural members at each floor.

Support System

A completely galvanized system consisting of fully threaded rods, slotted angles or double L bottom brackets (made out of 3.0 mm M.S. sheet) nuts, washer and anchor bolts confirming to SMACNA standards should be used.

Sr. No.	Maximum Duct Size(mm)	Hanger Rod Diameter	Interval (mm)
1.	Up to 700	6 mm	2000
2.	701 – 1200	8 mm	2000
3.	1201 – 2000	10 mm	2000
4.	Above 2000	12 mm	2000

As an alternative, slotted galvanized brackets attached to the top two bolts of the system may also be used as appropriate for the site condition.

To provide the required thermal brake effect, Neoprene or equivalent material of suitable thickness shall be used between duct support and duct profiles in all supply air duct does not enclosed by return air plenums.

Ducting on top of the ceiling shall be supported from the slab above, or from beams, after obtaining approval of the Engineer-in-charge. In no case shall a duct be supported from the ceiling hangers or be permitted to rest on a hung ceiling.

All metal work in dead or closed down spaces shall be erected in time to occasion no delay to other contractors in the building.

All ducts shall be totally free from vibration under all conditions of operations. Whenever duct work is connected to fans, that may cause vibrations in the duct, ducts shall be provided with two flexible connections located close to the unit in mutually perpendicular directions. Flexible connection shall be constructed of fire

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

resistant flexible double canvas sleeves at least 10 cm long, secured properly and bolted at both ends. Sleeve shall be made smooth and the connecting duct work rigidly held by independent supports on both ends. The flexible connection shall be suitable for pressures at the point of installation.

The two mating flanges of the ducts being joined with each other shall be made air tight by providing 3mm thick 20mm wide Sulphur-free foam rubber gasket on mating flanges.

5. **DAMPERS**

All dampers shall be of Galvanised iron construction with louver dampers of robust construction and tightly fitted. The design, method of handling, and control shall be suitable for the location and service required.

The damper shall be of opposed blade type. The sheet thickness of blade shall be 0.8 mm and of the frame shall be 1.0 mm.

Dampers shall be provided with suitable links, levers and quadrants as required for their proper operation; control or setting devices shall be made robust, easily operable and accessible through suitable access doors in the ducts. Every damper shall have an indicating device clearly showing the damper position at all times.

Dampers shall be placed in ducts and at every branch of supply air duct connections, whether or not indicated on the drawings, for the proper volume control and balancing of the system.

All the dampers at grille collars shall be of extruded aluminium construction with louver dampers of robust construction and tightly fitted

6. **Fire & Smoke Dampers**

- i) Fire dampers shall be provided in all supply air ducts and return air ducts (where provided), return air passage in the air – handling unit room and at all floor crossings. Access door will be provided in the duct before each set of fire dampers.
- ii) Fire dampers shall be multi blade louvers type. The blade should remain in the air stream in open position and shall allow maximum free area to reduce pressure drop and noise in the air passage. The blades and frame shall be constructed with minimum 1.6mm thick galvanized sheet and shall be factory fitted in a sleeve made out of 1.6mm galvanized sheet of minimum 400mm long. It shall be complete with locking device, motorized actuator and control panel.
- iii) Fire dampers shall be motorized smoke and fire dampers type. It shall be supplied with spring loaded UL stamped fusible link to close fire damper in the event of rise in duct temperature. Fire damper shall also close on receipt of fire

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

alarm signal to cut off air supply instantaneously. An electric limit switch shall also be operated by the closing of fire damper, which in turn shall switch off power supply to AHU blower motor.

- iv) Fire dampers shall be CBRI tested and certified for 90 minutes rating against collapse and flame penetration as per UL 555 – 195. (Under writers laboratories).
- v) Fire dampers shall be compatible with the fire detection system of building and shall be capable of operating automatically through an electric motor on receiving signal from fire alarm panel.
- vi) Necessary wiring from fire alarm panel up to AHU electric panel shall be provided by the other sub associates of fire alarm package and further from AHU electric panel to fire damper shall be provided by air conditioning contractor.

7. SUPPLY AIR REGISTERS/GRILLES

Supply air registers shall be of approved make and of aluminium construction with individually adjustable bars. Supply air registers shall be double deflection type, with removable key-operated volume control dampers. The outer frame shall be made from drawn aluminium sections.

All registers shall be selected in consultation with the Engineer.-in-charge, Different spaces shall require horizontal or vertical face bars, and different width of margin frames.

All registers shall have a soft, continuous rubber gasket between the periphery of the register and the surface on which it has to be mounted.

Registers shall be adjustable pattern as such grill bar shall be pivotable to provide pattern with 0 to 100 degree horizontal arc and upto 30 degree deflection up or down. Bars shall hold deflection settings under all conditions of velocity and pressure.

Bars longer than 45 cm shall be reinforced by a set back vertical member.

Registers shall be given a rust inhibiting prime coat and factory applied powder coated finish of approved colour.

8. SUPPLY AIR DIFFUSERS

Diffusers shall be of approved make and of Aluminium construction, square / rectangular in shape with flush fixed pattern or adjustable flow pattern. Diffusers for different spaces shall be selected in consultation with the Engineer-in-charge.

All supply air diffusers shall be equipped with removable key-operated volume control dampers. Anti-smudge ring may be required in specific applications. The

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

outer shell and diffusing assembly shall be made out of powder coated drawn aluminium section respectively.

9. **OUTSIDE AIR LOUVERS**

Exhaust/Fresh air louvers of 80 mm thick high performance (55% free area) drainable fixed louver type powder coated Aluminium frame and blades. Mullions to be sliding interlock type with integral internal drain. Jamb and mullion drains to be open on front face in order to direct water away from inside of louver. Blades to be one piece extrusions with gutters design to catch and direct water to jamb and mullion drains. Fasteners to be aluminium. Louvers to have framed 13 mm mesh removable mill finish aluminium bird screens.

10. **TESTING AND BALANCING**

After completion of the installation of the complete air distribution system, all ducts shall be tested for air leaks. Before painting the interiors, air distribution system shall be allowed to run continuously for 48 hours for driving away any dust or foreign material lodged within ducts during installation.

The entire air distribution system shall be balanced using approved anemometer. Air quantities at the fan discharge and at various outlets shall be identical to +/-5 percent in comparison of those specified and quoted. Leakage in each air distribution system shall be within 3 percent so that supply air volume at each fan shall be identical to, or no greater than 3 percent in excess of, the total air quantity measured at all supply outlets served by the fan. Branch duct adjustments shall be made by volume or splitter dampers. Dampers shall be permanently marked after air balance is complete so that these can be restored to their correct position if disturbed at any time. Complete air balance report shall be submitted to the Engineer.-in-charge. for scrutiny and approval, and six copies of the approved report shall be provided with completion documents.

IX PIPING

1. **SCOPE**

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

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

2. CHILLED AND CONDENSER WATER PIPING

2.1 All piping laid shall be as follows:

PIPE SIZE	MATERIAL		JOINTS & FITTINGS	SEALING MATERIAL
Upto 40 mm	M.S tube	(i)	Screwed/Welded	(i) Non-hardening
	Heavy Class	(ii)	Unions	(ii) Lubricant
	I.S. 1239	(iii)	Slip-on flanges	(iii) 3mm, 2-ply
	Latest revision			Rubber insertion.
50mm to 150mm	M.S tube	(i)	Welded	-----
	Heavy Class	(ii)	Slip-on flanges	
	I.S. 1239	(iii)	Slip-on flanges	(iii) 3mm, 2-ply
	Latest revision			Rubber insertion.
200 mm to 300 mm	E.R.W Pipes	(i)	Welded	-----
	I.S. 3589	(ii)	Slip-on flanges	
		(iii)	3mm, 2 ply	
	Latest revision			Rubber Insertion

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

350 mm	E.R.W Pipes	(i)	Welded	-----
and over				
	I.S. 3589	(ii)	Slip-on flanges	
		(iii)	6mm, 2 ply	
	Latest revision			Rubber Insertion

Pipe flanges to IS:6392 for all sizes.

- 2.2 All piping shall be black steel unless otherwise stated. Pipes shall be given one primary coat of red-oxide paint before being installed. Pipes shall be sloping towards drain points.
- 2.3 Fittings shall be new and from approved manufacturers, Fittings shall be of malleable casting of pressure ratings suitable for the piping system. Fittings used on welded piping shall be of the weldable type. Flanges shall be new. Supply of flanges shall include bolts, washers gaskets, etc., as required.
- 2.4 All equipment and valve connections shall be through flanges (Screwed for galvanised steel).
- 2.5 All welded piping is subject to the approval of the Engineer-in-Charge and sufficient number of flanges and unions shall be provided.
- 2.6 Gate valves/wafer type Butterfly valves shall be provided as required Conforming to the following specifications :

Butterfly valves shall conform to BS:5155, MSS SP 67 & API 609 and designed to fit without gaskets between mating flanges. The valves shall be suitable for flow in either direction and seal in both directions. The valve shall be of integral moulded design. Disc - SG Iron to IS:1865 SG 400/12. & BS:2789 Gr420/12 Nylon coated. The valve shall be of PN 16 rating.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

2.7 BUTTERFLY VALVES

a) size up to 150 mm dia (PN 16) Handle Operated

b) size 200 mm dia and above (PN16) Gear Operated

2.8 TWO WAY MOTORIZED BUTTERFLY VALVE

2.8.1 Valve

- a. Type of valve : Butterfly Valve.
- b. Body Material : Carbon steel ASTM A 216
- c. Body seat ring (if applicable) : Gr WCB
- d. Vane : SS-316
- e. Packing : Teflon
- f. Mounting Stool : Required.
- g. Shaft : SS-316/416
- h. Seat : Nitrile rubber
- J Fasteners : SS-316

2.8.2 Actuators

- Type : Electric .
- Duty. : On/Off
- Motor power supply : 230 V AC or 415 V 3-phase
- Hand wheel : Required
- Speed : As per manufacturer standard

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

NOTE:-

- a. Actuator must open/ close with one changeover contact. Control panel, if required, must be supplied integral with the Actuator.
- b. No gear box is envisaged, however if gear box is provided, the travel limit switches must be connected directly to the valve stem.
- c. Cover tube for the valve stem must be provided.

2.9 BALANCING VALVES

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

3. STRAINERS**3.1 Y-Strainers**

Strainers shall be preferably of the approved 'Y' type with fabricated steel bodies designed to the test pressures specified for the gate valves. Strainers shall have removable SS screen with 3.0 mm perforations and a permanent magnet. Strainers shall be provided with flanges or threaded sockets as required. They shall be designed so as to enable blowing out accumulated dirt and facilitate removal and replacement of screen without disconnection of the main pipe. All strainers shall be provided with equal size isolating valves so that the strainer may be cleaned without draining the system. Strainers shall be provided on the suction side of each pump; and inlet side of heat exchanger equipment.

3.2 Pot Strainers

Strainers shall be of approved type with fabricated steel bodies designed to the test pressures specified for the valves. Strainers shall have removable stainless steel screen with 1.5 mm perforations and a permanent magnet. Strainers shall be provided with flanges as required. They shall be designed so as to enable blowing out accumulated dirt and facilitate removal and replacement of screen without disconnection of the main pipe. All strainers shall be provided with equal size isolating valves and by-pass line so that the strainer may be cleaned without draining the system. Strainers shall be provided on the suction header of the pumps wherever shown in the drawings. The velocity across the filter mesh should not exceed one fifth of the velocity in the connecting pipe. The area of the filter mesh shall be five times of the area of the pipe connection.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

4. **EXPANSION TANK & AIR SEPARATOR**

4.1 **EXPANSION TANK**

The chilled water system shall be provided with pre-charged steel expansion tank in the plant room as shown on the drawings. The tank should be designed to absorb the expansion forces of the chilled water system while maintaining proper system pressure under varying operating system conditions. The shell of the tank shall be constructed out of carbon steel conforming to section 8, of ASME boiler & pressure vessel code. The vessel shall be designed for maximum design pressure of 150 psig. The tank shall be painted with one shop coat of dry enamel paint. The tank shall be provided with two 1 inch tappings in the shell for safety relief and system connection. The tank shall also have suitably sized drain connection. The tank shall have replaceable type, butyl – rubber bladder. The tank shall be pre-fitted with lifting rings & shall have suitable mounting arrangement. Expansion Tank shall be with pressurization unit complete with pressure gauges, transmitter, valves etc. including 2 pump sets (1 working 1 standby) whole assembly shall be from one source, pump rating shall be as per manufacturer standard and as per requirement.

5. **PIPING INSTALLATION**

The drawings indicate schematically the size and location of pipes. Pipes runs and sizes may, however, be changed to meet the site conditions. The Contractor on the award of the work, shall prepare detailed shop drawings showing the cross section, longitudinal section, detail of fittings, locations of isolating drain and air valves etc. They must keep in view the specific openings in buildings and other structures through which the pipes are designed to pass.

- 5.1 Piping shall be properly supported on or suspended from stands, clamps, hangers etc, as specified and as required. The tenderer shall adequately design all the brackets, saddles, clamps, hangers etc. and be responsible for their structural integrity.
- 5.2 Pipe supports shall be of M.S, adjustable for height and primer coated with rust preventive paint and finish coated black. Where pipe and clamp are of dissimilar material, a gasket shall be provided in between.

Spacing of pipe supports shall not exceed the following :

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Pipe Size (mm)	Spacing (M)
12 to 15	1.25
20 to 25	2.00
32 to 125	2.50
150 and above	3.00

Extra supports shall be provided at the bends and at heavy fittings like valves etc.

Pipe hangers shall be fixed on ceilings and walls by means of metallic cleats with fasteners/ Grouting in case of walls.

- 5.3 Vertical risers shall be parallel to walls and column lines and shall be straight and plumb. Risers passing from floor to floor shall be supported at each floor by clamps or collars attached to pipe and with a 12mm thick ribbed rubber pad or any other approved resilient material. Where pipes pass through the terrace floor, suitable curbing shall be provided to prevent water leakage.
- 5.4 Insulated piping shall be supported in such a manner as not to put undue pressure on the insulation. 1.80mm metal sheet shall be provided between insulation and the clamp saddle or roller extending at least 150mm on both sides of the clamp, saddle or roller.
- 5.5 Piping work shall be carried out with minimum disturbance to the other works being done at the site. A programme of work shall be chalked out in consultation with the Engineer-In-Charge.
- 5.6 Piping layout shall take due care for expansion and contraction in pipes.
- 5.7 All pipes using screwed fittings shall be accurately cut to the required sizes and threaded in accordance with IS:554/1955 and burrs removed before laying. Open ends of the piping shall be blocked, as the pipe is installed, to avoid entrance of foreign matter. Wherever reducers are to be made in horizontal runs, eccentric reducers shall be used if the piping is to drain freely, in other locations, concentric reducers may be used.
- 5.8 Air valves shall be provided at all high points in the piping system for venting. Valves shall be of the double float type, with gun metal body, vulcanite balls, rubber seating, etc. Air valves shall be of the sizes specified and shall be associated with an equal size gate valve with rising spindle to be 25 mm dia.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Drains shall be provided with drain plug valve equal size. Drains shall be piped through equal size G.I. pipe to the nearest drain or floor waste. Piping shall be pitched towards drain points.

5.9 **PRESSURE GAUGES:**

5.9.1 Pressure gauge shall be appropriate range and be complete with U tube, snubber, shut off gauge cocks etc. duly calibrated before installation.

- a) Pressure gauges shall have micro meter type.
- b) Scale of gauge shall be white with black letters (printed).
- c) Pressure gauges shall be as per IS-3624.
- d) Scale shall be so selected that normal process pressure is approximately 75% of full scale.

5.9.2 Pressure gauge shall be provided at locations as indicated on the drawings:

Care shall be taken to protect pressure gauges during pressure testing.

5.10 **THERMOMETERS:**

5.10.1 Thermometers shall be direct reading industrial type of appropriate range duly calibrated before installation.

- a) Temperature gauges shall be mercury in steel type with thermowell suitable for application.
- b) Dial type with die-cast aluminium, stove enamel black finish case, aluminium screwed ring and shatter proof glass.
- c) Accuracy shall be + 1.0% of full Scale or better.
- d) Minimum over range protection shall be 25% of full scale range.

5.10.2 Thermometers shall be installed in separable wells.

5.11 **INSULATION**

Pipe shall be insulated as required in accordance with specifications in Section- 'INSULATION'.

5.12 **VIBRATION ELIMINATION**

Flexible coupling joints shall be provided to eliminate vibrations from moving equipment as indicated in the Bill of Quantities and including foundation work.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

5.13 **TESTING**

- 5.13.1 All piping shall be tested to hydrostatic test pressure of at least one and a half times the maximum operating pressure, but not less than 10 Kg/Sq.cm for a period of not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified to the satisfaction of the Engineer.
- 5.13.2 Piping required subsequent to the above pressure test shall be retested in the same manner.
- 5.13.3 Systems may be tested in sections and such sections shall be securely capped.
- 5.13.4 The Engineer in charge shall be notified well in advance by the contractor of his intention to test a section of piping.
- 5.13.5 The Contractor shall make sure that proper noiseless circulation of fluid is achieved through all coils and other heat exchange equipment in the system concerned. If proper circulation is not achieved due to air bound connections, the Contractor shall rectify the defective connections. He shall bear all the expenses for carrying out the above rectifications including the tarring-up and re-finishing of floors, walls etc. as required.
- 5.13.6 No insulation shall be applied to piping until the completion of the pressure testing to the satisfaction of the Engineer.
- 5.13.7 The Contractor shall provide all materials, tools, equipment, instruments, services and labour required to perform the test, and shall ensure that the areas are cleaned up and spill over water is removed.

5.14 **PAINTING**

After the piping has been installed, tested and run for at least ten days of eight hours each, the piping shall be given two finish coats, 3 mils each on supply and return lines of approved colour as per CPWD specifications and instruction of Engineer-In-Charge. The direction of flow of fluid in the pipes shall be visibly marked in white arrows or as directed by the Engineer in charge.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

X INSULATION

1. SCOPE

This section cover the requirements of thermal insulation for chilled water & hot water piping, pumps, tanks, duct work, acoustic lining in duct work, AHU rooms etc. This does not cover exposed roof insulation.

2. MATERIAL TYPES

The insulation material to be used for various applications shall be any of the following, as required and as described in schedule of quantities.

2.1 PIPING INSULATION

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

- a) Resin bonded Glass wool/mineral wool insulation–Chilled water piping & equipment Insulation shall be used for pipe insulation like inside the AC plant room, inside the building. The pipe insulation should be in rigid sections and follow as per CPWD guide line.

2.1.1 MATERIAL SPECIFICATIONS

The insulation material shall satisfy the following requirements :-

i) For thermal application on pipes.

Material conductivity	Minimum Uniform	Maximum Thermal
C/m at	Density	(K. Cal/hr. degree
temp.)	(Kg/cu.m)	10 deg C mean

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

Glass wool	80 kg/cu.m	0.031
Mineral wool	144 kg/cu.m	0.031

ii) Air separator / Expansion Tank

Insulation of density not less than 80 kg/cu.m shall be used and finally finished with 0.63 mm Aluminium cladding.

2.1.2 INSULATION THICKNESS

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

i) For pipe insulation (for chilled water application)

Pipe Size (mm)	Glass Wool
a) 150 & below	50mm
b) above 150	75mm

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

- i) No insulation shall be applied on pipes until the pipes are satisfactory tested as specified in piping section.
- ii) The surface to be insulated shall be first cleaned and a coat of zinc chromate primer shall be given. The insulation shall be fixed tightly to the surface with hot bitumen / cold setting adhesive CPRX compound as recommended by the insulation manufacturer. All joints shall be staggered and sealed.
- iii) The insulation shall be finished as under :-

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- a) For all pipes the insulation over the pipe work shall be finished with 26 Gauge thick aluminium sheet cladding over a vapour barrier of 120 gm/ sq.m polythene sheet with 50 mm overlap and tied down with lacing wire and complete with type 3, grade – I TAR or roof felt strip (as per IS 1322 as amended upto date) at the joints.
- (iv) All valves, fittings, strainers etc. shall be insulated to the same thickness and in the same manner as for the respective piping , taking care to allow operation of valves without damaging the insulation .

2.1.4 APPLICATION OF INSULATION ON PUMPS

Glass wool 50 mm thickness shall be sandwiched between two aluminium sheets of 0.63 mm thickness and properly clamped to pump in two semicircular sections.

3. DUCT INSULATION

3.1 MATERIAL SPECIFICATION

The insulation for duct insulation shall be carried out from `O` Class resin bonded glass wool having a `K` value of 0.031 W/(M.K) at mean temperature of 10⁰ C. and a density of not less than 32 kgs/cubm.

Duct : Thickness 25 mm

3.2 APPLICATION OF INSULATION (THERMAL) ON DUCT

Duct insulation shall be applied as follows:

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

4. DUCT/AHU ROOM ACCOUSTIC LINING

4.1 MATERIAL SPECIFICATION

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Material for acoustic lining shall be resin bounded fiber glass. The thermal conductivity shall not exceed 0.031 Kcal/hr. deg C m at 10 deg C mean temperature and density shall not be less than 32 Kg./CuM. Thickness of insulation shall be 25 mm for duct lining and 50 mm for AHU room lining.

Acoustical lining of duct shall be done for the initial run of 6.0-meter duct.

4.2 METHOD OF APPLICATION ON DUCTS

1. The inside surface of duct on which the acoustic lining is to be provided shall be thoroughly cleaned with wire brush and rendered free from all dust and grease.
2. Then 25 x 25 sq.mm section of minimum 1.25 mm thick G.I. sheet shall be fixed on both ends of the duct piece.
3. The insulation slab shall then be fixed between these section of ducts using CPRX adhesive compounds and stickpins.
4. The insulation shall then be covered with reinforced plastic/fiber glass tissue, sealing all joints so that no fiber is visible.

4.3 METHOD OF APPLICATION OF ACOUSTIC LINING IN AHU ROOMS

- i) The wall / roof surface should be thoroughly cleaned with wire brush.
- ii) A 610 x 610 mm frame work of 25mm x 50 mm x 50 mm x 50 mm x 25 mm shape channel (shape as shown in CPWD specifications) made of 0.6mm thick GSS shall be fixed to walls leaving 610 mm from floor by means of raw plugs in walls and dash fasteners in ceiling. Similar frame work shall also be fixed on ceiling by means of dash fasteners.
- iii) Resin bonded glass wool as specified cut to size will be friction fitted in the frame work and covered with tissue paper.
- iv) Aluminium perforated sheet having perforation between 20-40% of thickness not less than 0.8mm shall be fixed over the entire surface neatly without causing sag / depression in between and held with screws. Sheet joints should overlap minimum 10mm.
- v) Aluminium beading of 25mm wide and thickness not less than 1.00 mm shall be fixed on all horizontal / vertical joints by means of screws.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

XI CONTROLS AND INSTRUMENTS

1. SCOPE

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

2. TYPE

All automatic controls shall be of approved as described in the various sections of these specifications.

3. AUTOMATIC CONTROLS

Automatic controls required for various types of equipment/machines have been described in the various sections of these specifications. The individual safety controls and various automatic controls shall be installed within the equipment/machines by the manufacturers before shipment. However, the following automatic controls, if not already installed on the equipment/machines, may need to be installed at site by the Contractor, as per the Schedule of Quantities.

4. 2 WAY MODULATING / PRESSURE INDEPENDENT BALANCING AND CONTROL VALVE

HVAC APPLICATION- COOLING & HEATING - AHU's/CSU

A pressure independent balancing and control valve shall be a self-balancing, pressure independent, 2-way control valve with 100% authority on the control valve. It can be fitted with an actuator to accept input signals from the control system.

Each Air Handling Unit /CSU Unit shall be provided with a 2-way Pressure Independent Balancing and Control Valve. The control valve should be a globe type.

Regarding control – The response characteristic should be independent of pressure,

A differential pressure controller should ensure 100% valve authority at all loads and all settings.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

Regarding Balancing – Each Valve should have a precisely adjustable maximum flow limitation as per the designed flow rate of coils. The balancing should be done only in the valve and not in the actuator so that in case of actuator failure, the balancing is not lost and the system can still function as designed.

All Valves actuators should be microprocessor based with a self calibrating feature to adjust to any valve travel or setting with full control range..

The valve should have a linear characteristic and the actuator should have a function that can convert it to a logarithmic characteristic to ensure that the valve-actuator combination can be used for all applications.

Minimum required differential pressure should not exceed 20 kPa for fan coil units DN32 and not exceed 30 kPa for air handling units to minimize pump head requirements,

The valve should be equipped with an electronic modulating actuator which can accept either 4(0)-20 mA / 2(0)-10 V DC signals. Operating voltage for actuator shall be 24V AC. The actuator shall be able to close against maximum differential pressure of 6 Bar

VALVE SPECIFICATIONS

Description	For 15 to 32 mm	For 40 to 150 mm
Diff Pressure (P1-P3)	16 To 400 kPa	30 To 400 kPa
Media Temperature	-10 ° to 120 °C	-10 ° to 120 °C
Body Material	Brass (CuZn40Pb2 - CW 617N)	Grey iron EN-GJL-250(GG25)
Test Ports	Needle measuring nipple	Needle measuring nipple
Leakage acc. to standard IEC 534	No visible leakage (at 100N)	max.0,01 - 0.05% of kv at 650N
Stem Seals	EPDM - CuZn40Pb2	EPDM -NBR
Maximum Close Off Pr	600 kPa	600 kPa
Pressure rating	PN16	PN16
Control Range	Standard IEC 534 Since CV Characteristic is linear control range is Infinity (1:256 as a result of the actuator-valve combination)	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

Control Valve Character	Linear characteristic and, with the help of actuator, logarithmic
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ACTUATOR SPECIFICATIONS FOR ALL SIZES

Supply Voltage	: 24V AC
Power Consumption	: 10 VA
Frequency	: 50 HZ
Control Input	: 2-10V DC, 4-20mA, 3-point Selection.
Position Output	: 2-10V DC 4-20mA
Body Housing Insulation	: Non Corrosive - IP 42 or higher

GENERAL SPECIFICATIONS: Pressure Independent Balancing and Control Valve shall be provided/installed at each outlet of cooling coil unit, Cassette, AHU & FCU.

A:- Valve Body and Characteristics:-

- The differential pressure controller should maintain a constant differential pressure across the control valve, irrespective of fluctuations in the system, with the help of a self adjusting diaphragm.
- The control valve shall accurately control the flow with help of a modulating actuator
- All valve sizes should have testing ports for verifying the flow by measuring the differential pressure.

B:- Valve Actuator and Housing:-

- The valve and actuator must have the ability to undertake both Logarithmic control characteristics and linear control characteristics. This ensures compatibility for both Water/Air and Water/Water Heat Exchanger.
- Control/Dip switch settings should be easy to access, to avoid Manual Contact directly with Integrated IC Circuit of the system.
- The actuator should not play a part in the balancing process. This will ensure that an operational issue in the actuator will not lead to a loss of balancing, causing problems elsewhere in the system.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- Only linear characteristics should not be acceptable as with this valve & actuator characteristic, the resultant energy characteristic will not remain linear and this shall lead to improper control leading to fluctuating room temperatures.
- In chilled water systems, the valve should be mounted with the actuator above the valve to prevent condensation water leaking into the actuator.

C:- Valve Flow Balancing :-

- Balancing & Control: The balancing should be accomplished by the spring loaded diaphragm and the control should be done by the actuator receiving signals from room thermostats or BMS.
- Flow Setting Balancing (Commissioning) for the valves should be simple and not require measuring devices.
- Setting the flow should not involve the actuator.
- Proper operation of the valve should not be dependent on additional operations like de-airing of the valve or flushing procedures

5. Thermostats :

Shall be cooling/heating electronic type with 3 point output for modulating 2 position reversible motor of two way valve of AHU/FCU/Cassette with sensing element located in the return air stream. The profile, mounting arrangements and exact location of the thermostats shall be as approved by the Engineer in charge. All thermostats shall be supplied with the standard mounting boxes, as recommended by the manufacturer.

Electronic type thermostats for cooling/heating application for actuating the two way modulating cum pressure independent balancing valve at each unit.

6. Instruments :

Instruments required for different types of machines have been described in the various sections of these specifications and shown on the drawings. Following instruments shall be provided as per the schedule of quantities.

Thermometers shall be of approved make, mercury-in-glass type with cast brass scale in a steel casing. Thermometers shall be filled with red reading mercury.

Thermometers shall be of the separable socket type and shall have extended neck, where required, for insulated pipes. The scale shall be 23 cm long. Thermometers shall be installed at chilled water supply and return at air

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

handling units, supply and return at chillers and condensers. Range of scales shall be 30-120 F (0-50) for air conditioning applications.

Pressure Gages shall be approved make, installed on suction and discharge sides of pumps, inlet and outlet at chillers, condensers and AHU's etc. as shown on the drawings and included in Schedule of Quantities. Suction side gauges at pumps shall be compound gauges. All gauges shall be provided with stem and shut of valve.

Air Flow Switches shall be of sturdy and corrosion resistant construction, suitable for monitoring air flow in ducts, and supplied with mounting plate and gasket for duct mounting. Paddle shall be of stainless steel of size 50mm x 150mm minimum. Air flow switches shall be chosen to suit the velocities to be monitored. Performance of air flow switches shall not be affected when mounted on ducts handling air below ambient dew point temperature

7. **Calibration and Testing :**

All automatic controls and instruments shall be factory calibrate and provided with necessary instructions for site calibration and testing. Various items of the same type shall be completely interchangeable and their accuracy shall be guaranteed by the manufacturer. All automatic controls and instruments shall be tested at site for accuracy and reliability before commissioning the installation.

8. **VARIABLE FREQUENCY DRIVE (VFD)**

8.1 **Air quantity flow control**

8.1.1 The VFD shall be a dedicated HVAC engineered design supporting HVAC

applications. The VFD and all its options shall be Factory built and Factory tested as a SINGLE unit and not at site.

8.1.2 The VFD shall be tested to UL 508C, CE marked and conform to the European Union Electro Magnetic Compatibility directive. The VFD shall be UL listed for a short circuit current rating of 100 kA and labeled with this rating.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

8.1.3 The VFD shall allow the motor to produce full rated power at rated motor voltage, current, and speed without using the motor's service factor. The VFD shall be using Advanced PWM control methodology for high motor performance. The motor current shall closely approximate a sine wave.

8.1.4 The VFD shall have a dual 5% impedance DC link reactor (Harmonic filters) on the positive and negative rails of the DC bus to minimize power line harmonics and protect the VFD from power line transients. The chokes shall be non-saturating. VFD shall have THD less than 5%.

8.1.5 IEEE519, 1992 recommendations shall be used for the basis of calculation of total harmonic distortion (THD) at the point of common coupling (PCC).

8.1.6 All VFDs up to 90 KW shall contain integral EMC Filters to attenuate RFI conducted to the AC power line and must be complying with the emission and immunity requirements of IEC 61800-3: 2004, Category C1 with 50m motor cable (unrestricted distribution) that are recommended for Critical Applications with high volume of Electronic Data communications for IIT's.

8.1.7 The VFD shall be able to provide variable torque Volts/Hz output to give full motor torque at any selected frequency from 20 Hz to base speed. Breakaway current of 160% shall be available.

8.2 **The VFD shall have the following features –**

8.2.1 A AUTOMATIC ENERGY OPTIMIZATION to automatically and continuously monitor the motor's speed and load to adjust the applied voltage to maximize energy savings

8.2.2 An Automatic Motor Adaptation algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or de-couple the motor from the load to perform the test.

8.2.3 The VFD shall be capable of running the system at programmed lower speed even in case of Phase loss. Protection against input transients, loss of AC line phase, output short circuit, output ground fault, over voltage, under voltage, VFD over temperature and motor over temperature.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

- 8.2.4 The VFD shall be fully protected from switching a contactor / isolator at the output with out causing tripping and it should not be necessary to provide the interlocks for Switches on Output side.
- 8.2.5 The Local Control Panel shall be alphanumeric, graphical, backlit display with provision for two levels of password protection. It is capable to show Five simultaneous parameters display. A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.
- 8.2.6 Standard Control and Monitoring Inputs and Outputs: Four programmable digital inputs Two programmable digital outputs, Two programmable relay outputs, Form C 240 V AC, 2 A with delay timers, Two programmable analog inputs (0-10 V or 4-20 mA), One programmable analog output. The Analogue/ Digital / Relay I/O shall be expandable using the additional modules based on the application requirement.
- 8.2.7 A real-time clock shall be an integral part of the VFD. All VFD faults shall be time stamped to support troubleshooting.
- 8.2.8 The VFD shall be able to store load profile data to assist in analyzing the system demand and energy consumption over time. There shall be a KWH counter available to record the Energy consumption of the equipment.
- 8.2.9 The VFD shall include a standard EIA-485 (RS 485) communications port and capability to communicate with BMS over Metasys N2 / Modbus RTU protocols. VFD shall have standard USB port for direct connection of Personal Computer (PC) to the VFD.
- 8.2.10 The VFD (≤ 90 kW) shall have 45°C Ambient temperature rating and (> 90 kW) shall have 40°C Ambient temperature rating at full speed, full load operation with continuous drive rated output current without any derating. Relative Humidity Rating shall be 0 to 95%, non-condensing, Elevation rating Up to 3300 feet without derating
- 8.2.11 VFDs ≤ 90 KW rating Enclosure protection: IP55, integral, with inbuilt Mains Disconnect with no additional cabinets.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

8.2.12 The VFD shall have provision for additional PID controllers which can be used to control Chilled Water Valve / Fresh Air Damper etc. in the system through the VFD and save I/O points required for BMS.

8.2.13 The VFDs shall have two-feedback PID controller to control the speed of the VFD shall be standard. This controller shall accept up to three feedback signals of same kind to support 3-Zone Feedback Control. The VFD shall be programmable to automatically select either maximum / minimum / average of the 3 feedbacks signal as the controlling signal.

- a) In case of Multi Motor Operation (Multiple Motors operated thru One VFD), the Distribution box shall be provided separately to distribute power coming from VFD to the respective motors with Over current protection provided for individual motors.

XII ELECTRICAL INSTALLATION

1. APPLICABLE CODES & STANDARDS

The design, manufacturing process and performance of the MV panel boards and all the equipment & instruments incorporated in the same shall comply with the latest Indian Standards issued by B.I.S. as follows :

BRIEF DESCRIPTION	REFERENCE STAND
Switch gear General Requirements	IS :13947-1993/IEC 60947-2
Factory Built Assemblies of Switch gear and Control gear and busbar trunking	IS : 8623 (Part I & Part II)
Miniature Circuit Breaker	IS : 8828
HRC Cartridge fuse	IS : 9224 (Part 2)
Current Transformers	IS : 2705

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

Indicating Instruments	IS : 1248
Busbar Connections and Accessories	IS : 5578, 11353
Code of Practice for Phosphating Iron & Steel	IS : 6005
PVC insulated wires	IS : 694

Note:- The above are minimum standards expected. The technical specifications to follow and those given in schedule of quantities, if found to be more stringent as compared to those listed above, then the more stringent specifications shall prevail.

2. **CONSTRUCTIONAL FEATURES**

- i The MV Panel shall be modular in design. There shall be welding only in the main frame of the panel. The frame shall be assembled with bolts and Nuts.. The profiles used in the assembly of the panel shall be restricted to only two designs. Each profile should have holes of standard size punched at standard pitch throughout the length of the profile. This facilitates the joining of vertical and members with bolts and Nuts. The joining of these members shall be dust and vermin proof and for this Neoprene Rubber is to be used.
- ii Doors shall be with concealed hinges and flush type locks. All doors shall be earthed to the profile by a yellow green 2.5 Sq. mm. wire lugged at both ends.
- iii All switchgears shall be mounted on clamps and fixtures such that there shall be flexibility for adjustments in X and Y axis. All partitions shall be made out of CRCA sheets. These partitions shall not be used for load bearing of switchgears. The profiles and doors shall be of 2 mm thick CRCA sheet and powder coated to RAL 7032. The partitions shall be of 1.6 mm CRCA sheet as specified above.
- iv Modular type MV Panel to assemble low voltage switchgear and copper busbar arrangement. The switch handle shall be interlocked such that the door of enclosure cannot be opened unless the switch is in OFF position, however, mechanical interlock defeat mechanism has to be provided. All MCCB's/Switches

only operating knob / handle shall only be visible other portion should be covered by suitable sheet. All rear doors shall be of hinged type with locking arrangement. Detachable bottom plates shall be provided at the

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

cable compartments and terminal chamber. Liberal space shall be provided in the cable compartment as well as switch compartment to facilitate termination of cables. Provision shall be made for clamping the cables in the cable compartment.

- v The panel shall have easily-removable and interchangeable sections. All service shall be capable of being performed with access from the front plus and a choice of any one side or rear for installation flexibility. To ensure grounding integrity and for static protection and EMI/RFI shielding, the removable exterior panels shall be grounded to the frame by way of stranded copper wire. Hinged doors shall provided access to the main input circuit breaker, and to all output switchgears.
- vi The unit shall be naturally convection-cooled. No fans for forced-air cooling system shall be used. The convection cooling method shall allow continuous full-load operation without activation of over-temperature circuits. Copper bus bars, sized in accordance with the NEC shall withstand 90 deg C minimum. Both for reliability and Heat rejection shall be through screened protective sides, which prohibits entry of foreign material.
- vii The busbar sizes should not be less than 120% of the rated current in amps of incomer & it should be so selected that the temperature should not rise 50 C above ambient. Copper busbar shall be supported with high quality non-hygroscopic insulating material. Separate busbar compartment provided on the sides housing three phase and neutral busbar should have front bolted cover, side busbar chamber shall have standardized dimension of 300 mm. The rating of the neutral busbar shall be 100% of that of phase busbar wherever required. The busbar shall be of ETP grade Copper.
- viii Power terminal blocks or bus-bar or bus-bar extensions shall be provided for each input and output feeders as per the switchgear rating and a parity-sized insulated ground conductor. All the outputs of 63A TPN & below shall be terminated to a Busbar type terminal connector at the rear side of the panel using C-rail. All the live parts of the terminations shall be provided with shrouding by transparent perplex sheet of not less than 4 mm thick. The accessories for proper fixing of the CT's shall be provided.
- ix The frame shall be configured to accept future field augmentation of additional cubicle sections.
- x The panel shall be supplied along with base plinth of 100 mm. height for each modular section and shall be made of C – channel of 6mm Thick.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- xi The panel shall be powder coated with Structure finish. The colour of the panel shall be siemens grey (color code IS:952) and block color to the plinth.
- xii Minimum surface area & depth of the panels shall be as specified in schedule of quantities. Dimension can increase as per GA drawings of Manufacturer.

3. **AIR CIRCUIT BREAKERS (A.C.B.)**

1. The ACBs shall comprise single units of Three / Four pole construction as per the single line diagram, having a rupturing capacity of 50kA at 415V AC for 1 second and shall be provided with door interlock. All ACB Should have single frame size for all ratings.
2. The ACB shall be type tested & certified for compliance to IS13947 from Indian testing authorities – CPRI, ERDA
3. For all ratings, the ACB shall have uniform panel cut-out, preferably on left or right side of the panel for allowing maximum utilization of panel space.
4. For safety of users, interlock should be provided between breaker operating mechanism & the arc chutes to prevent closing in case the arc chutes are not properly secured.
5. Draw out breakers should not close unless in distinct Service/Test/Isolated positions.
6. All current carrying parts shall be silver plated.
7. For ease of maintenance, it should preferably be possible to replace jaw contacts & cradle terminals without disturbing the busbar links.
8. It should be possible to know the control voltage ratings for all electrical accessories without opening the panel door.
9. Circuit breaker should provide an electrical indication when all pre-requisites for closing the breaker are fulfilled.
10. A padlocking arrangement shall be provided to prevent unauthorized racking operation.
11. An interlock should be provided to prevent racking operation with panel door open.

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

12. It should not be possible to rack out the breaker, unless a persistent OFF command is maintained.
13. It shall not be possible to commence racking operation, with breaker ON. Additionally, it should not be possible to close the breaker during racking operation, even by a remote closing command.
14. For Draw-out breakers, an arrangement shall be provided to prevent rating mismatch between breaker and cradle.
15. The ACBs shall be CE marked.
16. The insulation material used shall conform to Glow wire test as per IEC 60695.
17. It should be possible to lock the breaker in OFF condition, by way of a key interlock.
18. The breaker as supplied should meet IP42 protection.
19. The breaker should be able to accommodate Aluminum termination as specified in IS13947 – Part 2. Any accessories required to achieve the same shall be considered in the watt-loss data specified by the manufacturer.
20. Any changes in the busbar & dropper orientation/layout in the panel shall not call for any rework on the cradle/breaker.
21. Withstand capacity shall not be lower than Icu, atleast for the maximum short- time delay setting provided on the protection releases.
22. It should be possible to convert a manually spring charged breaker to motorized spring charged breaker, on site.
23. The opening time for ACB shall not exceed 40 ms at any current level.
24. The ACB shall provide electrical and mechanical anti-pumping.
25. Remote tripping device (Shunt release) should be able to trip the ACB, even at voltages as low as 10%.
26. Under Voltage and closing releases should not consume power in latched condition (when not required to operate the breaker).
27. Inspection of main contacts should be possible without using any tools. The breaker shall be provided with mechanical contact wear indicator.
28. Every control connection should be uniquely identified for standardization and electrical interchangeability at site.
29. It should be possible to access racking handle & carry out setting of the release from the front & without opening the panel door.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

30. ACB Shall be supplied with Spreaders as standard part of Breaker. No extra cost shall be paid for the same.
31. All ACBs shall have $I_{cs}=I_{cu}=I_{cw}$ for 1Sec
32. Rated impulse withstand voltage shall be 12KV for all ACBs.

3. PROTECTION RELEASE

1. The breaker should be equipped with micro-controller based release, offering overload (50% to 100%), short circuit (400% to 100% of rated current) and earth fault protection with settable time delays for all protections.
2. The release should be able to communicate on MODBUS RTU protocol using RS485 port.
3. The release shall be equipped with thermal memory and Users should be able to selectively enable the feature.
4. The release should provide local LED indication for identification of type of fault, without requiring using external power supply. All ACB should have display of Voltage, current and energy parameters. along with 10 trip fault history for O/L, S/C, E/F with time stamping. The fault indication should be available for a period of at least 60 hours, after tripping in the absence of main supply or battery back-up.
5. The release should provide separate electrical fault indication.
6. Critical functions like Earth Fault and Zone Selective Interlocking should be in-built and should not be provided through add-on devices.
7. The release should provide local indication of actual %age loading at any instant.
8. The release should be able to provide protection for 50% and 100% Neutral rating.
9. On-Line change of settings should be possible.
10. It should be possible to carry out testing of release without tripping the breaker.
11. The release shall meet the EMI / EMC requirements
12. Earth Fault Protection should have adjustable current setting 20% to 100% of ACB rated current.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

5. **LOAD MANAGER/MULTIFUNCTION METER**

1. The load manager shall be of 3 phase, 4 wire type and shall provide true RMS measurements of following parameters :
 - Voltage – Line to Line & Average, Line to Neutral & Average, Neutral to Earth
 - Current – Phase currents & Average, Neutral current
 - Phase angles of Vr, Vy, Vb, Ir, Iy, Ib
 - All parameters of Power for each Phase and Total
 - All parameters of Energy – kVAh, kWh, kVARh
 - Frequency of Supply
2. They shall be complete with the following functions :
 - History log of Hi-lo profile with minimum 4 peaks and minimum 4 lows for Voltage, Current, Frequency, Power factor and all other parameters of power with Day, Date and Time of Occurrence.
 - Shall have RS-485 Communication port.
 - Meter should have LCD Display with IEC 62053-21/22 compliance with 64 sampling rate, percentage THD and individual Harmonics of upto 31st level.
 - Accuracy class 1.0

6. **MOULDED CASE CIRCUIT BREAKERS**

1. The MCCBs shall comprise single units of triple pole/four pole construction as specified, shall be rated for 415 V AC.
2. All live parts shall be totally enclosed and shrouded with a heat resistant moulded insulating material housing. Operating mechanism shall be quick make, quick break and trip free type.
3. The MCCB shall be provided with the following features in microprocessor release:
 - a) Inverse-time-current tripping characteristics under sustained overload.
 - b) Instantaneous tripping on short circuit
4. All MCCBs shall have double break, positive isolation current limiting ,load line reversibility
5. The rated service breaking capacity (Ics) shall not be less than the ultimate short circuit breaking capacity ($I_{cs} = I_{cu}$)
6. Variable Thermal setting shall be provided in all MCCB s with thermal magnetic Release.

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

7. All MCCBs shall be provided with rotary handles and links for which nothing extra shall be paid.

7. **CURRENT TRANSFORMERS**

1. Current transformers shall be of the Cast Resin Type.
2. Current transformers shall not be directly mounted on the buses. Current transformers on circuit breaker controlled circuits shall be mounted on the fixed portion of the compartment.
3. All current transformers shall be earthed through a separate earth link.

8. **INDICATING INSTRUMENTS AND METERS**

1. Digital electrical indicating instruments shall be of minimum 96 mm square size and should have red coloured readout and 1" display height and of class 1.0 accuracy.

9. **CABLE TERMINATIONS AND ACCESSORIES**

1. Suitable double compression type, brass cable glands with check nuts, rubber sealing ring and brass washers mounted on a removable gland plate shall be provided to support all cables entering the switchgear. Cable Termination, glands, lugs, tags etc. part of cable item, nothing shall be extra paid under this item

10. **INTERNAL WIRING**

Wiring inside the panel shall be carried out with 660/1100 V grade, single core, PVC insulated, stranded copper conductor wires. Minimum size of conductor for power circuits is 2.5 sq. mm. Not more than two connection shall be made on any one terminal. All internal wiring shall be properly ferruled at the both termination. All control cables shall be terminated with crimping types lugs with colored PVC shrouds and shall have identification labels.

11. **TERMINAL BLOCKS**

1. Terminal blocks shall be of heavy duty and comprising of finely threaded pairs of brass studs of at least 6 mm diameter, links between each pair of studs, washers, nuts and locknuts. The studs shall be securely locked within the mounting base to prevent their turning. Insulated barriers shall be provided between adjacent terminals.
2. Terminals shall be shrouded. Terminal blocks shall be adequately rated to carry the current of the associated circuit. Minimum rating of the terminal block shall be 10 A.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

12. **CABLE TERMINATIONS**

Cable entries and terminals shall be provided in the Main L.T. Panel to suit the number; type and size of aluminum conductor power cables and copper conductor control cable specified.

Provision shall be made for top or bottom entry of cables as required. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated.

Barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.

Cable risers shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults.

13. **LABELS**

Labels shall be provided for Feeder designation, feeder equipment no, Compartment designation, panel designation main label. All labels shall comprise white letters on a black background and shall be made of non-rusting metal or 3-ply lamicaid or engraved PVC. Size of lettering shall be 6.0 mm. MV Danger Notice Boards shall also be provided.

14. **EARTHING**

1. Panel shall be provided with 25 x 5 mm copper earth busbar running along the entire length of the board. At either end of the earth bus, one clamp type terminal with nuts, bolts and washers shall be provided for bolting the earthing conductor.
2. Earth bus bars shall be supported at suitable intervals. Positive connection between all the frames of equipment mounted in the switchboard and earth busbar shall be provided by using insulated copper wires/bare busbars of cross section equal to that of the bus bar or equal to half the size of circuit load current carrying conductor, whichever is smaller.
3. All instrument cases shall be connected to the earth busbar using 660 V grade, single core 2.5 sq.mm stranded, copper conductor.
4. All non current carrying metal and hinged doors shall be earthed to the earth bar.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

15. TESTS

1. Panel shall be subjected to following tests as per relevant standards:
 - a) Mechanical operation test.
 - b) Power frequency H. V. test for 1 minute.
 - c) Insulation resistance at 500 V D.C. before/after 1 minute H.V. test.

16. DRAWINGS AND DATA

1. As part of the technical bid, the tenderer shall furnish the following data:
 - a) Schedule of Technical Data completely filled in.
 - b) Technical literature and catalogues of the equipment being offered.

17. TECHNICAL PARTICULARS

FOR MAIN MV PANEL and APFC PANELS

S. NO.	DESCRIPTION	PARTICULARS
1.0	PANELS	
1.1	Rated Voltage Phases & Frequency	415 V, 3 Ph, 4 wire, 50 Hz
1.2	System Neutral Earthing	Effectively earthed
1.3	One minute power frequency voltage a) Power circuit b) Control circuit c) Aux. Circuits connected to sec. of CTs	2500 V 1500 V 2000 V
1.4	Continuous current rating of busbars under reference ambient temp.	As mentioned in Schedule of Quantities
1.5	Short circuit current	50 KA for 1 sec (Three phase Symm)
1.6	Reference ambient temperature	40° C
1.7	<u>Control supply :</u>	
a.	DC supply for breaker tripping, closing and DC ckt tapped from DC control bus	30 V DC

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

b.	240VAC control supply for spring motor and panel space heater tapped from 240V AC control bus	240V AC
1.8	Maximum temperature of busbars & droppers and contacts at continuous current rating under site reference ambient temperature.	90° C
1.9	Colour a) Interior b) Exterior	Approved shade and colour
1.10	<u>Moulded case circuit Breakers & A.C.B.s</u>	
1.11	Rated Breaking Capacity (kA RMS at 415 V @ 0.25 P.F.)	As mentioned in the schedule of quantities
1.12	Releases Required a) Overload b) Short circuit c) Under voltage	As mentioned in the schedule of quantities

XIII VARIABLE PUMPING AND FREQUENCY DRIVES

Control Panel for Variable Speed Secondary Chilled Water System:

Variable Speed control panel will have the following as minimum: (See details below)

1. Dedicated Pump Logic Controller (DPLC).
2. VFD – One VFD per pump
3. DPT .
4. Controls enclosure as per below specification.
5. Necessary software duly downloaded.

Detailed specifications of Panel components:

1. Dedicated Pump Logic Controller

1.1 Approval

DPLC has been approved by major international bodies like U/L and will be marked as CE as minimum.

1.2 Number of Pumps

DPLC will be able to control minimum 3 No pumps (In case of Secondary Chilled water pump) or 2 No pumps (In the case of Tertiary pumps)

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

1.3 Analog Input Processing

DPLC will continuously scan the incoming signal from DPT's all the time and keep on processing the output. Output will be the most deviated one compared to the set point, which will be fed by the user, in DPLC.

1.4 Two Additional Analog Inputs

DPLC has provision for two additional analog inputs for:

- a). Taking input signal from Flow sensor (if provided by BMS contractor). This will help the system to protect the pumps against End Of Curve condition.
- b). Taking the input from any external sensor (e.g. return temperature sensor, supply temperature sensor, ambient temperature sensor etc). This input can be used to influence the system externally. DPLC should have provision to influence the main signal upto 8 steps.

1.5 Set Point

DPLC can be set for separate "set points" as per real time clock. DPLC should have a min of 7 alternate set points to be activated by external digital inputs.

If a lower differential pressure is acceptable during certain periods, for instance after normal working hours or weekends, the set point can be lowered to minimize power consumption.

DPLC should have night set back facility to enable the system to run at lower set point during night time.

DPLC should use digital inputs to switch between set points automatically at any point of time.

1.6 Automatic cascade control of pump

DPLC will start other pumps, which are available for operation, whenever system is not able to meet the demand for chilled water. Once demand is met then all the pumps will cut out with changeover, except for one pump. At least one pump will run at minimum 25% speed if DP value is satisfied.

1.7 Automatic Sequence Change

DPLC will have automatic changeover facility based on:

- a. Fault – When any pump/motor/VFD/starter fails.
- b. Operation – While running/cascading.
- c. Time – As per the time set in the DPLC (daily or weekly).

To ensure equal number of hours run by each pump and to control the number of starts (to avoid hunting) on each pump, the system will alternate the sequence of the pumps used each time the system starts.

Additionally, should the demand not allow the pump set to completely shut down over a 24 hour period; the DPLC will stop the pumps that are running and start the pump/pumps with the lowest number of operating hours.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

1.8 Auto Testing

DPLC will start the pumps, which have not been cut-in because of lower load, for 2 seconds each day, to ensure that all the rotating elements do not bind. DPLC should have an option to set the same on 24 hrs / 48 hrs / weekly basis

Following are VFD specification for Pump Application.

- 1 Provide variable frequency drives (VFD) based on variable frequency principles as specified in schedule of quantities.
- 2 Each drive system shall consist of a variable frequency drive to control the speed of a standard squirrel cage induction motor.
- 3 The variable frequency drive shall be a totally digital control drive of the pulse width modulated (PWM) type utilizing power transistors or IGBT's in the inverter section of the drive and shall have the following minimum specifications.
415 V +/- 10%, 3 ph, 50 Hz input power supply and 0 – 415V, 3 ph, 2.5 – 55Hz output. No transformers shall be used on either the input or output of the variable frequency controller.
- 4 Provide input transient protection and THD less than 5%..
- 5 Provide an incoming, horsepower rated, non-automatic circuit breaker with an operating mechanism which is door interlocked and pad-lockable in the open position. Also, provide input line fuses whose characteristics are coordinated with the drive's electronic protection circuits so as not to blow under normal output faults such as over current, short circuit and ground fault.
- 6 Provide line over and under voltage protection, phase loss protection and phase unbalance protection.
- 7 Provide inherent short circuit protection for line to line and line to ground faults. If either of these faults should occur on the output of the VFD, the VFD shall safely shut down without damaging any power circuit devices. Controllers utilizing fuses or isolation transformers to provide this protection shall not be acceptable.
- 8 Provide electronic instantaneous over current protection.
- 9 Provide current limit, of the high performance inner current loop type, adjustable between 0 and 110% of rated output. Independent adjustment shall be provided for both motoring.
- 10 The drive shall have a continuous duty service factor of 110% of rated output current.
- 11 Minimum efficiency of 95% at maximum load and speed.
- 12 Minimum line side displacement power factor of 0.96 at all speeds.
- 13 Maximum ambient temperature of 50°C.
- 14 Maximum humidity of 95% non-condensing.
- 15 Variable minimum speed of 0 – 80%.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- 16 Variable maximum speed of 50 – 110%.
- 17 Provide separately adjustable acceleration and deceleration ramps from 0.2 to 999.9 seconds (0 to 110% speed).
- 18 Provide controller internal over temperature protection.
- 19 Drive shall have IP20 protection including electronic motor protection to trip the drive off, should the motor over load or stall condition occur. IP20 drive module shall be mounted outside the controller panel and is not enclosed with any other enclosure.
- 20 Provide automatic restart after an inverter fault trip. The drive shall attempt to restart automatically 3 times with Lock-Out after the third attempt if a restart has not occurred. The feature can be defeated if auto restart is not required.
- 21 Provide a rotating motor restart feature. This feature will allow a Motor unit which has been shut down or has fault tripped, but is still rotating, to be restarted without first stopping the Motor unit. The VFD shall restart the motor at the speed at which it is rotating and then re-accelerate to the speed called for by the speed reference signal.
- 22 The drive shall be capable of running without a motor connected for setup and testing.
- 23 The drive shall be capable of accepting the opening of a remote motor disconnect while running without causing damage to the drive.
- 24 Provide auto restart after power outage (provided run enable is maintained).
- 25 Provide 4 frequency reject points to prevent the pump from operating at a resonant speed. Both the centre frequency and the band width shall be adjustable.
- 26 Provide a thermistor relay (3UN8) for all motors. If the relay operates due to a motor over temperature condition the VFD controller shall shut down and illuminate a door mounted “Motor Over temp” pilot light.
- 27 Provide motor overloads downstream of output contactor located within the VFD enclosure.
- 28 Provide automatic/manual signal follower for:
 - a) – 4-20 mA, b) – 0-10 VDC, c) – 0-5 VDC
- 29 Provide a door mounted and microprocessor driven, digital operator control module to allow the station operations personnel to set up and monitor the drive parameters, observe output speed, load and voltage, and monitor status and fault information, all as detailed below:

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

- 30 All readout information shall be displayed with a dot matrix LCD graphical/alpha-numeric high resolution display or approved equal. In addition, all information being displayed shall be presented in a user friendly descriptive word format. The use of coded or abbreviated displays shall not be acceptable.
- 31 Speed, load (power) and output voltage shall be continuously displayed when in the run mode.
- a) Direct keypad entry shall be provided to observe the following parameters:
- Maximum speed setting.
 - Minimum speed setting.
 - Acceleration rate
 - Deceleration rate
 - Current limit – motoring
 - Up to 3 frequency reject point to avoid operating at resonant speed points. The centre frequency and band width shall be displayed.
- 32 Direct keypad entry shall be provided to initially set or change the above noted parameters and only after a password is first entered by authorized personnel.
- a) Provide diagnostics for operator online status information. Each of the following status points shall be indicated by an individual LED:
- Power on
 - Ready
 - Run
 - Jog
 - Motor accelerating
 - Motor decelerating
 - Direction of rotation (forward or reverse) (if function enabled).
 - Auto mode (if function enabled)
 - Manual mode
 - Stop
 - Low reference (missing or zero speed reference)
 - External trip (interlocks open)
 - Power lost.
- b) Provide fault diagnostics to simplify troubleshooting. Each of the following points shall be indicated by an individual LTD:
- Lockout – (fault shutdown after 3 restart attempts)
 - Line fault (line over/under voltage, phase loss/unbalance)
 - Controller over-temperature

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

- Motor
- DC bus over-voltage
- DC bus under-voltage
- Auxiliary power supply fault
- Output fault – phase A
- Output fault – phase B
- Output fault – phase C.

33 Provide a keyboard entry to test if all LED's are operational.

a) Provide keypad accessibility to a non-volatile Fault History Memory which is not operator erasable. This memory shall store the following data for each of the thirty (30) days at least 10 most recent drive shutdowns:

- The fault which cause the shutdown
- Output frequency at time of trip
- Output voltage at time of trip
- Output load (power) at time of trip
- Whether the load was accelerating, decelerating or “at speed”
- Direction of rotation
- Time and date of the trip.

b) Provide the following control functions on the door mounted keypad:

- Run
- Stop
- Jog (enabled in stop mode only)
- Auto/manual (if auto mode is enabled)
- Forward/reverse (if function enabled)
- Accelerate (manual/mode)
- Decelerate (manual/mode)
- Direct speed set (manual mode)
- Provide digital elapsed time indication.

34 Provide additional LED's to allow signal tracing of the logic and base or gate driver circuit boards plus additional fault diagnostics.

35 Provide terminals for interlocking of up to 6 external interlocks e.g. fire-stat, etc.

36 Provide the following to interface with the Building Management System (BMS).

1 Dry contact closure from BMS for run command (auto mode).

2 4-20 mA (0-10 VDC, 0-50 VDC) signal from BMS for speed control (auto mode).

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- 3 Dry contact (N.O) output to BMS to indicate:
 - inverter ready
 - inverter fault
 - inverter running
- 4 0-10 VDC output to BMS, proportional to 0-110% speed.
- 5 0-10 VDC output to BMS, proportional to 0-110% load power.
- 37 The variable speed drive shall include active harmonic filters to keep THD within limits conforming to IEEE for IIT's installation.

EXECUTION

SYSTEM OPERATION

- 1 If "Manual" mode is selected the Drive/motor will start when the run key is depressed. The speed will be controlled by depressing the accelerate or decelerate keys on the keypad or by the direct speed set mode.
- 2 If "Auto" mode is selected the Drive/motor will start when a contact closure run command is received from the BMS. The speed will be controlled by a 4-20 mA (0-5, 0-10 VDC) speed reference signal from the BMS.
- 3 In the event of a power outage the drive shall automatically restart when the power returns the run command is maintained.
- 4 In the event of an inverter fault trip the drive shall attempt to restart automatically up to a maximum of 3 attempts. If, after 3 attempts, restart does not occur, the drive shall lock out.

Upon completion of the installation the supplier of the variable frequency drives shall supply three complete sets of service and manuals including wiring and connection diagrams. Provide certificate from manufacturer that VFD has been installed in accordance with manufacturer's instructions.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

XIV INSPECTION, TESTING AND COMMISSIONING

1. SCOPE

This section covers initial inspection and testing of compressor, condenser, chiller, AHUs, Fans at manufacturer's works, initial inspection of other equipments / materials on receipt at site, final inspection testing and commissioning of all equipment at site and description of testing requirements and procedure.

2. INITIAL INSPECTION AT MANUFACTURER'S WORKS

2.1 Screw Compressor

- i) Salient features such as model, capacity control, type of lubrication etc. shall be verified against the requirements visually without opening the compressors.
- ii) Manufacturer's internal test certificates shall be scrutinized to check compliance within the requirements as specified in the contract.
- iii) Free running test shall be carried out at the speed for which the motor is available with manufacturer but the speed shall not be less than that specified in contract. This test shall be carried out for 30 minutes in open space. During this running test following operations are to be noted :
 - a) Manual operation of capacity control
 - b) Lubrication oil pressure
 - c) Pneumatic test pressure test at 21 Kgf/ sq.cm for casing of compressor.
 - d) Vacuum test for the compressor for 0.5mm.

2.2.1 Condensers

- i) Manufacturer's internal test certificates shall be furnished and it shall be verified against contract requirements .

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

- ii) Pneumatic pressure test at twice the normal condensing pressure for gas side of condenser shall be carried out.
- iii) Hydraulic test at 10 Kgf/sq.cm for water side of the condenser shall be carried out.

2.2.2 Chiller

- i) Manufacturer's internal test certificate shall be furnished and same shall be checked as per contract requirements.
- ii) Pneumatic pressure test at twice the normal condensing pressure for gas side of condenser shall be carried out.
- iii) Hydraulic test at 10 Kgf/sq.cm for water side of chiller shall be carried out.

2.3 Chilling Unit

Routine tests / inspection for the various components shall be conducted as per manufacturer's standard practice and test certificates shall be furnished. A list of such inspection / testing shall be furnished well in advance and if the authority desire to witness this, the same shall be arranged accordingly at the works.

Site performance testing shall be conducted for computing the capacity, power consumption, free from abnormal vibration, objectable noise etc, and this shall be witnessed by the authority. Before calling this test, the system, should have run continuously for a period of 48 hrs continuously and contractor satisfy himself about the capability. All instruments like flow meter, anemometer, tong tester, thermometers etc. shall be provided by the contractor after duly calibrated and calibration certificate to be submitted. All consumable items and the labour required shall also be the responsibility of the contractor. The duration of the performance testing will be 72 hrs. continuously. The following parameters are to be recorded on hourly basis or as required by the authority. The test shall be done in 2 to 3 batches as per site requirement and peak monsoon.

1. The temperature at IN / OUT of the chiller.
2. Current consumption of all the drive motors.
3. Chilled water pressure and flow across the chiller.
4. Cooling water pressure and flow across the condensers.
5. Temperature IN/OUT across the cooling tower.
6. Operating parameters of the compressors.
7. Noise and vibrations levels of all the equipments.
8. Test on compressor interlocks and safety devices.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

9. Tripping of HP/LP/OP controls.
10. Working of capacity control.
11. Insulation values of windings of motors.
12. Starter operation and single phase tripping.
13. Setting of over load protections.

From the above readings, the chiller capacity will be computed and the guaranteed power consumption will be verified. The maximum permissible variation on power consumption and capacity of the compressor / Chiller unit shall be 3% of the guaranteed values. Power consumption readings are to be taken in the presence of the authority at the rate of one chiller per day.

The above performance test shall be conducted by the contractor for two seasons, In the peak summer and peak monsoon as decided by the authority. All the obligations of the contract shall be considered fulfilled only on satisfactory completion of these tests and guarantee shall commence only after this. These tests will be conducted only after completion of erection in all respects.

2.4 **Air Handling Units**

- i) Salient features such as model , size, physical dimensions, and other details of various sections, fan motor details, fan dia, static pressure etc. shall be verified against the contract requirements .
- ii) Manufacturer's internal test certificates for the motor and air handling unit shall be furnished and scrutinized as per contract requirements.
- iii) Test certificate for static and dynamic balancing of the fan/blower should be furnished. Fan balancing may be witnessed by Engineer-in-charge or his authorized representative.
- iv) Salient features like, type, material, no and gauge of fins and tubes and no. or rows of cooling coil shall be furnished and verified with reference to contract requirements during stage inspection.
- v) Hydraulic pressure to the extent of 10 Kg/Sq.cm or pneumatic pressure of 21 kgf/sq.cm shall be applied to cooling coil and this pressure should be maintained for 1 hour and no drop should be observed indicating any leaks.

3. **INITIAL INSPECTIN AT SITE**

3.1 **Ducting**

- i) The sheet used for ducting shall be checked for physical test at site. The physical test should include the sheet thickness and bend test as per relevant IS specifications.
- ii) Zinc coating of GSS sheet as mentioned in the tender documents may be got tested from a laboratory to verify that same meets the contract requirements.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

3.2 **Pumps**

- i) Salient features such as model and make shall be checked as per contract requirements.
- ii) The manufacturer's test certificate with Sr. No. head, discharge will be furnished and verified against contract requirements

3.3 **Cooling Tower**

- i) Salient features such as make, model dimensions, materials used, constructional details, number and size of nozzles, headers, size of tank etc. should be verified against the requirements. Inspection of cooling tower in knocked down condition would be carried out at the site.
- ii) Manufacturer's test certificates certifying the capacity of cooling tower and static balancing of fan should be furnished.

3.4 **Switch Gear, Control Gear, and Measuring Instruments**

These should be of specified make. For MV panel its switchgear & accessories shall be checked/tested of this tender.

3.5 **Electric Motors**

Electric motors should be of specified make, manufacturer's test certificate for electric motor shall be furnished.

3.6 **Pipes and Valves**

- i) It should be checked that the same is as per makes specified in contract.
- ii) Dimensions including weight shall be checked for pipes against the requirements of contract.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

3.7 **Insulation and acoustic lining**

- i) Physical verification for thickness and make should be made as per contract before application of insulation.
- ii) Manufacturer's test certificate for density should be furnished.

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

4. **FINAL INSPECTION**

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

i) **RUNNING IN PERIOD & DATE OF ACCEPTANCE**

a) After the installation work has been completed by the contractor, he will conduct tests and make adjustments as may be necessary to satisfy himself that the plant including low side equipments is capable of continuous running. There after he will offer to the department a running –in period of 7 days subject to a minimum aggregate of 120 hrs at his cost. The duty cycle of the plant during this running in period shall be same as that specified in the tender documents. In case of multiple compressor installations, all the compressors should be run by rotation. The plant will be operated and log of all parameters will be maintained during this period. The contractor will be free to carry out necessary adjustments etc. during this period without stopping the plant. Record of inside conditions will be made during this period to check the same are as per NIT requirements. The plant will be said to have successfully completed the running –in-period. After this the plant will be made available for beneficial use. After the plant has operated without any major break down/ trouble and inside conditions are maintained as per NIT requirements for the above specified running in period, it shall be taken over by the department subject to guarantee clause mentioned below. This date of taking over of plant after trouble free operation during the running in period shall be the date of acceptance.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

- b) Any loss of refrigerant or oil during the running in period shall be made good by the contractor free of charge.
- ii) Capacity test of the chilling unit and other major equipments shall be carried out as and when conditions become stabilized as per details given under Annexure A.
- iii) Seasonal testing may be carried out as and when outside condition become suitable.
- iv) After the trial run as in para (i) above, the AC contractor shall offer the plant for the seasonal test, namely test for summer or monsoon season whichever occurs earlier. The test results as per Annexure A shall be furnished.
- v) The equipment capacity computations as per para 'B' under notes of the Annexure A shall be carried out.
- vi) The input KW of the unit / TR at full load shall also be checked against contract requirements, if any.
- vii) Pressure drops across chiller and condenser at specified flow rates shall be checked against the contract requirements.
- viii) All instruments for testing shall be provided by the AC contractor. These shall be as per Note 'A' of Appendix A. The accuracy of the instruments shall be as follows :
 - a) Temperature: Liquid in glass thermometer having accuracy ± 1 deg. C as per IS: 4825.
 - b) Wet bulb Temperature: Sling psychomotor conforming to IS : 6017.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

Scale Error: For less than 0 Deg. C - 0.3 Deg C \pm 0.2 Deg C.

For over 0 deg. C. - 0.2 deg. C \pm 0.1 Deg.C.

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

d) Water flow meter: Water flow shall be measured using the arrangement installed as per schedule of work.

5. TESTING REQUIREMENTS AND PROCEDURES

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

The whole system balancing shall be tested with microprocessor based hitech instruments with an accuracy $\pm 0.5\%$

The instrument shall be capable of storing data and then down loading into a P.C. The HVAC contractor shall provide a minimum but not limited to the following instruments :

- Microprocessor based calculation meter to measure DB and WB temperature, RH and Dew point.
- Velo meter to measure air volume and air velocity.
- Pitot tube
- Electronic rotary vane Anemometer
- Accubalance flow measuring hood.
-

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

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

5.2 Air Systems

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

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

5.3 Water System

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

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

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

5.4 Unit capacity in Tons Refrigeration shall be computed from the temperature readings, pressure readings and water / brine flow measurements. Flow measurements shall be preferably through flow meters. Pumps shall be tested for discharge head, flow and BHP.

5.5 **Balancing Tolerance :**

Systems shall be balanced within the following tolerances :

1. Duct leakage rates (at operating pressures)

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

Under 70 L/S	10% of flow
Over / at 70 L/S	5% of flow
3. Water flow rates

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

Chilled water	2% of flow
Other	5% of flow
4. Heat flow rates Heat exchangers	5% of design capacity

Procedure:

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

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

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

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

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

5.6 Reports

Provide 3 copies of the complete balancing and testing reports to the department. Report shall be neatly typed and bound suitable for a permanent record. Report forms shall contain complete test data and equipment data as specified and safety measures provided with all equipments shall incorporate suitable safety provisions to ensure safety of the operating personal at all times. The initial and final inspection report shall bring out explicitly the safety provision in corporate in each equipments.

5.7 Final documentation

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

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

permanent indication. Notify the department of any areas marginal or unacceptable system performance.

The above tests and procedures are mentioned herein, for general guidance and information only, but not by way of limitation to the provision of conditions of contract and design / performance criteria.

Upon commissioning and final handover of the installation, the HVAC contractor shall submit (within 4 weeks) to the engineer – in – charge / department 6 (six) portfolios of the following indexed and bound together in hard cover ring binder (300x450mm) in addition to the drawings, as built in soft copy.

- Comprehensive operation and maintenance manual.
- Test certificates, consolidated control diagram and technical literature on all controls.
- Equipment warranties from manufacturers.
- Commissioning and testing reports.
- Rating charts for all equipment .
- Log books as per equipment manufacturers standard format.
- List of recommended spares and consumables.
- Any special tools required for the operation or the maintenance of the plant shall be supplied free with the plant.

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

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

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

ANNEXURE A

S.No.	Item	Test Results	
1.	Ambient conditions	D.B. Temp W.B. Temp %RH	-degC -deg C
2.	Compressor	R.P.M Suction pressure Discharge pressure oil pressure	-Kg/sq.cm -Kg/sq.cm -Kg/sq.cm
3.	Compressor motors	R.P.M. Voltage Current (i) at 100% load (ii) at partial load (a) (b) (c)	-Volts -amps -amps -amps -amps
4.	Water Chillers	Water flow rate Water temperature Entering Leaving Water Pressure Entering Leaving	-LPM -deg C -deg C -Kg/sq.cm -Kg/sq.cm

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

5.	Condensers	Water flow rate Water temperature Entering Leaving Water Pressure Entering Leaving	-LPM -deg C -deg C -Kg/sq.cm -Kg/sq.cm
6.	Pumps	R.P.M Motor current Discharge pressure Suction pressure	-amps -Kg/sq.cm -Kg/sq.cm
7.	Cooling Towers	Water temperature Entering Leaving Water bulb approach Fan motor voltage Fan motor R.P.M.	-deg C -deg C -deg C -amps -volts
8.	Airhandling units	Total air quantity Across coil Coil face area Air temperature Entering (D.B.) Entering (W.B.) Leaving (D.B.) Leaving (W.B.)	-cu.m / min. -Sq.m. -deg C -deg C

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

		Water Pressure Entering Leaving Water temperature Entering Leaving Water flow rate	-deg C -deg C -Kg/sq.cm -Kg/sq.cm -deg C -deg C -LPM
9.	Fresh air intakes	Face area Air quantity	-Sq.m. -cu.m / min
10.	Room conditions at the working plane (No. of readings shall be taken and averaged out)	Temperature D.B. W.B.	-deg C -deg C
11.	Controls	Function of each control shall be tested and report furnished	

Notes:-**A. Test Instruments**

1. All instruments for testing shall be provided by the air-conditioning contractor.
2. Thermometers used for measurement of temperature of water / refrigerant shall have graduation of 0.1 deg C and shall be got calibrated from N.P.L. or any recognized test house beforehand.
3. Thermometers used in the psychrometers shall have graduations of 0.2 deg C and shall be calibrated as at (2) above.
4. Pressure gauges shall also be got calibrated before hand from a recognized test house.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

5. Orifice type of flow meters shall be used for measuring flow rate through the condensers and chillers.

B. Capacity Computations

1. Condensing Unit :

The capacity shall be computed from the water temperature and water flow rate measurements of the condenser water and the compressor motor current readings. A reference may be made, if necessary to the manufacturer's motor performance characteristics for arriving at the B.H.P. consumption.

2. Water Chilling Unit :

The capacity shall be computed from the water temperature and water flow rate measurement of the chiller. Heat rejection from the condenser shall be computed from the water temperature and water flow rate measurements at the condenser.

3. Cooling Tower :

Water quantity measured at the condenser and the temperature of water at the cooling tower shall be recorded. Wet bulb approach shall be checked against design data recorded in the tender documents.

4. Air Handling Unit (Chilled Water Type) :

The capacity shall be computed from the water temperature and water flow rate measurement. A tolerance of + 5% from the tender documents value shall be acceptable in the capacity so computed. Air quantity shall be measured in the supply duct and checked with the quantity specified in the tender documents. A tolerance of + 10% in the air quantity shall be acceptable. The enthalpy difference of the entering and leaving the coil shall be computed from air temperature and recorded.

5. For the purpose of system capacity, the refrigeration tonnage obtained from the main refrigeration plant will be accepted.
6. If due to any reason, internal load mentioned in the tender specifications is not available psychometric computations for actual load conditions will be done and the plant, if found satisfactory will be accepted.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

SPECIAL CONDITIONS IBMS

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

AE-I
(EPD-4)

EE
(EPD-4)

AE (P)
(CPM (Housing))

EE(P)
(CPM (Housing))

TECHNICAL SPECIFICATIONS

BUILDING AUTOMATION SYSTEM

1.0 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES:

1.1 SPECIFICATION NOMENCLATURE

A. Acronyms used in this specification are as follows:

BMS Building Management System

GUI Graphical User Interface

POT Portable Operator's Terminal

DDC Direct Digital Controls

LAN Local Area Network

PICS Product Interoperability Compliance Statement

1.2 ARCHITECTURE:

- A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate both the ANSI/ASHRAE Standard 135-1995 BACnet, and Modbus technology communication protocols in an interoperable system.
- B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards including ANSI / ASHRAE™ Standard 135-1995, BACnet TCP to assure interoperability between all system components is required. For each BACnet device, the device supplier must provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet at all levels.
- C. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- D. Structured Query Language (SQL) or Java Database Connectivity (JDBC) or ORACLE compliant server database is required for all system database parameter storage. This data shall reside on a server for all database access.
- E. Two (2) level hierarchical topology is required to assure fast system response times and to manage the flow and sharing of data. Systems Requiring Router, Gateways are not acceptable.

1.3 WEB BROWSER CLIENTS

Systems requiring additional software (to enable a standard Web browser) to be resident on the DDC / client machine, or manufacture-specific browsers shall not be acceptable. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser.

The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.

The Web browser client shall support at a minimum, the following functions:

User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.

Graphical screens developed for the GUI shall be the same screens used for the Web browser client.

HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.

Storage of the graphical screens (Static) shall be stored in DDC directly and should not depend on any other hardware.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

The Web page shall get automatically refreshed without any user intervention.

Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:

Modify common application objects, such as schedules, calendars, and set points in a graphical manner. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator and set holidays

View logs and charts

View and acknowledge alarms

The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to adjust their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.

Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

1.4 SYSTEM DESCRIPTION & INPUT OUTPUT SUMMARY

The proposed system shall be a Direct Distributed Digital Control (DDC) system. It shall be a PC based system and shall combine latest state of the art technology with simple operating techniques. The entire Monitoring of Building Management System (BMS) shall be comprise of a network of interoperable, stand-alone digital controllers communicating on an open protocol communication network to a host computer within the facility and communicating via the Internet to a host computer in a remote location. The BMS shall communicate to third party systems such as Chillers, VAVs, Energy meters, UPS, DG, Lifts, VFDs & HT/LT circuit breakers, access control systems, fire-life safety systems and other building management related devices with open, interoperable communication capabilities.

The BMS framework shall utilize built-in Internet connectivity to a broad range of distribution partners in the building automation, energy services, power/utility, and industrial sectors. The Framework shall bring together

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

the ongoing computerization of control applications under single integrated system architecture.

The features shall be distributed both physically and functionally over the field controllers. Microprocessor based Direct Digital Distributed Controllers (DDC) shall interface with sensors, actuators and environmental control systems (i.e. HVAC units, chillers, pumps, fans, lighting etc.) and carry out followings functions:

- a. Individual input/output point scanning, processing and control.
- b. Centralized operation of the plant (remote control).
- c. Static / Dynamic graphic details of plant and building.
- d. Energy Management through optimization of all connected electrical and mechanical plants.
- e. Alarm Detection and early recognition of faults.
- f. Time, event and holiday scheduling as well as temporary scheduling.
- g. Prevention of unauthorized or unwanted access.
- h. Communication interface and control.
- i. Suggestive preventive maintenance for all equipment as well as own error diagnosis.
- j. Report generation.
- k. Optimum support of personnel.
- l. Data Visualization Tool

These Controllers shall be capable of functioning on a stand-alone mode i.e. in case of loss of communication with the central control station / Server, these shall function independently. DDC shall have microprocessors built-in as standard, which control the respective operation centers based on the required logic and also offer fast communication of data via the network communication system. The local access to these shall be either through an in-built display with keypad for each outstation or through a portable operator's terminal. The controllers shall be capable of executing advanced control algorithms like Optimum Start stop, PID control, auto PID tuning and schedule management. They shall also execute logic functions based on time and/or event. Totalization and averaging functions shall be an inherent feature of the controller.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Each stand-alone intelligent DDC Controller shall have a **dual 32 bit processor**, on board Ethernet connectivity. These shall also control any other operations on the floor and shall be sized to suit the operation centres or system requirement. This shall help in reducing the site electrical installation.

The number of controllers for central plant room equipments shall be decided by the contractor. Overall, the system shall be provided with 15% spare capacity, with spare of at least 15% points on each controller.

There shall be one BMS control station located in Control Room. The Operator Station should use a simple Web Browser in conjunction with the BMS Server software. The Computer shall be sized to cover the graphic display memory, planning information, software & data storage requirement. The display shall be in the form of dynamic color graphics and text format with menu driven pop-up windows and help facility.

The following software packages shall be loaded into the system as minimum standard:-

- a. Complete system operational software
- b. Site specific data manipulation software
- c. Graphics software
- d. Alarm indication software
- e. Internet Enabled Remote Monitoring Package.

DI=DIGITAL INPUT; AI=ANALOG INPUT; DO=DIGITAL OUTPUT; AO=ANALOG OUTPUT

IO Summary is attached as annexure.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

2.0 CENTRAL STATIONS SOFTWARE AND HARDWARE

2.1 CENTRAL STATION SOFTWARE

- A. A central server, located at Control Room, shall be provided. The server shall support all DDC's connected to the customer's network whether local or remote.
- B. Local connections shall be via an Ethernet LAN. Remote connections can be via ISDN, PSTN or dial-up connection.
- C. It shall be possible to provide access to all DDC & 3rd party integration units via a single connection to the server. In this configuration, each DDC can be accessed from the Graphical User Interface (GUI) or from a standard Web browser (WBI) by connecting to the Local Area network.
- D. The server software shall provide the following functions, at a minimum:
- Complete control and monitoring of IBMS system from colour graphics pages on the machine, or from a remote web browser.
 - Full client-server operation.
 - SQL / JDBC / ORACLE Database.
 - Comprehensive alarm handling with alarm retransmission and logging.
 - Scheduled recording of logged data from DDC.
 - Management of multiple controller occupation times.
 - Multilevel security system.
 - International language support
 - Display of HTML pages from company Intranet, or Internet.
 - Display of live, logged, or recorded data in multi-trace graphs.
 - Simple engineering path using drag and drop operations.
 - Self-learning of all local networks.
 - Help file in PDF format for viewing or printing.
 - Access to the configuration mode of devices.
 - Display all devices on the system connected via LANs, internet works, autodialed links and Ethernet Network connections.
 - Customised program creation environment.

The BMS software shall be simple, flexible and convenient to use such that an operator with minimal programming knowledge can use it to perform control / monitoring and to build programs for control applications, graphics to generate management information systems (MIS) reports. As well, on higher end it shall be possible to create customized programs to suite the site requirement by a software programmer. All necessary documents required to make customization possible

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

should be available along with the software without any additional charge.

The operating system shall be the Microsoft Windows XP / Windows 7 / Windows 2008 Server / Enterprise / Professional 32 / 64 bit multitasking environment. The networking software shall use Bacnet over IP.

2.2 Monitoring and control functions

Monitoring:

The system shall support data acquisition using periodic scanning, exception reporting or on operator request. The system shall support a range of scan intervals, ranging from less than 5 second up to several minutes as desired / required. The system shall allow certain selected points to be scanned more often / faster than other points.

The communication techniques shall be optimized to minimize network traffic while providing good system response and reliability. The system shall also provide utilities to compile aggregate statistics on communication link usage.

Control:

Control transactions issued by the operator shall be communicated to control devices using a write followed by read to ensure the integrity of the transaction. If the read following the write to the device indicates that the control action has failed, the operator shall be informed by means of a control failure alarm. The priority of the control failure alarm shall be configurable by the user.

2.3 System Database

The system shall provide a real-time database incorporating data from analogue, logical or pulse inputs. The database shall be configurable by the end user without the need for any programming and shall be able to modify on-line without interrupting operation of the system. In addition to point based information, the database shall also provide historization capabilities for analogue, digital, pulse; event based information and calculated values. This information shall be accessible by all facilities of the system such as custom displays, reports, trends, user written application, etc.,

The real-time database shall use suitable data structures to collect and store the following categories of data, as minimum.

- ◆ Access points
- ◆ Analogue points
- ◆ Status points
- ◆ Accumulator points
- ◆ Historical data
- ◆ Event data

The facility shall also exist to accommodate user defined data structures.

Each of the point database structures shall be comprised as a composite point with a number of associated parameters that may be referenced relative to a single tag

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

name. Specifically, each of these parameters shall be accessible by various sub-systems such as the graphical operator interface, report generation system and application program interface in a simple format without the need to know any internal storage mechanism.

The system shall maintain portions of the data base requiring frequent high-speed access as memory resident information and other less frequently accessed data as disk resident data.

Database backup shall be possible with the system on-line including backup of historical based data. The database backup shall be part of GUI software & shall be possible to configure automatic backup at regular interval without any user interference / attention. All other backup such as graphic pages / drawing etc can be windows based where simple copy & paste should be enough for taking backup other than database. Long term storage of this data shall be possible using the zip drive. The system shall have the provisions for importing this data at later date for analysis and long terms MIS reports.

Point data shall be stored in a composite point database structure that provides a wide range of configurable information including but not limited to:

- ◆ Point name and description
- ◆ Multiple locations for data storage and device scanning addresses.
- ◆ Scan period
- ◆ Multiple dead-band or hysteresis settings
- ◆ Monitoring and control access restriction information.
- ◆ Location of operator alarm handling instructions
- ◆ Location of ancillary information associated with the point.

2.4 Historical data storage

Collection of historical point data shall be configurable as part of the point definition. Once configured, this data shall be collected automatically. Historical data collection shall be provided for both snapshots and averages with intervals ranging from 5 seconds to several hours.

The system shall provide the necessary means to easily locate the particular value of interest for any of the historical points. The graphical operator interface, trend, report generation and application interfaces shall be able to access historical data.

2.5 Trending

The system shall provide flexible trending allowing real-time, historical or achieved data to be trended in a variety of formats. In addition, trend data types shall be able to combine to allow for comparisons between data e.g. current real-time data versus archived data. The system shall provide trending capability with following functions.

- ◆ Real time trending
- ◆ Historical trending
- ◆ Archived history trending

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- ◆ Trend scrolling
- ◆ Trend zoom
- ◆ Export option / Copying of currently displayed trend data to the clipboard for pasting into spreadsheet or document.

The system shall allow the trending of a minimum of 5 points in a single trend display set. For each trend set display it shall be possible for operators to configure the number of historical samples and ranges displayed. Points configured in trend sets shall be changeable on-line.

Operators shall be able to zoom in on information displayed on trend sets for closer inspection by dragging out an area of interest with the mouse or other pointing devices. From such a selection, it shall be possible to copy the underlying data to the windows clipboard for subsequent pasting into spreadsheet application such as Microsoft excel

2.6 Alarm Management

The software shall include a well organized alarm management facility to enable the operator to react quickly and efficiently to alarm conditions. Apart from the specific points identified for alarm annunciation in the I/O points schedule, the alarm types supported shall included:

- ◆ Very high value alarm
- ◆ Very low value alarm
- ◆ Large deviation alarm
- ◆ Rate of change alarm
- ◆ Unreasonable value alarm
- ◆ Delay to avoid nuisance alarm / short time change in value

The system shall permit any of these alarm types to be applied to the analog and accumulated points.

- ◆ The software shall permit at least 90 levels of alarm priorities to be assigned to each alarm ranging from the lowest to the highest. These levels shall be easily distinguished by the manner in which they are presented such as the color of the alarm message, blinking of the alarm message, varying audible alarms, etc., All alarm shall be logged in the event / alarm file and / or on the alarm printer. On acknowledgement of an alarm, it shall be possible to automatically issue a reset command to the controller so as to attempt to reset the alarm point.

2.7 Reporting

The system shall support a flexible reporting package to allow easy generation of report data. The reports provided shall include pre-configured standard reports for common requirements such as alarm / event reports and custom report generation facilities that are configurable by the user.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

The following pre-formatted reports shall be available on the system:

- ◆ Alarm / event report
- ◆ Operator trail report
- ◆ Point trail report
- ◆ Alarm duration report
- ◆ All point report
- ◆ Point attribute report
- ◆ Lockout summary
- ◆ Over-ride summary

Configuration of these reports shall only require entry of the schedule information, and other parameters such as point name or wildcard, filter information, time interval for search and destination printer to fully configure the report. No programming shall be required.

The requirement of the above mentioned reports shall be as follows:

Alarm/Event Report

This report shall be summary of all events of a specified type for nominated points occurring in a time period. The time period may be specified as an absolute start and end date and time, or as a period to the current time.

Operator trail report

This report shall be a summary of all operator actions relating to a specific operator in a specified period.

Point trail report

This report shall be provided to produce a summary of all events of a specified type occurring in a period on nominated points.

Alarm duration report

This report shall be provided to calculate the total amount of time a nominated point or group of points has been in an alarm condition over a given time period.

All point report

A report shall be provided to produce a list of point information, including point name, description, point type, engineering units, and current values.

Point attributes report

A report shall be provided for summaries of the points selected as per the following criteria:

- ◆ Out of service
- ◆ Alarm suppressed
- ◆ Abnormal input levels
- ◆ In manual mode.

Over-ride summary

This report shall be used to provide the summary of all points / commands that have been over-ridden by the operator.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

2.8 Time Schedules:

The system shall include the facility for time scheduling activities on both a periodic and one-off basis. All time schedules shall be configurable via the Operator workstation. Each time schedule entry shall consist of:

- ◆ Date
- ◆ Time
- ◆ Point name
- ◆ Point Parameter
- ◆ Target Value
- ◆ Type of scheduling
- ◆ The available time schedule type shall include:
 - Daily – to be executed everyday
 - Workday – to be executed on the week days
 - Holidays – to be executed on holidays
 - Individual days – to be executed on a particular day

The system shall also have the provision for programming temporary schedules that over-ride the normal schedule.

2.9 Energy Monitoring & Analysis:

Energy Monitoring & Analysis should be integral part of GUI. It shall support minimum of 50 Energy points for analysis purpose. The software shall provide the following feature but are not limited to,

- a) It shall be possible to generate & view detailed Daily, Weekly & monthly graphs of the energy meter / point identified.
- b) It shall be possible to see and analyze the total energy usage in a building and also shall be possible to identify by which system is major user of the energy.
- c) It shall be possible to compare the energy points week against week, day against day in a month, identify Maximum, Minimum & average daily values & Energy usage for different periods of time of the day.
- d) It shall be possible to make cost and consumption analysis or CO2 reports on consumption.
- e) Based on the energy consumed it shall be possible to rank the systems or building (in case of multi location buildings)
- f) Software shall allow the user to compare the predicted / forecasted energy or based on historic performance with current performance.
- g) It shall be possible to create energy signature with respect to ambient / outside temperature of the day
- h) Software shall allow the user to identify the exceptions happened in the system due to which energy consumption was increased.
- i) It shall be possible to compare the energy consumption after introducing a energy saving strategy for further fine tuning or to visualize the savings achieved.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

2.10 Operator Interface:

The operator interface provided by the system shall through an intuitive graphical user interface and shall allow for efficient communication of operational data and abnormal conditions. It shall provide a consistent frame work for viewing of information. Critical areas (such as alarm icons) shall be visible all the times. A predefined area on the screen shall provide operator messaging, and this area shall also be visible at all times.

The operator interface shall be interactive and based on graphics and / or icons. Standard tool bar icons and drop-down menus shall be available on all standard and custom display to allow easy access to common functions.

The system shall provide an operator interface with the following minimum capabilities:

- ◆ Window re-size, zoom in, zoom out.
- ◆ Dedicated icons and pull down menus to perform the following:
- ◆ Associated display
- ◆ Alarm summary
- ◆ Alarm acknowledgement
- ◆ Previous display recall
- ◆ Graphic call-up
- ◆ Trend call-up
- ◆ Point detail
- ◆ Current security level
- ◆ Alarm annunciation
- ◆ Communication fail annunciation
- ◆ Operator message zone.

2.11 Area assignment / area profile

Each operator shall be assigned one or more specific areas / functions of the facility with the appropriate monitoring and control responsibility. An area shall be defined in this context as a logical entity comprising of a set of points in the system. This in turn may represent a physical space in the facility or a particular utility or a particular equipment.

The system shall provide the facility to create area profiles, which combine areas and time periods, and which can be assigned to operators with the same area access requirements. By using area profiles in this way, area access can be specified to apply during certain time periods, allowing different areas of access at different times of the day or week.

2.12 Command partitioning

It shall be possible to assign to each operator a set of allowed commands / operating for each assigned area. With this feature, it shall for example be possible to configure an operator to set a digital point to On, but to disallow the same operator from setting the same digital point to OFF.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

2.13 Standard system displays

The following displays shall be included as part of the system:

- ◆ Alarm summary display
- ◆ Event summary display
- ◆ Point detail template displays
- ◆ Trend set template displays
- ◆ Communication status displays
- ◆ System status displays
- ◆ Operator scratch-pad display.

2.14 System Status Displays

These shall display the following information

- ◆ Points in alarm condition pending acknowledgement
- ◆ Points which remain in an alarm condition state but which have been acknowledged.
- ◆ Communication failure
- ◆ Printer Status
- ◆ Operator workstation status
- ◆ Controller status

2.15 Administrative Displays

The system shall provide the following full screen display

- ◆ Master system menu
- ◆ Report summary
- ◆ Alarm summary
- ◆ Event summary
- ◆ Display summary.
- ◆ Area assignment
- ◆ Holiday assignment
- ◆ History assignment
- ◆ Push-button assignment
- ◆ Operator definition
- ◆ Operator message board
- ◆ Events archive and retrieval
- ◆ Time period summary

2.15 Other requirements

It shall be possible to launch any windows based applications, such as Microsoft word or Microsoft excel, from within the operator interface.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

2.16 Help Facility

Software shall be provided to facilitate programming and storage of the system operation manuals in the hard-disk. The operation manual shall be retrieved by On Line Help mode so as to enable the operator to self learn the system operation, command, or function as and when needed.

This 'help' facility shall be made available to the operator by use of a dedicated key or a single key click on the mouse. A minimum help shall be available for every menu item and dialogue box.

The facility shall contain both text and graphics to provide information about the selected function directly.

The information provided shall be in simple clear language and shall be possible to search the help based on typical word included in the process.

When a point is overridden by operator command from an operator workstation or a local workstation, an alarm message shall be output to the appropriate alarm printer and to respective operator workstation. Alarm messages shall require operator acknowledgement.

When a point returns to normal, the event shall be recorded in control stations as 'Return to Normal'.

The Operator workstations shall be capable of displaying a list of all points in alarm for the building in a single summary. Systems which require the operator to make a separate summary for alarms shall not be acceptable. The software shall also provide details of particular alarm occurred on a point.

Contractor shall strictly follow the procedures as laid down in the necessary guidelines.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

3.0 3rd Party System Integrator Units:

- A. The 3rd party Integration unit shall provide the interface between bacnet / IP and the 3rd party field control devices such as DDC or PLC or any other devices which need to be integrated. These shall also provide supervisory capability of functions over the devices connected to it. **The purpose of using these units should be limited to integrate devices only, not for any DDC interface with GUI, provided by others.**
- B. The Unit must provide the following hardware features as a minimum:
- a. One no. on board RS-232 port
 - b. One No. on Board RS-485 port
 - c. Provision to include / add additional communication card
 - d. Battery Backup
 - e. Minimum RAM of 128 MB & Flash of 64MB
- C. The Unit must communicate over TCP/IP with communication speed of 10/100MBPS.
- D. The Integration unit shall have built in drivers for open protocol such as
- a. Bacnet over MSTP
 - b. Bacnet over IP
 - c. Modbus over MSTP
 - d. Modbus over IP
 - e. Lon FTT
 - f. Lon IP
 - g. Mbus over TCP
 - h. Mbus Serial
 - i. SNMP
 - J. BACNET / LONTALK

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

K. OPC

L. ONVIF

If the above drivers are add-on products, it shall be made available / considered while selecting the unit & the same to be confirmed in writing.

- E. The Integration unit shall provide flexibility of adding communication ports (RS485) by adding communication cards, minimum one slot, when required rather than adding additional unit itself.
- F. The Integration unit shall have inbuilt JAVA engine and it shall be possible to configure the IO, if required, of the 3rd party devices.
- G. The Integration unit should be capable of handling multiple protocol simultaneously and should not be restricted to single protocol.
- H. The Integration unit should have inbuilt memory for program storage.
- I. The Integration unit should automatically backup its database for the user defined interval.
- j. User authentication should be integral part of the unit.
- K. All vendors are required to provide the documentation highlighting the capabilities mentioned above.
- L. All units shall have LEDs for fault / status identification such as
 - a. LAN active (one per port in case of multiport units)
 - b. LED to display proper functionality / Status of the unit.
 - c. LED to display healthiness of CPU of the unit.

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

4.0 DIRECT DIGITAL CONTROLLER

4.1 DIRECT DIGITAL CONTROLLER (DDC) HARDWARE REQUIREMENT :

- 1) DDC controllers shall be capable of fully “stand- alone” operation i.e. In the event of loss of communication with other DDC’s or Control Station, they shall be able to function on their own.
- 2) The controllers shall consist of **single 32 bit microprocessors for reliable throughput**, with EEPROM based operating system on BACNET
- 3) The memory available to the controller board should serve as working space and there should not be any limitation of using particular function block other than the memory.
- 4) The controllers shall be UL listed and conforming to CE.
- 5) The controller shall have support programs built in RAM for minimum of 120 hours in the event of a power failure and it shall be possible to fit any battery thus expanding the time limit to 5 years. An alarm shall be generated on low battery voltage. The battery shall not be required to supply power to actuators, valves, dampers etc.
- 6) DDC shall have embedded **Bacnet/IP, Bacnet/Lontalk connectivity** so that it can be hooked into the Local Area Network (LAN) provided by the client / can be on dedicated network created by the vendor. Each DDC can be accessed from the **Graphical User Interface (GUI)** or from a standard Web browser (WBI) by connecting to the server.
- 7) Controller shall have capability to communicate with other controllers for any interlock or data sharing using peer to peer technology. The Controller which route the messages or data sharing through the system or any intermediate hard ware / controller shall not be acceptable.

Vendor to demonstrate this capability during the commissioning time and the same shall be verified at the time of handing over.
- 8) Each controller shall have RS232 port built on to it so that any trouble shooting required at field level can be carried out without removing the controller from the network (LAN).

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

- 9) All controllers shall accept **24V, 50Hz** Uninterrupted power supply, provided by end user, directly so that the in between hardware such as transformers and SMPS are avoided.
- 10) Controller shall support DHCP addressing over Local Area Network (LAN) so that the static IP requirements are reduced however a single static IP shall be provided for system so that it can be hosted on to internet in consultation with end user / consultant.
- 11) All controllers shall have capability to provide 24V DC auxiliary power supply for the sensor which requires power, however the same shall not be required to high power consuming devices / equipments such as actuators, dampers etc.

Vendors to provide details on the same at the time of offer.

- 12) The Controllers shall have proportional control, Proportional + Integral (PI) Control, Proportional plus Integral plus Derivative (PID) Control, Two Position Control and Time Proportioning Control and algorithms etc, all in its memory and all available for use by the user, i.e. all the control modes shall be software selectable at any time and in any combination. The analog output of Proportional Control, PI Control, and PID Control shall continuously be updated and output by the program shall be provided. Between cycles the analog output shall retain its last value. Enhanced integral action in lieu of Derivative function shall not be acceptable.

Automatic loop tuning facility should be available to tune the loop at regular interval and adjust the gain or the integral / derivative time.

- 13) The controllers shall have a resident real time clock for providing time of day, day of week, date, month and year. These shall be capable of being synchronized with system / time master clocks in the network.

Upon power restoration all clocks shall be automatically synchronized to the time master controller which will be set during the commissioning phase.

- 14) The microprocessor based DDC's shall be provided with power supply, A/D and D/A converters, memory and capacity to accommodate a maximum of 128 input/output (I/O) hardware points (with or without an expansion board).
- 15) If the controllers provided by the contractor have the configurable plug in function cards, then the following minimum specifications shall have to be met :
 - i) The cards shall provide for analog or digital, input or output, hardwired connections to the installed plant.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- ii) The quantity and combination of these cards shall be determined by the requirements of the plant in that location with the concurrence of the Owner/Consultant.
- 16) The DDC's shall have 15% spare capacity for each type of point (digital/analog input/output) to give flexibility for future expansion.
- 17) All DDC controllers shall have 10 / 12 bit A/D resolution and be capable of handling voltage, milli-ampere, resistance or open and closed contacts inputs in any mix, if required.

Analog inputs/outputs of the following minimum types shall be supported:

- a. 4-20 mA.
- b. 0-10 volts.
- c. 2-10 volts.
- d. Resistance Signals (either PTC or NTC such as PT 100, PT 1000, PT 3000, NTC20K)

Digital input/output types to be supported shall be, but not limited to the following:

- i) Normally-open contacts.
- ii) Normally-closed contacts.
- iii) Pulse inputs

Modulating outputs shall be true proportional outputs and not floating control type.

- 18) It shall be possible to change the analog inputs to accept any of the above depending upon the site condition or system requirement using a jumper.
- 19) Controller's packaging shall be such that, complete installation and check out of field wiring can be done prior to the installation of electronic boards.
- 20) All board terminations shall be made via plug-in connectors to facilitate trouble-shooting, repair and replacement. Soldering of connections shall not be permitted.
- 21) Controllers shall preferably be equipped with diagnostic LED indicators with at least indication for Power up Test OK, Watch dog and Bus Error. All LED's shall be visible without opening the DDC cover.
- 22) It shall be possible for the controllers to accept regulated uninterrupted power supply to maintain full operation of the controller functions (control, logging, monitoring and communications) in the event of a localized mains failure.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- 23) Controllers requiring fan cooling are not acceptable.
- 24) There shall be the facility for accessing controller data information locally, via a portable plug-in color LCD display which will be common to all controllers and normally removed to prevent unauthorized tampering. In either case, access to the system thus provided shall be restricted by passwords in the same way as at the main operator terminal.
- 25) In case the Portable operator Terminals (POT) are required to programmed the controllers, sockets shall be provided for same. Attachment of POT shall not interrupt or disable normal panel operation or bus connection in any way.
- 26) The controllers shall be housed in vandal proof boxes to protect them from tampering by any unauthorized personnel. All DDC controllers used in plant room spaces and external application shall be housed IP66/IP54 rating enclosures.
- 27) It shall be possible to add new controllers to the system without taking any part of the system off-line.
- 28) All DDC should have XML web service option which can be enabled in later stage for any higher interface with IT infrastructure or any other service.
- 29) Individual DDC should be BTL (Bacnet Testing Lab) tested.

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

4.2 DIRECT DIGITAL CONTROLLERS CAPABILITIES :

- 1) The Controllers shall have a self analysis feature and shall transmit any malfunction messages to the Control Station. For any failed chip the diagnostic tests, printout shall include identification of each and every chip on the board with the chip number/location and whether the chip "Passed" or "Failed" the diagnostic test. This is a desired requirement as it would facilitate trouble-shooting and ensure the shortest possible down time of any failed controller. Controllers without such safety feature shall be provided with custom software diagnostic resident in the EEPROM. The tenderer shall confirm in writing that all controllers are provided with this diagnostic requirement.
- 2) Operating system (O.S.) software for controllers shall be EPROM resident.
1. Controllers shall have resident in its memory and available to the programs, a relevant library of algorithms, intrinsic control operators, arithmetic, logic and relational operators for implementation of control sequences.
- 3) In the event of failure of communication between the controllers and/or Control Station terminal, alarms, reports and logs shall be stored at the controllers and transmitted to the terminal on restoration of communication.
- 4) In the event of memory loss of a Controller or the expiration of back-up power, on start-up of the unit the necessary data-base shall be downloaded manually so that the logic built are verified by the user. However, controllers requiring a manual intervention for the re-boot of software are not desired.
- 5) Where information is required to be transmitted between controllers for the sharing of data such as outside air temperature, it shall be possible for global points to be allocated such that information may be transmitted either on change of incremental value or at specific time intervals.
- 6) Controllers must be able to perform the following energy management functions as a minimum,
 - a. Time & Event programs
 - b. Holiday Scheduling
 - c. Maximum and Distributed power demand
 - d. Optimum start and stop program
 - e. Night purge
 - f. Load reset
 - g. Zero energy band
 - h. Duty cycle
 - i. Enthalpy analysis and control
 - j. Run Time Totalization
 - k. Sequencing and Optimization
 - l. Exception scheduling

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

1. Detailed description of software features and operating sequence of all available energy management software shall be submitted with the tender for evaluation by the consultant.
- 7) The DDC Controllers shall have Adaptive Control capability whereby the control software measures response time and adjusts control parameters accordingly to provide optimum control. The software shall allow self-tuning of the variable control loops (all or any of P, P+I, P+I+D) of the AHU's and chiller system so as to provide the most efficient and optimized controls at different load conditions. The energy management programs shall update their parameters based on past experience & current operating conditions.
- 8) Alarm Lockout shall be provided to prevent nuisance alarms. On the initial start up of air handler and other mechanical equipment a "timed lockout" period shall be assigned to analog points to allow them to reach a stable condition before activating an alarm comparison logic.

Tenderers shall indicate their proposed system alarm handling capability & features.
- 9) Run time shall be accumulated based on the status of a digital input point. It shall be possible to total either ON time or OFF time. Run time counts shall be resident in non-volatile memory.
- 10) It shall be possible to accommodate Holiday and other planned exceptions to the normal time programs. Exception schedules shall be operator programmable up to one year in advance.
- 11) All DDC shall have trend / log storing capacity in built into it. It shall be possible to have stored the data for at least 40 days @ 1 hour sampling time for all the points of the DDC (used or unused).
- 12) Minimum communication should be 10MBPS for each of the controller.
- 13) DDC should be forward compatible type so that any expansion or upgrade of the system required in the future is easily taken care off without scrapping / removing / disturbing the existing working system.
- 14) DDC Should allow user to include graphics, if required, however it shall be of static in nature.
- 15) All DDC Should be capable of sending email to specific user in the event of alarm, identified by end user / consultants.

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

5.0 PORTABLE OPERATORS TERMINAL (POT)

- 1) POT shall be provided to allow operator readout of system variables, override control and adjustment of control parameters. The POT shall be portable and plug directly into individual controllers for power and data.
- 2) The minimum functionality of POT shall include :
 - Set points to a fixed value or state.
 - Display diagnostic results.
 - Display sequentially all point summary and sequentially alarm summary.
 - Display/change digital point state, analog point value.
 - Display/change time and date.
 - Display/change analog limits.
 - Display/change time schedule.
 - Display/change run time counts and run time limits.
 - Display/change time and/or event initiation.
 - Display/change programmable offset values.
 - Access DDC initialization routines and diagnostics.
 - Enable/disable points, initiators and programs.
 - Display/change minimum ON/OFF and maximum OFF times.
- 3) The POT shall be complete with command keys, data entry keys, cursor control keys **or** liquid crystal display (LCD). Access shall be via self prompting menu selection with arrow key control of next menu/previous menu and step forward/backward within a given menu.
- 4) Connection of a POT to a controller shall not interrupt or interfere with normal network operation in any way, prevent alarms from being transmitted, or interfere with Control Station commands and system modifications.
- 5) Connection of POT at any controller shall provide display access to all controllers on that bus. In case the controller has a fixed LCD display and entry keyboard, then the display access shall be available on each screen.
- 6) It should be possible to override the commands given through POT by the Operator Control Station.
- 7) POT shall have touch screen color display and it shall possible to hook this to Local area Network so that the entire system data can be visualized.
- 8) POT shall have self learning capability so that it can recognize the DDCs on the network and update all points without any manual programming.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

6.0 DATA COMMUNICATION

The communication between controllers shall be via a dedicated or customer provided Ethernet communication network as per standards. Controller's microprocessor failures shall not cause loss of communication of the remainder of any network. All networks shall support global application programs, without the presence of a host PC.

Each controller shall have equal rights for data transfer. There shall be no separate device designated as the communication's master. Those systems using dependent controllers shall be pointed out by the contractor and a dual Hot redundant transmission media with automatic switching and reporting in the event of line faults will have to be provided.

The communication network shall be such that:

- 1) Every DDC must be capable of communicating with all DDC's on its own.
- 2) Network connected devices shall be capable of sending message after successive retries shall constitute a communication or device failure.
- 3) Each controller is to be provided with a communication watchdog to assure that the failure is reported to central station.
- 4) Error recovery and communication initialization routines are to be resident in each network connected device.
- 5) The communication protocol shall incorporate CRC (Cyclic Redundancy Check) to detect transmission errors.

Single or multiple standalone controller failures shall not cause loss of communication between active DDCs connected on the communication network. Full communication shall be sustained as long as there are at least two operational stand alone control panels active on the communication network.

All the System Integration Units shall be linked together on a Local Area Network.

The communication network shall include provision for automatically reconfiguring itself to allow all operational equipment to perform as efficiently as possible in the event of single or multiple failures.

The BAS supplier shall be required to provide details of standards to which their system conforms.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

7.0 FIELD DEVICES

7.1 ELECTRIC AND ELECTRONIC CONTROLS RELATED EQUIPMENT

General Requirements

All controls shall be capable of operating in ambient conditions varying between 0-55 deg. C and 90% R.H. non-condensing.

All Control devices shall have a 20 mm conduit knockout. Alternatively, they shall be supplied with adaptors for 20 mm conduit.

Ancillary Items

When items of equipment are installed in the situations listed below, the BAS contractor shall include the following ancillary items:

(i) Weather Protection

All devices required to be weatherproofed are detailed in the Schedule of Quantities. IP ratings for the equipment are mentioned in the respective section.

(ii) Pipework Immersion

Corrosion resisting pockets of a length suitable for the complete active length of the device, screwed ½" (13 mm) or ¾" (20 mm) NPT suitable for the temperature, pressure and medium.

(iii) Duct Mounting (Metal or Builders Work)

Mounting flanges, clamping bushes, couplings, locknuts, gaskets, brackets, sealing glands and any special fittings necessitated by the device.

7.2 TEMPERATURE SENSOR

Temperature sensors for space, pipes and ducts, shall be of the Resistance Temperature detector (RTD) type or thermistor. These shall be two wire type and shall conform to the following specifications :

- 1) Immersion sensors shall be high accuracy type with a high resistance versus temperature change. The accuracy shall be at least ± 1.33 deg C.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- 2) Immersion sensors shall be provided with separate Brass thermo well. These shall be manufactured from bar stock with hydrostatic pressure rating of at least 10 kgf/cm².
- 3) The connection to the pipe shall be screwed type. An aluminum sleeve shall be provided to ensure proper heat transfer from the well to the sensor. Terminations to be provided on the head. Flying leads shall not be acceptable.
- 4) The sensor housing shall plug into the base so that the same can be easily removed without disturbing the wiring connections.
- 5) Duct temperature sensors shall be with rigid stem and of averaging type. These shall be suitable for duct installation.
- 6) Outdoor air temperature sensor shall be provided with a sun shield.
- 7) The sensors shall not be mounted near any heat source such as windows, electrical appliances etc.

The temperature sensors may be of any of the following types :

- 1) PT 100, PT 1000, PT 3000
- 2) Thermistor

7.3 HUMIDITY SENSOR

Space and duct humidity sensors shall be of capacitance type with an effective sensing range of 10% to 90% RH. Accuracy shall be + 3% or better. Duct mounted humidity sensors shall be provided with a sampling chamber. Wall mounted sensors shall be provided with a housing. The sensor housing shall plug into the base so that the same can be easily removed without disturbing the wiring connections. The sensors shall not be mounted near any heat source such as windows, electrical appliances etc.

7.4 FLOW METER

Water flow meters shall be either Electro magnetic or ultra sonic type. For electromagnetic flow meter, teflon lining with 316 SS electrodes must be provided. The housing shall have IP 55 protection. Vendors shall have to get their design/ selection approved by the Consultant, prior to the supply.

The exact ranges to be set shall be determined by the contractor at the time of commissioning. It should be possible to 'zero' the flow meter

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

without any external instruments, with the overall accuracy of at least $\pm 1\%$ full scale.

7.5 PRESSURE TRANSMITTER FOR WATER

Pressure transmitters shall be piezo-electric type or diaphragm type. (Bourdon Tube type shall not be acceptable). Output shall be 4-20mA or 0-10V DC and the range as specified in the data sheet depending on the line pressure. Power supply shall be either 24 V AC, 24 V DC or 230 V AC. Connection shall be as per manufacturer's standards. The pressure detector shall be capable of withstanding a hydraulic test pressure of twice the working pressure. The set point shall fall within 40%-70% of the sensing range and detector shall have sensitivity such that change of 1.5% from the stabilized condition shall cause modulation of the corrective element. The sensor must be pressure compensated for a medium temperature of -10°C to 60°C with ambient ranging between 0°C to 55°C .

7.6 DIFFERENTIAL PRESSURE SWITCH FOR PIPE WORK

These shall be used to measure pressure differential across suction and discharge of pumps. The range shall be as specified in the data sheet. Switch shall be ON with increase in differential. Housing for these shall be weather proof with IP 55 protection. The pressure switch shall be capable of withstanding a hydraulic test pressure of 1.5 times the working pressure. The set point shall fall in 40-70% of the scale range and shall have differentials adjustable over 10%-30% of the scale range. The switches shall be provided with site adjustable scale and with 1 NO/NC contacts.

7.7 DIFFERENTIAL PRESSURE SWITCH FOR AIR SYSTEMS

These shall be diaphragm operated. Switches shall be supplied with air connections permitting their use as static or differential pressure switches.

The switch shall be of differential pressure type complete with connecting tube and metal bends for connections to the duct. The housing shall be IP 54 rated. The pressure switches shall be available in minimum of 3 ranges suitable for applications like Air flow proving, dirty filter, etc. The set point shall be concealed type. The contact shall be SPDT type with 230 VAC, 1A rating.

The switch shall be supplied suitable for wall mounting on ducts. It should be mounted in such a way that the condensation flow out of the sensing tips. Proper adaptor shall be provided for the cables.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

The set point shall fall within 40%-70% of the scale range and 1 has differentials adjustable over 10%-30% of the scale range. The switches shall be provided with site adjustable scale and with 1 NO/NC contacts.

7.8 AIR FLOW SWITCHES

Air flow switches shall be selected for the correct air velocity, duct size and mounting attitude. If any special atmospheric conditions are detailed in the Schedule of Quantity the parts of the switches shall be suitably coated or made to withstand such conditions. These shall be suitable for mounting in any plane. Output shall be 1 NO/NC potential free. Site adjustable scale shall also be provided.

7.9 AIR PRESSURE SENSOR

The pressure sensor shall be differential type. The construction shall be spring loaded diaphragm type. The movement of the membrane in relation to the pressure should be converted by an inductive electromagnet coupling which would give an output suitable for the controller. The pressure sensor shall be in a housing having IP 54 ratings in accordance with IEC 529. Suitable mounting arrangement shall be available on the sensor. The sensor shall come complete with the PVC tubes & probes.

7.10 WATER FLOW SWITCH

These shall be paddle type and suitable for the type of liquid flowing in the line. Output shall be 1NO/1NC potential free.

7.11 CO SENSOR

CO Sensor shall be integrated Surface mounted type on the field. These shall work on 24V AC/DC supply with the output being standard type i.e. 4-20 mA / 0- 10 Volts etc. Response time of the detector shall be <10 minutes

7.12 AIR VELOCITY SENSOR

Air Velocity Sensor shall be integrated Surface / Duct mounted type on the field. These shall work on 24V AC/DC supply with +/- 10% variation the output being standard type i.e. 4-20 mA / 0- 10 Volts etc with an accuracy of +/- 3%. It shall be possible to select the different ranges by changing the jumpers on the sensor. At least 3 selection ranges on the sensors are required.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

7.13 CO2 SENSOR – Space Type

CO2 Sensor shall be wall / Surface mounted type on the field. These shall work on 24V AC/DC supply with the output being standard type i.e. 4-20 mA / 0- 10 Volts etc. The sensing range required shall be 0-2000 PPM with good resolution.

The preferred type of sensing element / method is NDIR type with accuracy of +/-30PPM or +/-5% of measured value. Warm up time of sensor shall be <2 minutes & response time is better than 150 seconds. Sensor shall be suitable to fix & operate at 1500 to 1750mm above the finished floor level.

7.14 LEVEL SWITCH

The level switches shall have to meet the following requirement:

Type	:	Float Type/Capacitance type/Conductivity type
Mounting	:	To suit application.
Connection	:	Flanged ANSI 150 lbs RF Carbon steel
Float material	:	316 SS
Stem Material	:	316 SS
Output	:	1 NO, 1 NC potential free
Switch Enclosure	:	IP 55

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

8.0 ENCLOSURES FOR CONTROLLERS AND ELECTRICAL PANELS

All the controllers shall be housed in Lockable Vandal proof boxes which shall either be floor mounted or wall mounted. These shall be free standing, totally enclosed, dust and vermin proof and suitable for tropical climatic conditions.

The panel shall be metal enclosed 18 SWG CRCA sheet steel cubicle with gaskets between all adjacent units and beneath all covers to render the joints dust proof. All doors and covers shall be hinged and latched and shall be folded and braced as necessary to provide a rigid support. Joints of any kind in sheet metal shall be seam welded with welding slag ground off and welding pits wiped smooth with plumber metal.

All panels and covers shall be properly fitted and secured with the frame and holes in the panels correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with nuts. Self threading screws shall not be used in the construction of control panels. Knockout holes of approved size and number shall be provided in the panels in conformity with the location of incoming and outgoing conduits/cables. Lamps shall be provided to support the weight of the cables. The dimension of the boxes shall depend on the requirement with the colour decided in consultation with the Architect/Consultant.

Note: All panel enclosures used in plant room spaces and external to building shall be suitable for outdoor application (IP 54 protection).

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

9.0 CONDUITS AND WIRING

Prior to laying and fixing of conduits, the contractor shall carefully examine the drawings indicating the layout, satisfy himself about the sufficiency of number and sizes of conduits, sizes and location of conduits and other relevant details. Any discrepancy found in the drawings shall be brought to the notice of Architect/Engineers any modifications suggested by the Contractor shall be got approved by the Architect /Engineers before the actual laying of conduits is commenced.

9.1 CONDUITS/TRUNKER

Conduits and accessories shall conform to relevant Indian Standards. PVC conduits of required dia shall be used as called for in the schedule of quantities. Joints between conduits and accessories shall be securely made, with help of adhesive.

The conduits shall be delivered to the site of construction in original bundles and each length of conduit shall bear the label of the manufacturer.

9.2 CONNECTIONS

All jointing methods shall be subject to the approval of the Architect/Engineer. Separate conduits shall run for all power wiring.

The threads and sockets shall be free from grease and oil. Connections between conduit and controller metal boxes shall be by means of brass hexagon smooth bore bush, fixed inside the box and connected through a coupler to the conduit. The joints in conduits shall be smooth to avoid damage to insulation of conductors while pulling them through the conduits.

9.3 BENDS IN CONDUIT

Where necessary, bends or diversions may be achieved by means of bends and/or circular inspection boxes with adequate and suitable inlet and outlet screwed joints. In case of recessed system each junction box shall be provided with a cover properly secured and flush with a finished wall surface. No bends shall have radius less than 2-1/2 times the outside diameter of the conduit.

9.4 FIXING CONDUITS

The conduits, junction boxes, outlet boxes and controller boxes once installed in position, shall have their outlets properly plugged or covered so that water, mortar, insects or any other foreign matter does not enter into the conduit system. Surface conduits shall be fixed by means of spacer bar saddles at intervals not more than 500 mm.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

The saddles shall be 2 mm x 19 mm galvanized steel flat, properly treated, primer coated & painted, securely fixed to supports by means of nuts and bolts/rawl bolts and brass machines screws.

9.5 DRAWING OF CONDUCTORS

While drawing insulated wires/cable into the conduits, care shall be taken to avoid scratches and kinks which may cause breakage of conductors. No joint shall be allowed in case of breakage of any conductor. No joint shall be shaved off like length of the conductors. Insulation shall be shaved off like sharpening of a pencil and it shall not be removed by cutting it square to avoid depression/cutting of conducting material.

Strands of wires shall not be cut to accommodate & connect to the terminals. Terminals shall have sufficient cross-sectional area to take all the strands.

No wire shall be drawn into any conduit until all work of any nature that may cause injury to wire is completed. Before the wires are drawn into the conduit, the conduits shall be thoroughly cleaned of moisture, dust, dirt or any other obstruction. Where wires are connected to detectors, or panel, sufficient extra length of wires shall be provided to facilitate easy connections and maintenance.

Only licensed supervisors/wiremen shall be employed for cabling and other connected work. Only approved make of cables shall be used. The cables shall be brought to the site in original packing.

9.6 MODE OF MEASUREMENT

Signal Cable

The cabling running between DDC controllers to the field devices shall be termed as signal cabling. This cabling along with conduits shall be payable on per I/O point basis.

LAN Cable

The cable connecting various system integration units to the control station shall be termed as LAN cable. These cable alongwith conduits shall be measurable on unit length basis.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

10.0 SIGNAL CABLING & COMMUNICATION CABLING

The signal cable shall be of the following specifications:

- | | | |
|------------------------------------|---|--|
| a. Wire | : | Annealed Tinned Copper |
| b. Size | : | 1.0 sq. mm, stranded type |
| c. No. of conductors | : | Two (One pair) |
| d. Shielding | : | Overall beld foil Aluminium polyester shield. |
| e. Jacket | : | Chrome PVC |
| f. Nominal DCR | : | 17.6 ohm/km for conductor
57.0 ohm/km for shield |
| g. Nominal capacitance
at 1 KHz | : | 130 pF/m between conductors
180 pF/m between one conductor and other
Conductors connected to shield. |

11.0 LOCAL AREA NETWORK CABLE

Depending on the type of LAN system being used by the contractor, standard, manufacturer's specification shall apply.

12.0 BMS DELIVERABLES-

The deliverables expected from the BMS in broadly defined here under. However it is understood that the I / O summary detailed in this specifications will be reckoned while designing the system.

Ventilation:

1. Timed scheduled operation ventilation fans.
2. Facility to bring into any of the additional fans into operation in the event of maintenance on any of the main in-line fans.
3. Status of fans
4. Status of Generator room, STP room, and toilet ventilation fans
5. Status of staircase pressurization and kitchen exhaust fans
6. Run Time Reports for above equipment
7. Trending of CO concentration levels.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

Chillers:

The chiller supplier shall provide software interface by providing linking of all Chiller Microprocessor panel for communication between panels. Additionally, he shall provide single point gateway for high level integration with read/write capability to the BMS system.

1. Data logging of Chillers – operating parameters.
2. Fault history.
3. Cycle operation of Chillers on standby mode whenever applicable during night charge cycle.
4. Chiller sequencing and load sharing.
5. Status.
6. Customized Trends/Schedules etc. pertaining to various Chiller parameters
7. Maintenance Alarm Pop up

Pumps:

Primary and secondary Brine pumps:

1. Control and Status
2. Time totalizing- led/lag for standby operation.
3. Data logging
4. Pump status
5. Run Time of the pumps

Secondary Chilled water pumps with VFD:

1. Loading history
2. Pump Status
3. Run Time of the pumps

Air handling units (Standard AHU's)

1. Space Temperature Set point control
2. Actual space / RA Temperature
3. Filter status
4. Fan status
5. Auto/Manual operation status
6. Fan on/off status
7. Control valve status
8. Run Time for the Fan/Motors
9. PID Control for Valves

Air handling units (AHU's with return air fans, if applicable):

1. Emergency smoke evacuation:
2. Fans and damper control on actuation of smoke sensor.
3. Night purge / Free cooling:
4. Fans, Dampers and control valve control on ambient temperature sensing.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

5. Balance deliverables as under iii. Above
6. PID Control for Valves
7. Run Time for Fan/Motors
8. Customized Control Strategy & Switching Logic

Plumbing system:

1. Monitoring of water levels in under ground tanks and overhead tanks
2. Pumps run hours
3. Pump on-off status
4. Run Time

STP:

1. Run hours pumps in the system
2. High water level alarm

Electrical monitoring and data logging:

Parameters relevant to Automatic Transfer Switches (ATS) at the origin of utility supply and standby sources and Multi Data Meters (MDM) in outgoing feeders as per following.

(Through integration as all MDMs shall be provided with communication ports)

Data Points to be monitored & trended for MDMs: kW, kWh, kV Ar.p.f, V, A, Power outages, DG run

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

4.0 SPECIFICATIONS FOR SOLAR WATER HEATING SYSTEM

4.1 The scope of work comprises design, supply, testing & commissioning of indirect circulation solar heating system for heating domestic water. The solar hot water system will be of following specifications:

- 4.1.1 Capacity - As per bill of quantities
- 4.1.2 Outlet temperature - 60°
- 4.1.3 No. of panels - As per bill of quantities
- 4.1.4 Location of panels - On roof
- 4.1.5 Heat transfer fluid - Treated water
- 4.1.6 Capacity of SS vessel - As per bill of quantities .

4.1.7 Submittals

The contractor shall submit the following along with the tender.

- a) Performance chart and curve.
- b) Specific model, type and size of each item.
- c) Calculation for solar system performance.
- d) Submit data showing that the contractor has successfully installed system of the same type and design specified.
- e) To submit drawings of the system, size containing system, schematic diagram, collector layout and roof plan.

4.2 Specifications

4.2.1 Standard or Pre-Approved Products

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

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

4.2.2 **Nameplates**

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

4.2.3 **Piping system**

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

4.2.4 **Pipe Insulation**

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

4.2.5 **Calibrating Balancing Valves (for multiple collector banks)**

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

4.2.6 **Pressure Gauges**

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

4.2.7 **Thermometers**

Supply thermometers with wells and separable bronze sockets.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

4.2.8 **Pipe Hangers and Supports**

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

4.2.9 **Valves**

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

4.3 **Collector Subsystem**

4.3.1 **Solar Collector Construction**

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

4.3.2 **Collector Warranty**

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

4.3.3 **Solar Collector Performance**

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

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

per bank while providing for balanced flow and for thermal expansion considerations.

4.4 **Solar Collector Array**

4.4.1 **Net Absorber Area and Array Layout**

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

4.4.2 **Piping**

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

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

4.4.3 **Supports for Solar Collector Array**

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

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

4.4.4 **Pumps**

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

4.4.5 **Heat Transfer Fluid**

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

4.4.6 **Tempering Valve**

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

4.4.7 **ELECTRICAL WORK**

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

4.4.8 **PAINTING AND FINISHING**

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

4.5 **INSTALLATION**

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

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

4.6 **System Flushing and Disinfection**

Flush and disinfect the piping system.

4.7 **Collector Subsystem**

4.7.1 **Collector Array**

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

4.7.2 **Array Piping**

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

4.7.3 **Array Support**

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

4.7.4 **Pipe Expansion**

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

4.7.5 **Valves**

Install ball valves at the inlet and outlet of each bank of manifold collectors. Install calibrated balancing valves at the outlet of each collector bank and mark final settings on each valve. Install a union adjacent to each ball valve.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Balance flow through the collector piping with at least one balancing valve left in the open position. Locate tempering mixing valve downstream of auxiliary water heater to control hot water delivery temperature.

4.7.6 **Roof Penetrations**

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

4.8 **INSPECTION AND TESTING**

4.8.1 **Instructions**

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

4.8.2 **Acceptance Testing and Final Inspection**

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

4.8.3 **Hydrostatic Test**

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

4.8.4 **Operational Test**

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

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

4.8.5 **Overall System Operations**

Demonstrate each solar energy system will operate properly while unattended for a period of at least 72 hours. As required by system design, demonstrate the system controller will start the pumps after being warmed by the sun, and that it will properly shut down during cloudy weather or in the evening over a minimum of three complete cycles. It is permissible to manipulate the temperature of the storage tank by the introduction of cold water.

4.8.6 **Temperature Sensor Diagnostics**

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

4.9 **FIELD TRAINING**

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

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

TECHNICAL SPECIFICATIONS FOR FIRE-FIGHTING SYSTEM

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

a. **CODES & STANDARDS**

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

IS:554	Dimensions for pipe threads where pressure tight joints are required on the threads
IS:638	Sheet rubber jointing and rubber insertion jointing.
IS:778	Copper alloy gate, globe and check valves for water work purposes
IS:780	Sluice valves for water-works purposes (50 mm to 300 mm).
IS:901	Couplings, double male and double female, instantaneous pattern for fire fighting
IS:1239	Mild steel tubes, tubulars and other wrought (Part I & II) steel fittings
IS:884	Swinging type wall mounted hose reel with drum,
IS:388	Hose tubing.
IS:4038	Foot valves for water-works purposes

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

IS:5290	Landing valves
IS:10221	Anti corrosion treatment for underground MS pipes.
IS:5312	Swing check type reflux (non-return) valves
	Rules for Automatic sprinkler installation & Tariff Advisory Committee
PUMPS	
IS:1520	Horizontal centrifugal pumps for clear, cold and fresh water.
BS:599	Methods of testing pumps.
PTC:8	ASME Power Test Codes - Centrifugal Pumps
MOTOR	
IS:325	Induction motors, three-phase
IS:900	Induction motors, installation and maintenance, code of practice for
IS:7816	Guide for testing insulation resistance of rotating machines.
IS:4029	Guide for testing three phase induction motors.
IS:3043	Code of practice for earthing.
Further to those stated above, the design, manufacture, installation and performance of motors shall conform to the latest Indian Electricity Act and Indian Electricity Rules. The motor shall also be acceptable to the Tariff Advisory Committee.	
CODES AND STANDARDS FOR CONTROL PANEL	
Equipment shall conform to the latest applicable Standards as mentioned In case of conflict between the Standards and this specification, this specification shall govern	
IS:13947 (Part 2&5), 1993	Low voltage switchgear & control ar
IS:2147, 1966	Degree of protection
IS: 13947 (Part 4, Sec. I), 1993 BS: 60947-4-1, 1992: IEC:158	Contactor for voltage not exceeding 1000V AC
IS:375, 1993	Marking and arrangement of bus bars
IS:694, 1990 & IS:8130, 1984	PVC Insulated cables and aluminum conductor
IS:1248,1991	Direct cting electrical indicating instruments
IS:13703, 1991	Low voltage fuses

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

IS:13118 (All parts), 1991	Alternating current circuit breakers
IS:2705 (Part 1 to 4), 1992	Current transformers
IS:3156 (Part 1 to 3), 1992	Voltage transformers

4. Electrical Driven Pump Sets

- 4.1 The electrical fire pumps shall be suitable for automatic operation and both the motor and pump shall be assembled on a common bed plate, fabricated from MS channel. The pumps shall be horizontal split casing centrifugal type direct driven by means of a flexible coupling with coupling guard. The pumps shall be single/multi stage designed for continuous operation and shall have a continuously rising head characteristic without any zone of instability. The delivery pressure at pump outlet shall be not less than 7 Kg/sq.cm. in any case.
- 4.2 The motor for each pump shall have a 15% margin of power rating over the rated pump input power and shall be totally enclosed fan cooled type conforming to relevant protection class of IS 4691-1968. The class of insulation shall be 'F' and motor shall be rated for continuous duty and shall have horse power necessary to drive the pump at 150 percent of its rated discharge with at least 65% rated head. The motor shall conform to IS 325-1978.
- 4.3 In case the pump & motor/engine are from different manufacturers, the contractor shall assume full responsibility in the operation of the pump and the drive as one unit.
- 4.4 All pumps shall be capable of a minimum of 150 percent of rated capacity at a total head of not less than 65 percent of the total rated head. The total shut-off head shall be within 120 percent of total rated head on the pump.
- 4.5 An automatic air release valve shall be provided to vent air from the pump. This valve shall be located in the pump house in the discharge line between the pump and the discharge check valve.
- 4.6 The centrifugal pumps shall conform to IS 1520.
- 4.7 The pump casing shall be heavy section close grained cast iron and designed to withstand 1.5 times the working pressure. The casing shall be provided with shaft seal arrangement as well as flanges for suction and delivery pipe connections as required.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- 4.8 The parts like impeller, shaft sleeve, wearing ring etc. shall be of non-corrosive metal like bronze/brass/gun metal. The shaft shall be stainless steel.
- 4.9 The bearings of the pumps shall be effectively sealed to prevent loss of lubricant or entry of dust or water.
- 4.10 The pumps shall be provided with plates indicating the suction lift, delivery head, discharge, speed and number of stage.
- 4.11 The cable boxes and terminators of motors shall be suitable for receiving 1.1 KV grade armored power cables and so designed to enable easy disconnection and replacement of cables.
- 4.12 The base plate shall be supported on suitable height cement concrete foundation of 1:2:4 (1 cement : 2 coarse sand : 4 coarse aggregate) ratio. Edge of foundation shall be protected by MS channel of size 35 x 35 X 3 mm all around.

5. Diesel Engine

- 5.1 The diesel engine of diesel fire pump shall be required to operate under the conditions of site environment and the same shall be designed with regard to case of maintenance, repair, cleaning and inspection. This will also provide interchangeability of parts.
- 5.2 The engine shall be capable of both automatic and overriding manual start by push button without any preliminary heating of combustion chamber and all controls/mechanisms which have to be operated in the starting process shall be within easy reach of the operator.
- 5.3 The automatic start of Diesel Engine shall be initiated by a high torque DC motor charged by one set of two batteries each of 12V capacity and of 180AH rating.
- 5.4 The battery bank shall be used for no other purpose than starting of the engine and shall be fully charged at all times with provisions for trickle & boost chargers. After starts of the engine the charger shall be disconnected, the battery being fed from the engine dynamo. The battery charger of air cooled type shall be able to charge one battery bank at a time.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

- 5.5 The engine shall be multi cylinder/ vertical 4 stroke cycle water cooled developing required HP at the operating speed of 1500 RPM to drive the fire pump. The continuous capacity of diesel engine available for the load shall be after correction of ambient temperature and humidity. This shall be at least 20% greater than the maximum HP required to drive the pump at its duty point. The engine shall also be capable of driving the pump at 150% of the rated discharge at 65% of rated head. The engine shall have 10% overload capacity for one hour in any period of 12 hours continuous run.
- 5.6 The diesel engine shall conform to BS 649/IS 1601/IS 10002 all amended upto date.
- 5.7 Engine Accessories – The engine shall be complete with the following accessories:
- (i) Fly wheel dynamically balanced.
 - (ii) Direct coupling for pump and coupling guard.
 - (iii) Radiator with hoses, fan, water pump, drive arrangement and guard.
 - (iv) Corrosion resister
 - (v) Air cleaner, dry type
 - (vi) Fuel service tank support, semi-rotary pump and fuel oil filter with necessary pipe work.
 - (vii) Pump for lubricating oil and Lubricating oil filter.
 - (viii) Electrical silencer battery (2 x 12V)
 - (ix) Exhaust silencer with necessary pipe work.
 - (x) Governor.
 - (xi) Instrument panel housing all the gauges including Tachometer, hour meter and starting switch with key (for manual starting).
 - (xii) Necessary safety controls
- 5.8 Cooling System – The engine cooling system shall be radiator water cooled system. The radiator assembly shall be mounted on the common bed plate. The radiator fan shall be driven off the engine as its auxiliary with a multiple fan belt. Cooling water shall be circulated by means of an auxiliary pump of suitable capacity driven by the engine in a closed circuit. When half of the belts are broken, the remaining belts shall be capable of driving the fan.
- 5.9 Fuel System – The fuel shall be gravity fed from the engine fuel tank to the engine driven fuel pump. The engine fuel tank shall be mounted either over or adjacent to the engine itself or suitably wall mounted on brackets at a height not less than 60cm above the fuel injection pump. The fuel filter shall be suitably located to permit easy servicing.

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

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

The fuel tank shall be of welded steel construction (3 mm thick) and of capacity sufficient to allow the engine to run on full load for atleast 8 hours . The tank shall be complete with necessary floor mounted support, level indicator (protected against mechanical injury) inlet, outlet, overflow connections and drain plug and piping to the engine fuel tank. The outlet should be so located as to avoid entry of any sediment into the fuel line to the engine.

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

- 5.10 Lubricating Oil System - Forced feed Lubricating Oil System shall be employed for positive lubrication. Necessary lubricating oil filters shall be provided, located suitably for convenient servicing.
- 5.11 Exhaust System – The exhaust system shall be complete with residential silencer suitable for outdoor installation, and silencer piping including bends and accessories needed. Silencer pipe shall be extended up to 1 m outside pump house duly insulated with 50 mm thick glass wool and 1.00 mm thick aluminium sheet cladding. The total back pressure shall not exceed the engine manufacturer's recommendation. The exhaust shall be. MS heavy class pipe. All piping within the pump room and external exposed shall be lagged with 50mm thick asbestos with two layer of chicken wire mesh and cladding of aluminum sheet. All above mentioned works shall be included in the cost of the DG pump set. Nothing extra shall be paid on account of this.
- 5.12 Governing system - The engine shall be provided with an adjustable governor to control the engine speed within 5% of its rated speed under all conditions of load upto full load. The governor shall be set to maintain rated pump speed of maximum pump load.
- 5.13 Engine shut down mechanism – This shall be manually operated and shall return automatically to the starting position after use.
- 5.14 Engine Instrumentation – Engine instrumentation shall include the following –
 - (i) Lubricating oil pressure gauge
 - (ii) Lubricating oil temperature gauge
 - (iii) Water pressure gauge

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

- (iv) Water temperature gauge
 - (v) Hour meter
 - (vi) The instrumentation panel shall be suitably resident mounted on the engine.
- 5.15 Engine Protection Devices – Following engine protection and automatic shut down facilities shall be provided:
- (i) Low lubricating oil pressure
 - (ii) High cooling water temperature
 - (iii) High lubricating oil temperature
 - (iv) Over speed shut down.
- 5.16 Pipe Work – All pipe lines with fittings and accessories required shall be provided for fuel oil, lubricating oil and exhaust systems, copper piping of adequate sizes shall be used for lubricating oil and fuel oil. MS piping will be permitted for exhaust.
- 5.17 Anti Vibration Mounting – Suitable vibration mounting duly approved by Engineer-in-charge shall be employed for mounting the unit so as to minimize transmission of vibration to the structure.
- 5.18 Battery Charger – Necessary float and boost charger shall be incorporated in the control section of the power and control panel, to keep the battery under trim condition. Voltmeter to indicate the state of charge of the batteries shall be provided. The charger shall have the capacity to restore a full discharged battery to a state of full charge in 10 hours with some spare margin over maximum charging rate. Visual and audible annunciation for trouble or failures in the power supply system such as charger failure, 'batter low voltage' etc. shall be provided.

6.0 Power Control Panel

- 6.1 General features – The power and control panel shall be totally enclosed, free standing, floor mounted cubical type, fabricated out of sheet not less than 2mm thick. Where necessary, additional stiffening shall be provided in the frame work. General construction shall be of compartmentalization and sectionalisation such as mains incomer, electric w/s pump, AC pump, pressurization pump, priming pump and control, so that there is no mix up of power and control wiring and connections in the same sections as far as possible. The panel shall be front operated type with all connections accessible from the front. Front doors shall be hinged type. Back doors shall be hinged type or removable type for inspection. The door hinges shall be concealed type. The doors shall be provided with quick fixing doors knobs with indication. The general arrangement of the panel shall be got approved before fabrication. The cubicle construction shall be to IP 21 as per IS:2147.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

- 6.2 Cable entries and gland plates – All cable entries shall be through gland plates which are removable and sectionalized. Necessary compression type glands shall also be provided. Where heavy cables are bought in and terminated, suitable clamps shall be incorporated to relieve the stress on the glands due to the weight of the cable. Cable entries shall be from top.
- 6.3 Busbar and Connections – The busbars shall be air insulated and of copper and of adequate cross section. Current density shall not exceed 130 amps per sq.cm. All connection to individual, circuits from the busbars shall preferably be with solid connections. The busbars and the connections shall be suitable covered with PVC sleeves or in an approved manner. Busbars shall be suitable supported using non hygroscopic insulated supports such that they may stand 50 KA RMS symmetrical current for one second. High tensile bolts and spring washers shall be provided at busbar joints.
- 6.4 Earthing Arrangement – Copper strip 25mm x 5mm shall be run at the rear of the board, bonding all the sections suitably. 2 Nos. earth terminals shall be provided at the ends of the strip for connection to earth system. Earth terminals shall be with a flexible loop and the hardware shall be of GI or passivated and plated iron.
- 6.5 Terminal Blocks and Small Wiring - Terminal blocks shall be of heavy duty type and generally not less than 15 amps 250V grade upto 100V, and 600V grade for the rest of the functions. They shall be easily accessible for maintenance. All control wiring inside the panel shall be with PVC insulated copper conductor of 2.5 sq. mm size and 600V grade conforming to IS:694-1977, suitable colour coding may be adopted. Wiring harness shall be neatly formed and run preferably function wise, and as far as possible segregated voltage wise. Identification ferrules shall be used at both ends of the wires.
- 6.6 Instrument and lamps – All indication lamps and instruments shall be of size 96mm conforming to Clause 1.5 of IS 1248 for accuracy.

Current transformers shall be provided with ammeters.

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

All indicating lamps and voltmeter shall be protected with MCB.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- 6.7 Labels – All internal components shall be provided with suitable identification labels suitably engraved labels shall be based at the panel for all MCCBs, switches, instruments, push buttons, indicating lamps etc.
- 6.8 Painting – The entire panel shall be given a primer coat of red lead after degreasing and phosphating treatment, and 2 coat of final paint of approved shade before assembly of various items.

7.0 Piping

7.1 Pipes of the following are to be used.

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

7.2 PIPING INSTALLATION

- (i) The drawings indicate schematically the size and location of pipes. Pipes runs and sizes may, however, be changed to meet the site conditions. The contractor on the award of the work, shall prepare detailed working drawings showing the cross section longitudinal section, details of fittings, locations of isolating drain and air valves etc. they must keep in view the specific openings in buildings and other structures through which the pipes are designed to pass.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

- (ii.) Hangers and supports shall be capable of carrying the sum of all concurrently acting loads. They shall be designed to provide the required supporting effects and allow pipeline movements as necessary. All guides, anchor, braces, dampener, expansion joint and structural steel to be attached to the building structure trenches etc. shall be provided. Hangers and components for all piping shall be approved by the Consultant / Client / Architect.
- (iii) Pipe supports shall be of steel, adjustable for height and primer coated with rust preventive paint and finish coated black. Where pipe and clamp are of dis-similar material, a gasket shall be provided in between. Pipe supports shall be spaced suitably keeping in view the site and structural requirements of different locations. Pipe hangers shall be fixed on walls and ceilings by means of dash fasteners.
- (iv) Flanged joints shall be used for connections to vessels, equipment, flanged valves and also on suitable straight lengths of pipeline of strategic points (@ at every 15-20 mtr.) to facilitate erection and subsequent maintenance work.
- (v) Excavation for pipe line shall be in open trenches. Pipes shall be buried atleast one meter below ground level and shall have 230 mm x 230 mm masonry supports atleast 300mm high at 3m intervals. Masonry work to have plain cement concrete foundation (1 cement : 4 coarse sand : 8 stone aggregate) of size 380 x 380 x 75 thick resting on firm soil.
- (vi) Wherever required Contractor shall support all trenches or adjoining structures with adequate supports to prevent land slides.
- (vii) On completion of testing and painting trenches shall be refilled with excavated earth in 15 cm layers and compacted.
- (viii) Contractor shall dispose off all surplus earth within the site.
- (ix) Contractor shall provide suitable cement concrete anchor blocks for overcoming pressure trusts in underground / external pipes. Anchor blocks shall be of cement concrete 1:2:4 mix.
- (x) Fittings shall be new and from reputed manufacturers. Fittings shall be of malleable casting of pressure ratings suitable for the piping system. Fittings used on welded piping, shall be of the weldable type. Flanges shall be new and from standard manufacturers.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

- (xi) Tee-off connection shall be through reducing tees, wherever possible, otherwise ferrules welded to the main pipe shall be used. Drilling and tapping of the walls of the main pipe shall not be resorted to.
- (xii) All equipment and valve connections shall be through flanges.
- (xiii) All welded piping is subject to the approval of the Engineer-in-charge and sufficient number of flanges and unions shall be provided.
- (xiv) Pipe supports shall be of steel, adjustable for height and primer coated with rust preventive paint and finish coated black. Where pipe and clamp are of dissimilar material, a gasket shall be provided in between. Pipe supports shall be spaced suitably keeping in view the site and structural requirements of different locations. Pipe hangers shall be fixed on walls and ceilings by means of dash fasteners.
- (xv) Piping work shall be carried out with minimum disturbance to the other works being done at the site. A program of work shall be chalked out in consultation with the Engineer-in-charge.
- (xvi) Piping layout shall take due care for expansion and contraction in pipes and the expansion joints in the building.
- (xvii) All pipes using screwed fittings shall be accurately cut to the required sizes and threaded in accordance with IS:554 and burs removed before laying. Open ends of the piping shall be locked as the pipe is installed to avoid entrance of foreign matter. Wherever reducers are to be made in horizontal runs, eccentric reducers shall be used if the piping is to drain freely. In other locations concentric reducers may be used.

7.3 Vibration Elimination

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

7.4 Testing

- (i) All piping shall be tested to hydrostatic test pressure of 14 Kg/sq.cm. or twice the design pressure whichever is higher for a period of not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified to the satisfaction of the Engineer-in-charge.
- (ii) Piping required subsequent to the above pressure test shall be re-tested in the same manner.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- (iii) Systems may be tested in sections and such sections shall be securely capped.
- (iv) The Engineer-in-charge shall be notified well in advance by the contractor of his intention to test a section of piping and all testing shall be witnessed by the Engineer-in-charge or his authorized representative.
- (v) The contractor shall make sure that proper noiseless circulation of fluid is achieved through the system concerned. If proper circulation is not achieved due to an bound connections. The contractor shall notify the defective connections. He shall bear all the expenses for carrying out the above rectifications including the tarring-up and re-finishing of floors, walls etc. as required.
- (vi) The contractor shall provide all materials, tools, equipment, instrument, services and labour required to perform the test and shall ensure that the plant room and other areas are cleaned up and spill over water is removed.

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

7.5 Painting

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

8.0 STRAINERS :

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

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

9.0 Air Vessel and Air release valve

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

10.0 Pressure Switches

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

11.0 Low Water level indicator and switch

To prevent the dry running of fire pumps due to emptying of the static tank, a water level indicator and switch shall be provided. This shall trip the electric motor or stop the diesel engine, as the case may be when the water level goes below a present level. This shall also furnish a distinct low water level audio visual alarm. This should indicate the level of water at different stages in the Power and Control Panel.

12.0 Power Supply for Controls

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

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

battery for the engine. The battery shall remain trickle charged at all times from the battery charger at the control section.

13.0 Vertical Wet Risers

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

14.0 Stand Post External Yard Hydrants

- 14.1 Yard or External Hydrants shall be as per IS:908 and the valve as per IS:5290-1977 type 'A'. The hydrant shall consist of stand post assembly and a masonry base 200 mm X 200 mm X 200 cm high and shall be made at the point where it comes out of the soil. Stand post column shall be cast iron, casted in one piece conforming to grade 20 of IS:210-1970. The valve shall complete with hand wheel, quick coupling connection spring and blank cap. The hydrant shall be laid on 150/100 dia main tee off to 100mm dia.
- 14.2 Yard or External hydrant shall be controlled by a cast iron butterfly valve. Hydrant shall have oblique female instantaneous pattern 63 mm diameter outlet with caps and chains. The hydrant shall be of gunmetal and flange inlet and single outlet conforming to IS:5290, flanged riser of required height to bring the hydrant to level above ground. The valve body, stop valve, check valve, nut, instantaneous female outlet and blank cap shall be of leaded-tin bronze conforming to Grade-II of IS:318-1962. The valve spindle shall be of brass rod conforming IS:320 - 1962. The hand wheel shall be mild steel or cast iron washers gaskets shall be of rubber conforming to IS:638 - 1965 or leather conforming to IS:581 : 1969.
- 14.3 Each external hydrant shall be provided with two nos. 63 mm. Diameter 15 mtr. Long hose pipe with gunmetal male and female instantaneous type

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

coupling, machined wound with G.I. wire hose of IS 636 type A and couplings to IS:903 with IS certification, gunmetal branch pipe with 20 mm nozzle conforming to IS:903.

- 14.4 All hydrants outlets shall be situated one metre above the ground level.
- 14.5 Metal box enclosing the yard hydrant is being paid separately. However, the masonry work to support this metal box is deemed to be included in the unit rate of the item.
- 14.6 Opening in the stand post shall be suitable to accept the hydrant landing valve.

15.0 Hose Pipe

- 15.1 Hose pipe shall be 63 mm in dia & 15 meter length and fabric reinforced rubber lined as per IS 636 Type 'A'. They shall be flexible and capable of being rolled.
- 15.2 All hose pipes shall carry ISI marking on the body of the hose.
- 15.3 The instantaneous couplings shall be as per IS:901. It shall be fixed to the hose pipe by galvanized wire and copper rivets.

16.0 INTERNAL HYDRANT :

- 16.1 Internal hydrant shall be provided at each landing or at suitable location consisting of single / twin headed gunmetal landing valve as indicated in BOQ with 63 mm dia. Outlet and 80 mm inlet (IS:5290-1969) with separate shut off valve. Landing valves shall be 63 mm dia. oblique female instantaneous pattern with caps and chains. Landing valves shall be of gunmetal and fitted with instantaneous coupling conforming to IS:901. The valve body, stop valve, check valve, nut, instantaneous female outlet and blank cap shall be of leaded-tin bronze conforming to Grade-II of IS:318-1962. The valve spindle shall be of brass rod conforming IS:320 - 1962. The hand wheel shall be mild steel or cast iron washers gaskets shall be of rubber conforming to IS:638 - 1965 or leather conforming to IS:581 : 1969. The coupling shall be fitted with an internal plug secured by chain landing valves shall be installed on hydrant riser at a height of 1.0 to 1.2 meter from the floor level.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- 16.2 Each internal hydrant shall be provided with two nos. 63 mm. Diameter 7.5 mtr./15 mtr. Long hose pipe with gunmetal male and female instantaneous type coupling, machined wound with G.I. wire hose of IS 636 type A and couplings to IS:903 with IS certification, gunmetal branch pipe with nozzle conforming to IS:903.
- 16.3 To avoid undesirably high pressure in the hydrants and hoses, special pressure reducing arrangements like orifice plates in the landing valves shall be provided and nothing extra shall be paid in this account. The limit of operating pressure from valves shall be 7 Kg/cm² and the orifice plate shall be so designed to restrict the pressure to above value. The orifice plate shall be fabricated of 6mm thick, stainless steel plate.
- 16.4 A cap with chain is to provide one head of the outlet which will have an instantaneous pattern female coupling for connecting to hose pie and adoption and other head for the first & hose reel connections.

17.0 **HYDRANT VALVES (LANDING VALVES)**

Landing valves shall be 63 mm dia. oblique female instantaneous pattern with caps and chains. Landing valves shall conform to IS:5290 in all respects. Double headed landing valves shall have separate control valves. Landing valves shall be of gunmetal and fitted with instantaneous coupling conforming to IS:901. The valve body, stop valve, check valve, nut, instantaneous female outlet and blank cap shall be of leaded-tin bronze conforming to Grade-II of IS:318-1962. The valve spindle shall be of brass rod conforming IS:320 - 1962. The hand wheel shall be mild steel or cast iron washers gaskets shall be of rubber conforming to IS:638 - 1965 or leather conforming to IS:581 : 1969. The coupling shall be fitted with an internal plug secured by chain landing valves shall be installed on hydrant riser at a height of 1.0 to 1.2 metre from the floor level.

18.0 **HOSE CABINETS (HOSE BOX)**

Each hydrant shall be housed in a Hose cabinet of suitable size. The hydrant cabinet shall hold double / single headed hydrant as specified , 2 hoses and one branch pipe as required. Internal hydrants shall normally fit the size of the niche made for it. The cabinet shall be of minimum 14 SWG M.S. sheet with centre opening, double glass front doors (clear glass of 5 mm thickness). The glass shall be firmly fixed by means of steel clips and screw with rubber beading. Hinges shall also be screwed and not welded. The corner members (frame) shall be of 25 x 25 x 3 mm thick angle. The hose box shall be firmly fixed to the wall/support by means of brackets and dash

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

fasteners. The steel work shall have one coat of primer and two coats of red paint. The words "Yard Hydrant", "Hydrant" etc. should be painted in white or red on the glass in 75 mm high letters. The hose box shall be lockable.

19.0 **AIR CUSHION TANK**

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

20.0 **First Aid Hose Reel (Swinging type)**

- 20.1 MS sheets may be used in the manufacturing of sides of hose reel. These shall conform to 'D' drawing type sheet specified in IS:513-1968
- 20.2 The hose reel shall be directly tapped from the hydrant ring main through 25 mm dia pipe, the drum and the reel being firmly held against the wall by use of dash fasteners. The hose reel shall be swinging type (180 degrees) and the entire drum, reel etc, shall be as per IS:884-1969. The rubber tubing shall be of approved quality and the nozzle shall be 6mm dia shut off type.
- 20.3 Manually operated stop valve of 20 mm size shall be provided for the hose reel and hose reel tubing shall be 20 mm dia & length specified.

21.0 **Branch pipe & Nozzle**

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

22.0 **Fire Brigade Connections**

- 22.1 The fire brigade outlet landing to storage tank from siamease connections shall not be connected directly into the side of the storage tank but arranged to discharge not less than 150 mm above the top edge of the tank.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- 22.2 It shall be installed at height not more than one metre at street level in a wall box at location given by Engineer-in-charge. Piping only for the purpose of connecting different accessories shall be paid under the respective items. However, different accessories like Tee, Bends, Flanges, insertions in order to fix the Siamese connections in wall box shall be born by the contractor & nothing extra shall be paid on this account.

22.3 Fire Brigade Inlet

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

23.0 External Hose Cabinet

- 23.1 The external hose cabinets shall be made of not less than 2.0mm thick sheet steel having centre opening glazed door. The size of the cabinet shall be approx. 120 cm (H) x 60 cm (W) x 50 cm and supported by means of a brick pedestal which shall have 12 mm thick plaster of 1: ration and finished with 2 coats of snowcem paint.
- 23.2 Hose cabinet should be painted with two coats of rust resisting fire red paint over a coat of primer.
- 23.3 The box shall have central openings and spring locking arrangements which can be operated with handle without a key after breaking the glass. The hose cabinets shall be provided with locking arrangements by means of socket spanner.
- 23.4 The front opening doors shall have glass glazing of suitable size.
- 23.5 The thickness of the glass shall be 5.5 mm at least and the same shall be fixed by means of 12 mm x 12 mm square M.S./Aluminum bars on both sides and screwed to the shutter frame.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

- 23.6 The word FIRE will be painted in the red color with letter size of 75 mm height.
- 23.7 The portion embedded in concreted/brocks shall be painted with one coat of red oxide (Primer)
- 23.8 The contractor shall get the necessary drawings of cabinet (to be fabricated by him) approved by Engineer-in-Charge before going ahead with this item.

24.0 Sluice valves

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

25.0 Valves Pits

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

26.0 Non-return valves

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

27.0 Polymeric Corrosion Protection Tape (Pypkote cloth)

Polymeric corrosion protection tape (pypkote cloth) shall be wrapped on MS pipes to be buried in earth. This corrosion protection tape shall be 4mm thick and would conform to requirements of IS 10221 and A W W A C 203 for prefabricated tapes. Before application of polymeric corrosion protection tape all foreign matter in pipe shall be removed with help of wire brush and suitable primer shall be applied over the pipe thereafter. The primer shall be allowed to dry until the solvent evaporates and the surface becomes tacky.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

Corrosion protection taps shall then be wound around the pipe in spiral fashion and bonded completely to the pipe. The overlaps shall be maintained at 15mm and 250mm shall be left uncoated on either end of pipe to permit installation & welding. This area shall be coated insitu after the pipe line is installed.

28.0 SPRINKLER SYSTEM

28.1 SCOPE OF WORK:

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

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

28.2 SPRINKLER HEADS

- (i) Sprinkler heads shall be provided at approximate spacing so as to cover 9-10 sq.mtr. per sprinkler head. The spacing shall however be in uniformity with the drawings and properly coordinated with electrical fixtures, ventilation ducts and grilles and other services along the ceiling. Sprinkler heads shall be gunmetal quartz bulb type with a temperature rating of 68°C. Sprinkler heads shall be of upright conventional type with fusible link for operation. Sprinkler head shall be approved by the under writers Laboratories (U.L.) or Fire Officers Committee (FOC). The finish shall be as specified in bill of quantities.
- (ii) Contractor shall install cabinet (fabricated from 16 Gauge M. S. sheets with lockable glass shutters. Shelves for keeping spare sprinklers and spanner at locations approved by the Engineer-in-Charge and given in the schedule of quantities. The contractor shall also give required tools for removing and fixing of different types of sprinkler free of cost as directed by Engineer-in- Charge.

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

28.3 **PENDENT TYPE SPRINKLER HEAD**

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

28.4 **CONCEALED TYPE / WITH ROSSETE SPRINKLER HEAD**

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

28.5 **INSATLLATION CONTROL VALVE & REALATED EOUIPMENTS FOR SPRINKLER STSTEM**

- (i) The sprinkler installation shall have a set of installation control valve comprising of main stop valve, alarm valve and water motor gong.

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

- (ii) Installation control valve for sprinkler system shall consist of a 100 mm /150 mm vertical alarm valve with a provision to install water operated turbine alarm. A cast iron Butter fly valves of 100 mm/150 mm (as required) shall be provided on downstream of alarm valve.
- (iii) One water operated turbine alarm with gong shall be provided. The alarm shall operate and sound a gong on the drop of pressure and flow of water in the mains. The drawing of Installation Control valve assembly shall be got approved from the Engineer-in-Charge and installed at approved location. The Alarm shall be provided with suitable test cock.
- (iv) Installation Control Valve shall include CI Butter fly valve, Alarm valve, Alarm Motor and Gong, Drain Valve, Test valve, Drain piping and all fittings including 2 Nos. Pressure gauges required to complete the work.
- (v) Both alarm valve and turbine alarm shall have TAC/FOC/UL/FM approval.

29.0 **FLOW SWITCH**

- 29.1 Flow switch shall have a paddle made up of flexible material of the width to fit within the pipe bore. The terminal box shall be mounted over the paddle / pipe through a connecting socket. The switch shall be potential free in either NO or NC position as required. The switch shall be able to trip and make/ break contact on the operation of a single sprinkler head. The terminal box shall have connections for wiring to the Fire alarm panel. The seat shall be of stainless steel. The flow switch shall have IP: 55 protections.
- 29.2 The flow switch shall work at a minimum flow rate of 100 LPM. Further, it shall have a retard to compensate for line leakage or intermittent flows.

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

30.0 **BUTTERFLY VALVE**

- 30.1 The Butterfly valve shall be suitable for waterworks and tested to minimum of 16 kg/sq cm Pressure. The valves shall fulfill the requirements of BIS(Indian Standard)BS: 5155 or AWWA C 504, API 609 and MSS-SP-67.
- 30.2 The body shall be of cast iron to IS: 210 in circular shape and of high strength to take the minimum water pressure of 10 kg/sq cm. The disc shall be heavy-duty cast iron with anti-Corrosive epoxy or nickel coating.
- 30.3 The valve seat shall be high grade elastomer or nitrile rubber. The valve in closed position shall have complete contact between the seat and the disc throughout the perimeter. The elastomer rubber shall have a long life and shall not give away on continuous applied water pressure. The shaft shall be of ENB grade carbon steel.
- 30.4 The valve shall be fitted between two flanges on either side of pipe flanges. The valve edge rubber shall be projected outside such that they are wedged within the pipe flanges to prevent leakages.
- 30.5 The valve shall be supplied with manual gear operated opening/ closing system by lever.

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

	I/O Summary																										
Sr. No .	Description	Qty	AI	DI	A O	D O	S.I .	By IBMS Provider	By respective 3rd paty contractors	Immersion Sensor	Ambient T+RH	Flow Meter	DPS Water	Pressure Sensor	DPS Air Across Fan	DPS air across Filter	Duct type Temp Sensor	Duct Pressure Sensor	CO2 Sensor	Current Relay	CO Sensor	Level Switch	Sensor	Immprocessor	Level Switch		
1	High Side																										
A	Water Cooled Chillers	4																									
1	Chillers On/Off Command					4		Relay output @ 2 amp, 230 V and Wiring & termination at Chiller	Microprocessor accepting (2 amp. NO contact) remote start / stop																		
2	Chiller Run Status			4				Wiring & termination	Termination detail of Potential Free NO contacts and AI/AO at the microprocessor panel																		
3	Chillers Trip Status			4				Wiring & termination																			
4	Chillers Auto/Manual Status			4				Wiring & termination																			
5	Chiller Main header Inlet & Outlet Temperature Feedback (2 plant room & 2 each for boys & girls hostel)		6					Immersion temperature sensor with Matching Thermowell	Welding of socket in line and installation, Co-ordination and pipe cleaning after welding.	6																	
6	Chiller Individual Outlet Temp. Feedback		4					Immersion temperature sensor with Matching Thermowell		4																	

No. of Insertions –I NIL

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

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7	Condensor Main header Inlet & Outlet Temperature Sensor Feedback		2					Immersion temperature sensor with Matching Thermowell		2															
8	Chiller Isolation Valves Open / Close Command					4		Relay output (1 SPDT for open and close) @ 2 amp, 230 V, Wiring & termination on valve actuator	Motorised butterfly valve at CHW supply line to accept 1 SPDT for opening and closing of valves.																
9	Chiller Isolation Valves Open / Close Status			8				Wiring & termination	VFC to be provided in BF valve actuator for Feed back.																
10	Condensor Isolation Valves Open / Close Command					4		Relay output (1 SPDT for open and close) @ 2 amp, 230 V, Wiring & termination on valve actuator	Motorised butterfly valve at CHW supply line to accept 1 SPDT for opening and closing of valves.																
11	Condensor Out Valves Open / Close Status			8				Wiring & termination	VFC to be provided in BF valve actuator for Feed back.																
12	Ambient Temperature & Humidity Sensor		2					Ambient temp + RH sensor			1														
13	Chilled Water Flow Meter Feedback		1					Clamp on Ultrasonic Type Water Flow Meter.	Installation Provision of Flow meter with suitable size of flanges			1													
14	Chiller microprocessor (software) integration for Chiller-intrinsic parameter monitoring (15 points per chiller)						80	Integration with Chiller Microprocessor Unit on BACnet/IP or MODbus RTU over	BACnet IP Open protocol or MODBUS-RTU Protocol mapping Details , network interface card for above and all wiring termination details for																

No. of Insertions –I NIL

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

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No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

No. of Insertions –I NIL

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No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

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No. of Correction -C NIL

No. of Omissions – O NIL

No. of Insertions –I NIL

No. of Insertions –I NIL

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No. of Correction – C NIL
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								and termination	auto mode in the control circuit															
2	AHU Run Status			68				Differential Pressure Switch (0-400 pascals)	Provision for Installation of DP switch tube in AHU body, across blower						68									
3	AHU Auto/Manual Status			68				Wiring & Termination	Termination details at auxiliary potential free contact of auto manual switch															
4	AHU Trip Status			68				Wiring & Termination	Termination details at auxiliary potential free contact of Trip Relay															
5	AHU Pre Filter Status			68				Differential Pressure Switch (0-200 pascals)	Provision for Installation of DP switch tube in AHU body, across Filter						68									
6	Return Duct Air Temperature Monitoring		68					Duct mount Temp Sensor in Return Duct	Suitable installation Provision provided by HVAC Contractor in return duct.							68								
7	CHW Motorized Valve Modulation				68			Output signal 0-10 Vdc from DDC Controller to Motorized Valve Actuator	2 Way Control Valve by HVAC, with acceptance of 0-10 V DC Signal															
8	VFD Speed % Modulation Command				68		43	Output signal 0-10 Vdc from DDC Controller to VFD	VFD Vendor shall provide port & mapping details to release information on BACnet MS/TP or on MODBUS-RTU															
9	Duct Static Pressure Monitoring		68					Static Pressure Sensor	Suitable installation Provision provided by HVAC Contractor in								68							

No. of Correction –C NIL

No. of Omissions – O NIL

No. of Insertions –I NIL

No. of Insertions –I NIL

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									supply duct.																	
10	Fresh Air Damper % Modulation Command				68			Output signal 0-10 Vdc from DDC Controller to Damper Actuator																		
11	CO2 Monitoring		68					CO2 Sensor	Suitable installation Provision provided by HVAC Contractor in return duct.									68								
12	VAV Boxes open close status								Damper Actuator																	
13	FCU / Cassette - Monitoring (2 Girls + 2 Boys)	10						Bacnet / IP / Modbus / MSTP	Control by BMS compactable thermostat																	
	Total IO Points AHU		20 4	27 2	20 4	68	43																			
H	Ventilation System																									
	Basement Fans+ lift (18 Fans for Girls Hostel, 7 Fans for Boys Hostel & 8 fans Acd)	33																								
1	Fan On/Off Command					33		Relay output @ 2 amp, 230 V, wiring and termination																		
2	Fan Run Status			33				Wiring, Termination & Current relay											33							
3	Fan Auto/Manual Status			33				Wiring & Termination																		
4	CO Level Monitoring [(For basement of 790sqm) - Min 3 Zones - Girls Hostel & (For		5					CO Sensor												5						

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

No. of Insertions –I NIL

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No. of Correction – C NIL
No. of Omissions – O NIL
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No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

No. of Insertions –I NIL

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No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

No. of Insertions –I NIL

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No. of Correction – C NIL
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No. of Insertions – I NIL

No. of Insertions –I NIL

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									Parameters																	
4	Access Control (03 Nos, one for each building)						30		Integration of Access Control System through Modbus/Bacnet/OPC Protocols of all Parameters																	
5	Energy meter Integration	20					200		Integration of through Modbus/Bacnet/OPC Protocols of all Parameters																	
	Total IO Points Integration		0	0	0	0	3270																			
	GRAND TOTAL		231	525	208	141	3413			18	1	1	12	4	68	68	68	68	68	33	5	20	3	3		
			4518																							

No. of Insertions –I NIL

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

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LIST OF APPROVED MAKES

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

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S. No.	ITEMS	MAKE
1.	PVC INSULATED FRLS COPPER WIRE/ TELEPHONE CABLE/ TV CABLE (ISI MARK)	Havells/ Polycab/ Finolex/ Skytone/ Batra Henlay/ Rallison/ Anchor/ L&T/ Rajnigandha/ RR Kabel/ World Cab
2.	MODULAR SWITCH, SOCKET, PLATES, GI BOX, RJ11 SOCKET, RJ 45 SOCKET AND ALL OTHER MODULAR ACCESSORIES, FOOTLIGHT, STEP TYPE FAN REGULATOR, SHAVER SOCKET OUTLET POINT, CARD SWITCH, COURTESY PANEL	Anchor (Voila)/ MK Honeywell (Blenze Plus)/ Legrand (Arteor)/ Schneider Electric (Opale) /ABB (IVIE)
3.	STEEL CONDUIT AND ACCESSORIES ISI MARK	AKG/ BEC/ RMCON/ VIMCO
4.	PVC CONDUIT AND ACCESSORIES	PRECISON/ MODI/ AKG/ DIAMOND/ FINOLEX
5.	UNDER FLOOR METAL TRUNKING, FLOOR BOXES, JUNCTION BOXES AND ALL ACCESSORIES	MK / LEGRAND/ OBO BETTERMAN
6.	XLPE INSULATED, PVC SHEATHED, ARMOURED/UNARMOURED 1.1 KV GRADE LT CABLE/ CONTROL CABLE ISI MARK	HAVELLS / POLYCAB/ FINOLEX/ GRANDLAY/ CABLE CORPORATION OF INDIA/ RALLISON/ RR KABLE/ SKYTONE/ UNIVERSAL
7.	CABLE GLAND	JAINSON/ BRACO/ COMET/ GRIPWELL
8.	CABLE LUGS/ THIMBLE	DOWELLS/ JAINSON/ BRACO/ COMET
9.	MS CABLE TRAY I/C ACCESSORIES	BEC/ MEM/ C & S/ OBO BETTERMAN/RMCON
10.	DWC PIPES, HDPE PIPES I/C ACCESSORIES	REX/ DURALINE/ TIJERIA
11.	MCB DB, MCB'S, ISOLATORS, RCCB'S, RCBO'S, INDUSTRIAL SOCKET, HRC FUSE ETC I/C ACCESSORIES	LEGRAND/ HAGER/ SEIMENS/HAVELLS / SCHNEIDER ELECTRIC/ ABB
12.	LIGHTING FIXTURE, STREET LIGHT, BOLLARDS, POST TOP AND ACCESSORIES	AS PER THE BOQ

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

13.	OCCUPANCY SENSOR	LEGRAND/ WIPRO/ HAVELLS / SCHNEIDER ELECTRIC
14.	CEILING FANS I/C ACCESSORIES	AS PER THE BOQ
15.	WALL BRACKET FANS I/C ACCESSORIES	AS PER THE BOQ
16.	EXHAUST FAN I/C ACCESSORIES	AS PER THE BOQ
17.	TELEPHONE DISTRIBUTION BOARD/ TAG BLOCK	HENSEL ELECTRIC- KRONE BOX/ TVS R&M/ ITL/ MALSON
18.	DOOR CONTROLERS, SMART CARD READERS, ADDRESSABLE MANUAL CALL POINT, ACCESS CONTROL SOFTWARE I/C ALL ACCESSORIES	HONEYWELL/ BOSCH/ HID
19.	ELECTROMAGNETIC DOOR LOCK,	BEL/ ASSA ABLOY/ TRIMEC
20.	ADVANCE LIGHTING ARRESTOR, LIGHTING EVENT COUNTER I/C ALL ITS ACCESSORIES	INDELEC/ TERCEL/ ABB/ NIMBUS
21.	UPS I/C ACCESSORIES	EMERSON VERTEV/ LEGRAND/ PEGASUS/ APC/ HITACHI
22.	UPS BATTERIES	AS PER THE UPS OEM STANDARD
23.	CCTV DOME/ BULLET/ PTZ CAMERA	CP PLUS/ HONEYWELL/ HIKVISION/ IMPULSE/SAMSUNG
24.	WORK STATION/ COMPUTERS	HP/ DELL/ LENOVO/ IBM
25.	NVR/ DVR	CP PLUS/ HONEYWELL/ HIKVISION/IMPULSE/ SAMSUNG
26.	LED COLOR MONITOR	SAMSUNG/ SONY/ PANASONIC
27.	CAT6 UTP CABLE, PATCH PANEL, IO'S, PATCH CORD	LEGRAND / BELDON / PANDUIT/ SIEMON/ COMMSCOPE
28.	LAYER SWITCHES	CISCO/ HP/ JUNIPER
29.	FIBER OPTIC CABLE	LEGRAND / BELDON / PANDUIT/ SIEMON/ COMMSCOPE

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

30.	EPBAX /IPABX SYSTEM, OPERATOR CONSOLE, SOFTWARE I/C ACCESSORIES	CISCO/ POLYCOM/TADIRAN/AVAYA
31.	ANALOG PHONE, DIGITAL PHONE I/C ACCESSORIES	CISCO/ POLYCOM/TADIRAN/AVAYA
32.	OCTAGONAL/ CONICAL POLE/ HIGH MAST POLE I/C ACCESSORIES	BAJAJ/ WIPRO/ PHILIPS/ SURYA ROSHNI
33.	HIGH MAST FITTING	AS PER THE BOQ
34.	MAIN ADDRESSABLE FIRE ALARM PANEL, REPEATER PANEL, DETECTORS, TELEPHONE JACK, FIREFIGHTER HANDSET, MANUAL CALL POINT, ISOLATOR MODULE, CONTROL MODULE, MONITOR MODULE, CEILING MOUNTED SPEAKER, STROBE, DVC, SOFTWARE I/C ALL ACCESSORIES	NOTIFIER/ BOSCH/ EDWARDS/ HONEYWELL/ TYCO / JHONSON CONTROL
35.	RESPONSE INDICATOR	NOTIFIER/ BOSCH/ AGNI/ STERLING & WILSON
36.	FIRE SURVIVAL CABLE	BATRA HENLAY/ HAVELLS/ FINOLEX/ NO BURN/ LAPP KABLE/ RALLISON
37.	LIFTS	KONE/ MITSUBISHI/ OTIS/ SCHINDLER/ JOHNSON LIFTS PVT LTD CHENNAI
38.	11 KV HT VCB PANEL I/C ACCESSORIES	L & T/SIEMENS / ABB / KIRLOSKAR / CROMPTON GREAVES/SCHNEIDER ELCTRIC
39.	11 KV OIL/DRY TYPE INDOOR TRANSFORMER I/C ACCESSORIES	CROMPTON GREAVES / KIRLOSKAR /ESENNAR/ SIEMENS/ ABB/ VOLTAMP
40.	11 KV HT CABLE ISI MARKED	HAVELLS/ POLYCAB/ FINOLEX/ GRANDLAY/ CABLE CORPORATION OF INDIA/ RALLISON/ RR KABLE/ SKYTONE/ UNIVERSAL
41.	PLC	SEIMENS/ ALLEN BRADLEY/ ROCKWELL AUTOMATIC
42.	CHANGE OVER SWITCH	SIEMENS / ABB / L&T / GE/TELEMECHANIQUE

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

43.	LT PANEL, APFC PANEL MANUFACTURER/ FABRICATORS	ADVANCE PANEL AND SWITCHGEARS PVT LTD/ TRICOLITE ELECTRICAL INDUSTRIES (PVT) LTD/ BSPL, BHOPAL/ PRECISION SYSTEM CONTROL / APPLICATION CONTROL PANELS PVT. LTD. / NEPTUNE / ASSOCIATED SWITCHGEAR PVT. LTD./
44.	MCCB'S (ICS=100%ICU)/ MPCB I/C ACCESSORIES	L&T (DSINE)/ SEIMENS (3VA)/ SCHNEIDER ELECTRIC (COMPACT NS)/ ABB (TMAX)/ LEGRAND(DPX3)
45.	AIR CIRCUIT BREAKERS, BUSCOUPLER I/C ACCESSORIES	L&T (U-POWER)/ SEIMENS (3WL)/ SCHNEIDER ELECTRIC (MASTER PACT)/ ABB(TMAX)/ LEGRAND(DMX3)
46.	DIGITAL PANEL METER/ ELECTRONIC LOAD MANAGER/ MULTIFUNCTION METER	CONZERV/ AE/ KRYKARD/ ENERCON/ NEPTUNE
47.	INDICATING LAMP (LED TYPE)	SEIMENS/ TEKNIC/ L&T
48.	SELECTOR SWITCH/ PUSH BUTTON SWITCH/ EMERGENCY SWITCH	KAYCEE/ BCH/ L&T SLAZER/ SEIMENS/ SCHNEIDER ELECTRIC
49.	CONTACTORS/ OVER LOAD RELAY	SIEMENS / ABB / L&T / GE/TELEMECHANIQUE
50.	M.V. POWER CAPACITORS /HARMONIC BLOCK REACTOR	MALDE(MOMAYA) /(MEHER) / UNIVERSAL / SAIF ELECTRONICS/ EPCOS/ NEPTUNE /PRISTINE/ L&T- ISI MARKED
51.	CT, PT	L&T / AE / KAPPA / C&S
52.	APFC RELAY	L&T / ENERCON / NEPTUNE DUCATI/BELUK
53.	SURGE DIVERTERS	INDELEC/ TERCEL/ ABB/ NIMBUS
54.	NUMERICAL, PROTECTIVE RELAYS	AREVA MICOM / ABB-RE SERIES / SIEMENS/ L&T
55.	RISING MAIN, BUS TRUNKING, END FEED UNITS, TAP OFF BOXES I/C ALL CONCERNED ACCESSORIES	LEGRAND/ C&S/ SCHNEIDER ELECTRIC/ GE/ GODREJ / L&T
56.	DEISEL ENGINE FOR DG SET	CUMMINS/ CATERPILLAR/ VOLVO PENTA/ PERKINS/ MTU

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

57.	ALTERNATOR FOR DG SET	KIRLOSKAR/ STAMFORD/ LEROY SOMER/ CROMPTON GREAVES
58.	AMF/ SYNCHRONISATION PANEL FOR DG SET	OEM/ OEA OF DG SET
59.	RUBBER HAND GLOVES	ISI mark
60.	SHOCK TREATMENT CHART	-
61.	INSULATING MAT	ISI MARK
62.	METAL PIPES (M S / G I)	TATA/ JINDAL HISSAR/ PRAKASH SURYA/ ZENITH
63.	PIPE FITTINGS	UNIQUE / RM / KIRTI / SANT
64.	GUN METAL VALVES	LEADER / KIRLOSKAR / ADVANCE/ SANT/ ZOLOTO
65.	SINGLE HEADED HYDRANT VALVES, FOUR WAY FIRE BRIGADE INLET & SHUT OFF NOZZLE	PADMINI / NEW AGE / OMEX / MINIMAX / SUPEREX/SAFEFIRE
66.	RUBBER HOSE FOR HOSE REEL	Jyoti Padmini / Bharat / Eversafe / Kesra/Sri(LPCB)
67.	SLUICE & NON-RETURN VALVES	LEADER / KIRLOSKAR / ADVANCE/ SANT/ ZOLOTO
68.	PRESSURE SWITCH	INDFOSS / SWITZER / SYSTEM SENSOR / DANFOSS
69.	PRESSURE GAUGES	FIEBIG/ H-GURU / BELL/ WIKA
70.	PUMP FOR FIRE FIGHTING SYSTEM	MATHER & PLATT/ KIRLOSKAR/ KSB
71.	MOTOR FOR FIRE FIGHTING SYSTEM	ABB / SIEMENS / CROMPTON GREAVES / KIRLOSKAR
72.	MECHANICAL SEAL	DURAMETALLIC/ SEALOL
73.	DIESEL ENGINE FOR FIRE FIGHTING SYSTEM	ASHOK LEYLAND / KIRLOSKAR / CUMMINS
	(NOTE: PUMP AND MOTOR SHALL BE ASSEMBLED AT PUMP MANUFACTURER'S WORKS)	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

74.	ENAMEL PAINTING OF PIPES ETC	ASIAN / GOODLAS NEROLAC / ICI / BERGER
75.	PAINT PRIMER	ASIAN / JENSON NICHOLSON / BERGER
76.	FASTENERS.	HILTI / FISCHER
77.	WELD RODS	ADVANI / MANGALAM / ESAB
78.	BALL VALVES	RB (ITALY) / BUGATTI / ZOLOTO / AUDCO.
79.	BUTTERFLY VALVE	C&R / INTERVALVE / CE/ AUDCO/ KIRLOSKAR/ SANT
80.	FIRST AID RUBBER REEL, HOSE REEL	DUNLOP / JYOTI / KESARA
81.	RUBBER GASKETS	C I C / VARUNA
82.	BRANCH PIPE	PADMINI / NEW AGE / OMEX / MINIMAX/ SUPEREX
83.	Y STRAINER	JAYPEE / GRANDPRIX / LEADER / HAMMER / KARTAR
84.	WAFER TYPE NON-RETURN VALVES	C & R / ADVANCE / KIRLOSKAR / AUDCO
85.	SPRINKLERS (ALL TYPES) (INCLUDING ROSETTE PLATE)	TYCO / HD / VIKING / NEWAGE
86.	INSTALLATION CONTROL VALVE	TYCO / HD /VIKING./ CD
87.	GAS FLOODING FIRE PROTECTION SYSTEM	FIRETREX/LIFEGUARD/TRACEFIRE/SAFEFI RE
88.	FIRST AID HOSE DRUM	MINIMAX / NEWAGE / OMEX / SUPREX
89.	FLOW SWITCH	SYSTEM SENSOR / VIKING / HONEYWELL
90.	NUTS & BOLTS	LAKSHMI / UNBRAKO
91.	SPRINKLER HANGER SUPPORTS	INTELLOTECH / CAMRY / CHILLY/ HITECH
92.	HUME PIPE	HINDUSTAN/PRANALI/NATIONAL NP2 CLASS
93.	C.I. FOOT VALVE	NORMEX/C&R/ZOLOTO/KIRLOSKAR

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

94.	FIRE EXTINGUISHER	SAFEX/CEASFIRE/MINIMAX/FIREX/LIFEGUARD
95.	ANNUNCIATION PANEL	MIRCOM/EDWARDS/MORLEY RISTINE
96.	DELUGE VALVE	HD/MATHER+PLATT/NEWAGE
97.	AIR BREATHING APPARATUS SET	HONEYWELL/SAFETY PRODUCT/DRAEGER
98.	AUTO GLO SIGNAGES	GLO-LITE / GLO-LINE / AGNI / MR. LITE
99.	PIPE COAT	IWL LIMITED / STP / PYPKOTE
100.	VERTICLE INLINE PUMP, SUBMERSIBLE DRAINAGE PUMP, TUBEWELL PUMP I/C ACCESSORIES	KIRLOSKAR/ KSB/ MATHER & PLATE/ GRUNDFOS
101.	STARTERS, TIMERS	L & T / SCHNEIDER ELECTRIC / SIEMENS / ABB / LEGRAND
102.	LIQUID LEVEL CONTROLLERS LIQUID LEVEL INDICATORS	ACTIVE COTNROL/ APEX AUTOMATION/ MV INSTRUMENTS
103.	FILTER	BRISANZIA/ ENVIROTECH UTILITY OR APPROVED EQUIVALENT
104.	RO PLANT	ION EXCHANGE/ BRISANZIA/ ENVIROTECH UTILITY/ EUREKA FORBES
105.	CHLORINATOR	ASIA LMI/ TOSHNIWAL/ PROMINENT
106.	WATER CHILLING UNIT	CARRIER/ TRANE/ DAIKIN MCQUAY/ YORK/ DUNHAMBUSH
107.	PUMPS AND MOTOR FOR HVAC SYSTEM	GRUNDFOSS / XYLEM / WILO / ITT / ARMSTRONG/ KIRLOSKAR
108.	VARIABLE PUMPING SYSTEM	GRUNDFOSS / XYLEM / WILO / ITT / ARMSTRONG/ KIRLOSKAR
109.	COOLING TOWER	MIHIR / ADVANCE / PAHARPUR/BELL/ CASE
110.	AIR HANDLING UNIT	WAVES/ZECO/EDGETECH/NUTECH/ SYSTEMAIR/ VTS /CARYAIRE (FLAKTWOOD) / HUMIDIN

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

11.	CENTRIFUGAL FAN FOR AHU	NICOTRA/ COMEFRI / KRUGER / GREENHECK /DYNAAIR/FLAKTWOOD/ BLOWTECH/HUMIDIN
12.	FAN COIL UNIT	WAVES/ ZECO/ EDGETECH/ NUTECH
13.	AXIAL FLOW FAN	KRUGAR/GREENHECK/SYSTEMAIR/AIRFL OW/ HUMIDIN
14.	VFD	ALLEN BRADLY/ DANFOSS/ ABB / HONEYWELL / SIEMENS/SCHNIEDER
15.	AHU/FCU MOTOR	HAVELLS/ SIEMENS/ MARATHON/ ABB / CROMPTON /BHARAT BIJLEE/GE
16.	INLINE FAN/ PROPELLER FAN	OSTBERG/LAU/CARYAIRE/ KRUGER/ AIRFLOW/ FLAKTWOOD/ KANALFLAKT / GREENHECK / NICOTRA/ HUMIDIN
17.	AUXILIARY RELAYS	SIEMENS/L&T/CUTLER HAMMER/JYOTI
18.	GRILLES/DIFFUSER/FIRE DAMPERS	TRISTAR/ CARYAIRE/AIRFLOW/ SYSTEMAIRE/ DYNACRAFT/ COMOS/ AIRPRODUCTS/ DYNAMIC / SERVEX /RAVISTAR
19.	ACTUATOR ASSEMBLY	BELIMO/DANFOSS/SIEMENS/ HONEYWELL /ANERGY
20.	G.I. SHEETS	BHUSHAN/TATA/SAIL/JINDAL/LLOYD/ NIPPON
21.	FACTORY FABRICATED DUCTING	DUCTOFAB/ZECO/ROLASTAR/ECODUCT/ TECHNO/ NU AIR(NUTECH)
22.	FLEXIBLE PIPE CONNECTION	RESISTOFLEX/EASYFLEX
23.	BUTTERFLY VALVE FOR HVAC WORK	ADVANCE/AIP/UTAM&VTM/SKS/ AUDCO/ ZOLOTO/C&R/CASTLE/ HONEYWELL/DANFORCE
24.	MOTORIZED BUTTERFLY VALVE FOR HVAC WORK	ADVANCE/HONEYWELL/AIP/SKS/ AUDCO/ ZOLOTO/C&R/CASTLE /DANFORCE
25.	BALANCING VALVE FOR HVAC WORK	ADVANCE/AIP/UTAM&VTM/SKS/ DANFOSS / FLOWCON / ZOLOTO / BELIMO /HONEYWELL/CASTLE

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

26.	NON-RETURN VALVE FOR HVAC WORK	ADVANCE/AIP/UTAM&VTM/SKS/ LEADER /AUDCO / ZOLOTO/SANT/HONEYWELL/KIRLOSKAR/ SIEMENS
27.	POT / Y STRAINER/SUCTION GUIDE FOR HVAC WORK	EMERALD/RAPIDCOOL/SM/SANT/ UTAM & VTM/ RAPID COOL/LEADER/SANDHU
28.	THERMOMETER /PRESSURE GAUGE FOR HVAC WORK	EMERALD/ANERGY/HONEYWELL/ H-GURU/ METZER/ BESTOBELL/ STAR SCIENTIFIC /FIEBIG/TAYLOR
29.	BALL VALVES	RAPIDCOOL/EMERALD/CIM/SANT/ADVANCE/ UTAM & VTM
30.	PICBV VALVE	DANFOSS/FRESSE/FLOWCON/HONEYWELL
31.	AIR & DIRT SEPARATOR	EMERALD/ANERGY/SANT
32.	AIR VENT	SIEMENS/ HONEYWELL / JOHNSON CONTROL / ANERGY
33.	FLOW SWITCH	ANERGY/SIEMENS/BELIMO/EMERALD/ SYSTEM SENSOR / SWITZER/HONEYWELL
34.	EXPANSION TANK	ANERGY/EMERALD/ARMSTRONG
35.	GLASS WOOL	U.P. TWIGA/OWEN CORNING
36.	NITRILE RUBBER	ARMACELL/K-FLEX/A-FLEX/ ARMAFLEX/THERMAFLEX/A-FLEX/K-FLEX
37.	VIBRATION ISOLATOR PADS	RESISTOFLEX / KANWAL
38.	ADHESIVES	CISCHEM/ PIDILITE/CISBOND
39.	FASTENERS & SUPPORT	FISHER/HILTI/RAWPLUG
40.	CENTRAL CONTROL SYSTEM	HP / DELL / LENOVO / COMPAQ
41.	COLOUR LASER PRINTERS	HP / CANNON / EPSON
42.	BUILDING MANAGEMENT SYSTEM	SCHNEIDER / HONEYWELL (WEBS)/JOHNSON CONTROLS/ SIEMENS

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

43.	BUILDING MANAGEMENT APPLICATION/GUI SOFTWARE	SCHNEIDER / HONEYWELL (WEBS) / JOHNSON CONTROLS / SIEMENS
44.	DIRECT DIGITAL CONTROLLER	SCHNEIDER / HONEYWELL (WEBS) / JOHNSON CONTROLS / SIEMENS
45.	NETWORK AREA CONTROLLER/ROUTER/GLOBAL CONTROLLER	SCHNEIDER / HONEYWELL (WEBS) / JOHNSON CONTROLS / SIEMENS
46.	THIRD PARTY INTERFACE INTEGRATOR UNIT	SCHNEIDER / HONEYWELL (WEBS) / JOHNSON CONTROLS / SIEMENS / SAN TELEQUIP
47.	IMMERSION TYPE TEMPERATURE SENSORS	SCHNEIDER / HONEYWELL / JOHNSON CONTROLS / SIEMENS / OMICRON
48.	CLAMP TYPE ULTRASONIC FLOW METER FOR MEASURING CHILLED WATER FLOW	SHINETECH / KAMSTRUP / ONICON / THERMO PRO
49.	OUTSIDE AIR TEMPERATURE & RH SENSOR.	SCHNEIDER / HONEYWELL (WEBS) / JOHNSON CONTROLS / SIEMENS / OMICRON
50.	CURRENT RELAY	VERIS / SETO / OMICRON / OMRON / P.E
51.	WATER LEVEL SWITCHES / LEVEL TRANSMITTER	NEVELCO / OMICRON
52.	DIFFERENTIAL PRESSURE SWITCH (BLOWERS & FILTERS)	SCHNEIDER / HONEYWELL / SIEMENS / OMICRON
53.	WALL / DUCT MOUNT TEMPERATURE SENSOR	SCHNEIDER / HONEYWELL (WEBS) / JOHNSON CONTROLS / SIEMENS / OMICRON
54.	FLAME PROOF LEVEL SWITCH / LEVEL TRANSMITTER	VEKSLER / FILPRO / ABB / TECHTROL / OMICRON
55.	DC VOLTAGE TRANSDUCERS	SETO / ABB / RISHABH / L&T / OMICRON
56.	PRESSURE SENSOR FOR MEASURING LINE PRESSURE	SCHNEIDER / HONEYWELL / JUMO / SIEMENS / OMICRON / HUBA-CONTROL
57.	DUCT TYPE RH SENSOR	SCHNEIDER / HONEYWELL / SIEMENS / OMICRON

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

58.	DIFFERENTIAL PRESSURE SWITCH- WATER APPLICATION	SCHNEIDER / HONEYWELL / SIEMENS / OMICRON / UNITED ELECTRIC
59.	POWER FACTOR TRANSDUCER/FREQUENCY TRANSDUCER/ KW TRANSDUCER	VERIS / SETO / OMICRON /OMRON / ABB / RISHABH / L&T
60.	CO2 SENSOR	SCHNEIDER / HONEYWELL/ SIEMENS / OMICRON / AIRSENSE
61.	DIFFERENTIAL PRESSURE TRANSMITTER-WATER APPLICATION	SCHNEIDER / HONEYWELL/ JUMO / SIEMENS / OMICRON / HUBA-CONTROL
62.	DUCT PRESSURE SENSOR	SCHNEIDER / HONEYWELL/ SIEMENS / OMICRON / AIRSENSE
63.	WATER FLOW SWITCH	SCHNEIDER / HONEYWELL/ SIEMENS / OMICRON
64.	NETWORK RACKS AND ACCESSORIES	PRESIDENT/ RITTAL/ VALRACK/ CISCO/ WIPRO
65.	SCENE SELECT PANEL	MK/ LUTRON/ PHILIPS
66.	POP-UP-BOXES	LEGRAND / FREEZER-TECHNO

Note :- All the E&M equipment should be compatible with IBMS as per the IO summary of NIT, for this nothing extra will be paid by the department.

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

**SCHEDULE OF TECHNICAL PARTICULARS
TO BE FILLED BY THE CONTRACTOR FOR APPROVAL
AFTER AWARD OF WORK**

S.No.	Particulars	Offered
A.	MAIN FIRE ALARM CONTROL PANEL	
1	Manufacturer	
2	Make & Model Number	
3	UL Listed	
4	No of Loops provided	
5	No of Detectors and / or Devices that can be connected per Loop	
6	2 Way fire fighter communication system	
7	Integrated digital voice command centre module (for voice evacuation)	
8	No of channels on digital voice evacuation module	
9	Zone control function (DVE module)	
10	Voltage Range	
11	Standby Current	
12	Response time	
13	Size of LCD Display	
14	Inbuilt printer (for automatic printing of alarms etc)	
15	Programmable Keypad	
16	Password Protection	
17	Real Time Clock and Calendar	
18	Tamper Resistant	
19	Battery Charger	
20	Standard Relays for Alarm and Exception Reporting	
21	Peer to peer networking capability	
22	Additional Features	
B.	REPEATER PANEL	
1	Model Number	
2	Manufacturer	
3	Size of LCD Display	
4	No of Detectors and / or Devices that can be connected per Loop	
5	UL Listed	
6	Zone selection facility	
7	Remote microphone facility	
8	Peer to peer networking capability	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

C.	DIGITAL AUDIO AMPLIFIER	
1	Model Number	
2	Manufacturer	
3	UL Listed	
4	No of audio channels	
5	Total output (in Watts)	
D.	OPERATOR WORKSTATION	
1	Make & Model of P.C.	
2	RAM Memory Capacity	
3	Hard Disc Capacity	
4	Size of Monitor	
5	Window Operating System	
6	Make & Model of Laser Printer	
E.	MULTI SENSOR DETECTOR	
1	Model Number	
2	Manufacturer	
3	UL Listed	
4	Address setting	
5	Dip switch address setting	
6	Voltage Range	
7	Standby Current	
8	LED Current	
9	Sensitivity range	
10	Air Velocity	
11	Temperature	
12	Relative Humidity	
13	Tamper Resistant	
F.	HEAT DETECTORS	
1	Model Number	
2	Manufacturer	
3	UL Listed	
4	Address setting	
5	Dip switch address setting	
6	Voltage Range	
7	Standby Current	
8	LED Current	
9	Fixed temp set point	
10	Rate of rise	
11	Temperature	
12	Relative Humidity	
13	Tamper Resistant	
G.	MANUAL CALL POINT	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

1	Model Number	
2	Manufacturer	
3	UL Listed	
4	Temperature	
5	Relative Humidity	
6	Normal Operating Voltage	
7	Maximum SLC Loop Voltage	
8	Maximum SLC Loop Current	
H.	ADDRESSABLE CONTROL MODULE	
1	Model Number	
2	Manufacturer	
3	UL Listed	
4	Temperature	
5	Relative Humidity	
6	Normal Operating Voltage	
I.	ADDRESSABLE MONITOR MODULE	
1	Model Number	
2	Manufacturer	
3	UL Listed	
4	Temperature	
5	Relative Humidity	
6	Normal Operating Voltage	
J	FAULT ISOLATOR MODULE	
1	Model Number	
2	Manufacturer	
3	UL Listed	
4	Temperature	
5	Relative Humidity	
6	Normal Operating Voltage	
7	Maximum SLC Loop Voltage	
8	Maximum SLC Loop Current	
K	RESPONSE INDICATOR	
1	Model Number	
2	Manufacturer	
3	UL Listed	
4	Temperature	
5	Relative Humidity	
6	Normal Operating Voltage	
L	SURFACE MOUNTED VOICE EVACUATION SPEAKERS	
1	Model Number	
2	Manufacturer	
3	UL Listed	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

4	Mounting	
5	Power Consumption	
6	Frequency response	
7	Variable wattage settings	
M	BOX TYPE VOICE EVACUATION SPEAKER	
1	Model Number	
2	Manufacturer	
3	UL Listed	
4	Type	
5	Mounting	
6	Power Consumption	
7	Frequency response	
8	Variable wattage settings	
N	VOICE EVACUATION SPEAKER WITH STROBE	
1	Model Number	
2	Manufacturer	
3	UL Listed	
4	Mounting	
5	Power Consumption	
6	Frequency response	
7	Variable wattage settings	
8	Frequency of strobe	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

**SCHEDULE OF TECHNICAL PARTICULARS
TO BE FILLED BY THE CONTRACTOR FOR APPROVAL
AFTER AWARD OF WORK**

S.No.	Particulars	Offered
1	ELECTRIC FIRE PUMP	
A	MOTOR	
(i)	Make	
(ii)	Frame Size	
(iii)	Type	
(iv)	Protection type	
(v)	Insulation class	
(vi)	Electrical Particulars (Voltage/ No. of Phase/ Frequency)	
(vii)	I S confirming to	
(viii)	HP	
(ix)	Speed	
B	Pump	
(i)	Make	
(ii)	Catalouge Number	
(iii)	Type	
(iv)	Frame Size	
(v)	Discharge	
(vi)	Total Head at Full Discharge	
(vii)	BHP absorbed (a) at rated head and discharge	
(viii)	(b) at 150 % of rated discharge and 65% of rated Head	
(ix)	Casing material	
(x)	Impeller material	
(xi)	Shaft material	
(xii)	No. of Stages	
(xiii)	Type of drive	
(xiiv)	Type of seal	
(xv)	IS confirming to	
2	DIESEL FIRE PUMP	
A	Diesel Engine	
(i)	Make and model number	
(ii)	Type	
(iii)	HP	
(iv)	Speed	
(v)	No. of cylinders	
(vi)	IS/BS standard confirming to	
(vii)	Type of cooling	
(viii)	Fuel consumption at full load	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

(ix)	Overload capacity	
(x)	Efficiency	
B	PUMP	
(i)	Make and catalogue number	
(ii)	Type	
(iii)	Frame Size	
(iv)	Discharge	
(v)	Total Head at Full Discharge	
(vi)	BHP absorbed (a) at rated head and discharge	
(vii)	(b) at 150 % of rated discharge and 65% of rated Head	
(viii)	Casing material	
(ix)	Impeller material	
(x)	Shaft material	
(xi)	No. of Stages	
(xii)	Type of drive	
(xiii)	Type of seal	
(xiv)	IS confirming to	
3	PRESSURISATION PUMP	
A	MOTOR	
(i)	Make	
(ii)	Frame Size	
(iii)	Type	
(iv)	Protection type	
(v)	Insulation class	
(vi)	Electrical Particulars (Voltage/ No. of Phase/ Frequency)	
(vii)	IS confirming to	
(viii)	HP	
(ix)	Speed	
B	PUMP	
(i)	Make and catalogue number	
(ii)	Type	
(iii)	Frame Size	
(iv)	Discharge	
(v)	Total Head at Full Discharge	
(vi)	BHP absorbed	
(vii)	Casing material	
(viii)	Impeller material	
(ix)	Shaft material	
(x)	No. of Stages	
(xi)	Type of drive	
(xii)	Type of seal	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

(xiii)	IS confirming to	
4	BOOSTER PUMP	
A	MOTOR	
(i)	Make	
(ii)	Frame Size	
(iii)	Type	
(iv)	Protection type	
(v)	Insulation class	
(vi)	Electrical Particulars (Voltage/ No. of Phase/ Frequency)	
(vii)	IS confirming to	
(viii)	HP	
(ix)	Speed	
B	PUMP	
(i)	Make and catalogue number	
(ii)	Type	
(iii)	Frame Size	
(iv)	Discharge	
(v)	Total Head at Full Discharge	
(vi)	BHP absorbed	
(vii)	Casing material	
(viii)	Impeller material	
(ix)	Shaft material	
(x)	No. of Stages	
(xi)	Type of drive	
(xii)	Type of seal	
5	PIPES	
A	MS PIPES	
(i)	Make	
(ii)	Class	
(iii)	IS confirming to Pipes	
(iv)	IS confirming to fittings	
B	GALVANISED IRON PIPE	
(i)	Make	
(ii)	Class	
(iii)	IS confirming to Pipes	
(iv)	IS confirming to fittings	
6	VALVES	
A	BUTTER FLY VALVE	
(i)	Make	
(ii)	Class	
(iii)	IS confirming to	
B	NON Return Valve	

No. of Correction – C NIL
 No. of Omissions – O NIL
 No. of Insertions – I NIL

(i)	Make	
(ii)	Class	
(iii)	IS confirming to	
C	GATE VALVE	
(i)	Make	
(ii)	Class	
(iii)	IS confirming to	
D	POT STRAINER	
(i)	Make	
(ii)	Class	
(iii)	IS confirming to	
(iv)	Material of Body and Thickness	
(v)	Material of Strainer	
7	HOSE PIPE	
(i)	Make	
(ii)	Diameter	
(iii)	IS confirming to	
8	HOSE REEL	
(i)	Make	
(ii)	Length	
(iii)	Diameter	
(iv)	IS confirming to	
9	HOSE CABINET (For External Hydrant)	
(i)	Size (LXBXH)	
(ii)	Thickness of the sheet steel used	
10	AIR VESSEL	
(i)	Diameter	
(ii)	Length	
(iii)	Material	
(iv)	Thickness of the sheet	
(v)	Pressure for which tested	
11	ELECTRIC PANEL	
(i)	Make	
(ii)	Make of MCCB used	
(iii)	Thickness of sheet metal used	
(iv)	Make of Contactors	
(v)	Make of cables and size of cables for different motors	
12	SPRINKLER HEAD	
(i)	Make	
(ii)	Body material	
(iii)	Type	
13	FLOW SWITCHES	

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

(i)	Make	
(ii)	Bellow material	
(iii)	Type	
14	PRESSURE SWITCHES	
(i)	Make	
(ii)	Diaphragm material	
(iii)	Type	
15	INSTALLATION CONTROL VALVE ASSEMBLY	
(i)	Make	
(ii)	IS confirming to	
16	OTHER ACCESSORIES if any	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

TECHNICAL DATA SHEET
TO BE FILLED IN BY THE CONTRACTOR FOR APPROVAL AFTER AWARD OF WORK

1. WATER-COOLED ROTARY SCREW CHILLERS

S.No	PARAMETER	REQUIREMENT	PROPOSAL
1	Manufacturer	To be specified by tenderer	_____
2	Model Number	To be specified by tenderer	_____
3	Noise Levels	To be specified by tenderer	_____ dBA at 3 metres
4	Location	On Terrace	
5	Overall Dimensions: (approx)	To be specified by tenderer	
5a	Length		_____ mm
5b	Width		_____ mm
5c	Height		_____ mm
6	Clearances required	To be specified by tenderer	_____ m (overhead) _____ m (side) _____ m (tube cleaning)
	COMPRESSORS		
7	Manufacturer	To be specified by tenderer	_____
8	Model Number	To be specified by tenderer
9	Number of compressors	To be specified by tenderer	

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

10	Type of compressor	Mono Screw / Twin Screw	
11	Refrigerant Type	R-134A	
12	Cooling capacity in TR at given conditions(7/12 & 32/36 Deg C)	To be specified by tenderer	_____ TR at given conditions
13	Selected Design Operating Conditions :	To be specified by tenderer	___ / ___ Deg C Evaporator ___ / ___ Deg C Condensor
14	Suction Temperature	To be specified by tenderer	_____ Deg C
15	Condensing Temperature	To be specified by tenderer	_____ Deg C
16	Full load power consumption in KW at above conditions.	To be specified by tenderer	_____ kW
17	Unloading flexibility per compressor	20% - 100%	
	MOTOR DETAILS		
18	Manufacturer	To be specified by tenderer	_____
19	Model Number	To be specified by tenderer	_____
20	Rating of Motor in kW	To be specified by tenderer	_____ kW
21	Operating power supply	415V±10%,50Hz,3 Ph, AC	
22	Starter Type	To be specified by tenderer	_____
	EVAPORATORS (Shell & Tube)		
23	Type of construction	Flooded	
24	Fouling Factor	0.0001 (metric units)	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

25	Fluid side pressure drop	To be specified by tenderer	_____ mtrs of WC
26	No. of passes on tube side	2	
	WATER-COOLED CONDENSERS		
27	Type of construction	Shell & Tube type	
28	Fouling Factor	0.0002 (metric units)	
29	Fluid side pressure drop	To be specified by tenderer	_____ mtrs of WC
30	No. of passes on tube side	2	
	POWER CONSUMPTION		
31	IkW/TR at 100% (At condensor water inlet temp of 32 Deg C)	To be specified by tenderer	_____ ikW / TR
32	IkW/TR at 75% (At condensor water inlet temp of 24.5 Deg C)	To be specified by tenderer	_____ ikW / TR
33	IkW/TR at 50% (At condensor water inlet temp of 18.3 Deg C)	To be specified by tenderer	_____ ikW / TR
34	IkW/TR at 25% (At condensor water inlet temp of 18.3 Deg C)	To be specified by tenderer	_____ ikW / TR

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

2. PUMPS

SNo	PARAMETER	REQUIREMENT	PROPOSAL
	PRIMARY CHILLED WATER PUMP		
1	Manufacturer	To be specified by tenderer	_____
2	Model No.	To be specified by tenderer	_____
3	Type of Pump	To be specified by tenderer	
4	Power consumption (kW)	To be specified by Tenderer	_____ kW
5	Pump speed rpm	Not exceeding 1440 rpm	
6	Pump discharge (in LPM)	1820	_____ LPM
7	Pump head pressure (in M)	15 M	_____ Mtrs
8	Motor Rating (HP)	To be specified by Tenderer	_____ hp
9	Class of Protection	Minimum IP 55	
10	Performance Curves	To be enclosed with offer	
11	Pump Efficiency	To be specified by Tenderer	_____
	CONDENSOR WATER PUMP		
1	Manufacturer	To be specified by tenderer	_____
2	Model No.	To be specified by tenderer	_____

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

3	Type of Pump	To be specified by tenderer	
4	Power consumption (kW)	To be specified by Tenderer	_____ kW
5	Pump speed rpm	Not exceeding 1440 rpm	
6	Pump capacity (in LPM)	2400	_____ LPM
7	Pump head pressure (in M)	25	_____ Mtrs
8	Motor Rating (HP)	To be specified by Tenderer	_____ hp
9	Class of Protection	Minimum IP 55	
10	Performance Curves	To be enclosed with offer	
11	Pump Efficiency	To be specified by Tenderer	_____

SNo	PARAMETER	REQUIREMENT	PROPOSAL
	SECONDARY CHILLED WATER PUMP		
1	Manufacturer	To be specified by tenderer	_____
2	Model No.	To be specified by tenderer	_____
3	Type of Pump	To be specified by tenderer	
4	Power consumption (kW)	To be specified by Tenderer	_____ kW
5	Pump speed rpm	Not exceeding 1440 rpm	
6	Pump discharge (in LPM)	1820 LPM	_____ LPM
7	Pump head pressure (in M)	35 M	_____ Mtrs

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

8	Motor Rating (HP)	To be specified by Tenderer	_____ hp
9	Class of Protection	Minimum IP 55	
10	Performance Curves	To be enclosed with offer	
11	Pump Efficiency	To be specified by Tenderer	_____

3. COOLING TOWER

SNo	PARAMETER	REQUIREMENT	PROPOSAL
	General Data		
1	Make	To be specified by Tenderer	
2	Model	To be specified by Tenderer	
3	Location	On Terrace	
4	Operating weight of each	To be specified by Tenderer	_____ kgs
5	Noise Level	To be specified by Tenderer	_____ dBA at 3 metres
	Design Data		
6	Heat rejection	400 TR & 200 TR	_____ TR
7	Condenser water flow rate	2400 LPM	
8	Fouling factor	0.132 (sqm-k)/kW	
9	Design wet bulb temperature	28.0 °C	
10	Inlet temp. of water	36.0 °C	

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

11	Cooling tower leaving water temp.	32.0 °C	
12	Make-up water requirement per hour.	To be specified by Tenderer (<1.2% of Water Circulated)	_____ LPM
	Fan		
13	No. of fans	To be specified by Tenderer	_____ Nos
14	No. of blades	To be specified by Tenderer	_____ Nos
15	Fan Brake HP	To be specified by Tenderer	_____ BHP
16	Air flow rate (m ³ /min)	To be specified by Tenderer	_____ CMH
17	Efficiency	To be specified by Tenderer	_____ %
	Motor		
18	Make/Model No.	Manufacturer standard	
19	KW rating	To be specified by Tenderer	_____ kW
20	Type	TEFC	
21	IP Protection class	IP 55	
22	Insulation class	Class F	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

**SCHEDULE OF TECHNICAL PARTICULARS
TO BE FILLED BY THE CONTRACTOR FOR APPROVAL
AFTER AWARD OF WORK**

S/L	Description	OFFERED RATINGS
1	Group Control	
2	Type	
3	Fireman Switch	
4	No. of Passengers	
5	Speed in Metre/sec.	
6	Floors served	
7	No. of Stops (Landings)	
	All on one side	
8	Total Travel (Approx.)	
9	Hoistway width	
10	Hoistway depth	
11	Traction Machine	
12	Clear Pit depth	
13	Clear Overhead	
14	Control System	
15	Power for Machine	
16	Auxillary Power	
17	<u>CAR :</u>	
A	Flooring	
B	Car Enclosure and dimensions	
C	False Ceiling	
D	Car Ceiling.	
E	Car doors.	
F	Lighting & Ventilation.	
G	Main Car operating panel.	
H	Secondary Car Panel	
I	Auto voice announcement for floor nos.	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

J	Intercom connected to Masters at fire control room and machine room and slave at main lobby	
K	Attendant/automatic selector switch	
L	Independent operation key switch	
M	Non-stop travel button	
O	Automatic fan switch-off at preset time	
P	Public address system for channel music and announcements (Only cabling provision in travelling cable)	
R	Car capacity indicator	
S	Cabin sill	
T	Additional facilities for disabled person	
18	Automatic Rescue Device	
19	Landing sills	
20	Landing Doors	
21	Door Architraves	
22	Hall Button Panel	
23	Hall lantern and chime	
24	Hall position indicators on all floors and GIP on GF	
25	Next landing	
26	Safe Landing	
27	Fireman Emergency Operation	
28	Door Knudging Operation	
29	Main Floor Parking	
30	False Call Cancellation	
31	False Call Cancellation	
32	Flashing Hall Lantern	

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

SCHEDULE OF TECHNICAL PARTICULARS
TO BE FILLED BY THE CONTRACTOR FOR APPROVAL AFTER AWARD OF
WORK

S. No.	Details of Particulars	Remarks
TRANSFORMERS		
1.1	Make	
1.2	Type	
	a) Type of Winding	
	b) Type of enclosure	
1.3	Output in kVA (continuous rating)	
1.4	Frequency	
1.5	Voltage between phases (HV on no load)	
1.6	Voltage between phases (LV on no load)	
1.7	Impedance at normal voltage ratio at 75 ° C.	
1.8	Efficiency at unity power factor.	
	(a) Full load	
	(b) $\frac{3}{4}$ load.	
	(c) $\frac{1}{2}$ load.	
1.9	Iron losses at normal voltage ratio.	
1.10	Copper losses at normal voltage ratio, at full load..	
1.11	Regulation at unity P.F. at 75° C	
1.12	Reactance at normal voltage and ratio	
1.13	Resistance of H.V. winding at 75° C.	
1.14	Regulation at 0.8 P F at 75 deg C	

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

S. No.	Details of Particulars	Remarks
--------	------------------------	---------

1.15 Resistance of M.V. winding at 75° C.

1.16 OVER- LOAD : The transformers are capable of carrying overload as follows:-

Percentage Load. hours.	When starting Cold (in hours)	After running continuously in
----------------------------	----------------------------------	----------------------------------

- (a) 25%
- (b) 50%
- (c) 100%

1.17 Overall dimensions of the Transformer

1.18 CPRI – Type test certificates be enclosed for all type tests applicable as per IS.

- LT PANELS

- 2.1 Make
- 2.2 Thickness of the Sheet metal
- 2.3 Size of the busbars
- 2.4 Material of Busbars – Copper
- 2.5 Busbar insulation
- 2.6 Overall dimension
- 2.7 Degree of Protection

APFC PANELS

- 3.1 Make of the Panel
- 3.2 No. of Capacitors
- 3.3 No of steps and capacity of each
- 3.4 Make of the Capacitor
- 3.5 Overall dimension

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

S. No.	Details of Particulars	Remarks
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BUS BAR TRUNKING

- 4.1 Size of the enclosure
- 4.2 Thickness of the sheet metal used
- 4.3 Size of the bus bar
- 4.4 Bus bar insulation
- 4.5 General arrangement indicating the insulating material between the busbars and its thickness
- 4.6 No of flexible joints
- 4.7 No of separators or fire barriers provided and material used
- 4.8 Details of copper flexible and expansion joints

- HT PANEL

- 5.1 Make
- 5.2 Type
- 5.3 Rated Current Amps
- 5.4 Overall dimensions & weight
- 5.5 Breaking Current kA, MVA at 11 kV.

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

SCHEDULE OF TECHNICAL PARTICULARS
TO BE FILLED BY THE CONTRACTOR FOR APPROVAL
AFTER AWARD OF WORK

Sl. No.

I. Engine

1. Make
2. Model/ISS reference
3. No. of cylinders
4. Rated R.P.M.
5. Method of Starting
6. Aspiration Method
7. BHP
8. Specific Fuel oil consumption (gm/BHP/hr.)
9. Lub. Oil recommended
10. Lub. Oil pressure
11. Qty. of lub. oil required
12. Time required for starting
13. Lub. oil sump capacity
14. Nos. of exhaust pipe required.
15. Dia. of exhaust pipe
16. Whether meets CPCB norms for Emission
17. Fuel Consumption at full load
18. Any other data.

II. Alternator

1. Make
2. Enclosure Details
3. Full Load output in KVA
4. Full Load output in KW at 0.8 PF

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

5. Designed over load capacity at max. ambient temp.
6. Efficiency at full load
7. Class of Insulation of rotor
8. Class of Insulation stator

III. General:

1. Overall Length of DG set L x W x H
2. Overall Weight of DG set
3. Noise Level of DG Set at one Metre with Acoustic Enclosure

IV. AMF Panels

1. Make
2. Type (Floor/Wall mounted)
3. Overall dimensions (L x B x H)
4. Finish

V. Generator Control Panel:

1. Make

VI. Acoustic Enclosure:

1. Make
2. Size
5. Details of Acoustic Lining Material & Make

L.T. Panel :

1. Make
2. Thickness of the sheet metal
3. Size of the bus bars
4. Material of bus bars – copper/aluminum
5. Bus bar insulation
6. Over all dimension
7. Degree of protection

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

SCHEDULE OF QUANTITY

Name of work:- C/o Stage-I of Phase-II, Delhi Technological University at Bawana Road, Delhi (SH: -C/o Academic Blocks AB-3 & AB-4, Boys Hostel H-5 & Girls Hostels HG-5 & HG-6 and all external and internal services including external development and landscaping, and allied civil and E&M works).

S.No	Description	Qty	Unit	Rate	Amount
	Sub- Head - I , Earth Work				
1.1	Earth work in surface excavation not exceeding 30 cm in depth but exceeding 1.5 m in width as well as 10 sqm on plan including getting out and disposal of excavated earth upto 50 m and lift upto 1.5 m, as directed by Engineer-in-Charge:				
	All kinds of soil	7812	sqm	53	414036
1.2	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means over areas (exceeding 30cm in depth. 1.5m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth, lead upto 50m and lift upto 1.5m, disposed earth to be levelled and neatly dressed, as per directed by Engineer-in-Charge.				
	All kinds of soil	30818	cum	125.95	3881527
1.3	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan) including dressing of sides and ramming of bottoms, lift upto 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.				
	All kinds of soil	345	cum	166.4	57408
1.4	Excavating trenches of required width for pipes, cables, etc, including excavation for sockets and dressing of sides, ramming of bottoms, depth upto 1.5 m including getting out the excavated materials, returning the soil as required in layers not exceeding 20 cm in depth, including consolidating each deposited layers by ramming, watering etc., stacking serviceable material for measurements and disposal of unserviceable material as directed, within a lead of 50m :				
a	Pipes, cables etc. exceeding 80 mm dia. but not exceeding 300 mm dia.	2330	metre	225.45	525299
b	Pipes, cables etc. exceeding 300 mm dia. but not exceeding 600 mm dia.	400	metre	352	140800
1.5	Extra for every additional lift of 1.5 m or part thereof in excavation /banking excavated or				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	stacked materials.				
	All kinds of soil	22064	cum	51.75	1141812
1.6	Filling available excavated earth (excluding rock) in trenches plinth sides of foundations etc in layers not exceeding 20 cm in depth consolidating each deposited layer by ramming and watering, lead upto 50m and lift upto 1.5m.	4714.638	cum	125.75	592866
1.7	Supplying and filling in plinth with M sand (manufactured from using C & D waste recycled material) under floors, including watering, ramming, consolidating and dressing complete.	895	cum	1180.25	1056324
1.8	Carriage of Surplus earth by Mechanical transport including loading unloading and stacking, lead upto 10 km as per direction of Engineer in charge.	4471	cum	203.42	909491
1.9	Credit for taking surplus soil out site the DTU permise and arranging madatory permissionsas per instructions of site Engineer.	26081	cum	56.2	-1465752
	Sub - Head - II , Concrete Work				
2.1	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level :				
b	1:4:8 (1 Cement : 4 coarse sand : 8 graded stone aggregate 40 mm nominal size).	672	cum	4478.15	3009317
c	1:5:10 (1 Cement : 5 coarse sand : 10 graded stone aggregate 40 mm nominal size).	1348	cum	4209.05	5673799
2.2	Providing and laying cement concrete in retaining walls, return walls, walls (any thickness) including attached pilasters, columns, piers, abutments, pillars, posts, struts, buttresses, string or lacing courses, parapets, coping, bed blocks, anchor blocks, plain window sills, fillets, sunken floor,etc., up to floor five level, excluding the cost of centering, shuttering and finishing :				
	1:2:4 (1 Cement : 2 coarse sand : 4 concrete aggregate 20 mm size)	41	cum	6547.7	268456
2.3	Providing and laying damp-proof course 50mm thick with cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 concrete aggregate 10 mm size).	506	sqm	320.25	162047
2.4	Extra for providing and mixing water proofing material in cement concrete work @ 1kg per 50 Kg of cement.	3237	per 50 Kg of Cement	47.95	155214

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

2.5	Providing and applying a coat of residual petroleum bitumen of grade of VG-10 of approved quality using 1.7kg per square metre on damp proof course after cleaning the surface with brushes and finally with a piece of cloth lightly soaked in kerosene oil.	506	sqm	91.9	46501
2.6	Making plinth protection 50mm thick of cement concrete 1:3:6 (1 cement :3 M sand : 6 graded stone aggregate 20 mm nominal size) over 75mm thick bed of dry brick ballast 40 mm nominal size, well rammed and consolidated and grouted with fine sand including finishing the top smooth	937	sqm	450.35	421978
	Sub - Head - III , RCC Work				
3.1	Centering and shuttering including strutting, propping etc. and removal of form for all heights :				
a	Foundations, footings, bases of columns, etc. for mass concrete.	1473	sqm	193.95	285688
b	Walls (any thickness) including attached pilasters, buttresses, plinth and string courses etc.	38000	sqm	378.6	14386800
c	Suspended floors, roofs, landings, balconies and access platform.with water proof ply 12mm thick	55706	sqm	497.45	27710950
d	Lintles, beams, plinth beams, girders, bressumers and cantilevers.with water proof ply 12mm thick	33194	sqm	418.95	13906626
e	Columns, Pillars, Piers, Abutments, Posts and Struts.	27731	sqm	467.85	12973948
f	Stairs, (Excluding landings) except spiral - staircases.	4700	sqm	419.35	1970945
g	Edges of slabs and breaks in floors and walls.				
	Under 20 cm wide	21035	metre	122.2	2570477
3.2	Extra for additional height in centering, shuttering where ever required with adequate bracing, propping etc. including cost of de-shuttering and decentering at all levels, over a height of 3.5 m for every additional height of 1 metre or part thereof (Plan area to be measured.)				
	Suspended floors, roofs, landing, beams and balconies (Plan area to be measured).	55796	sqm	171.5	9569014
3.3	Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level.				
	Thermo - Mechanically Treated bars of grade Fe-500D or more.	11810 24	kg	56.6	66845958
3.4	Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete above plinth level.				
	Thermo - Mechanically Treated bars of grade Fe-500D or more.	34348 34	kg	56.6	194411604

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

3.5	Add for plaster drip course/ groove in plastered surface or moulding to R.C.C. projections.	4270	metre	34.15	145821
3.6	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying but excluding the cost of centering, shuttering, finishing and reinforcement, including 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 Engineer-in-charge.				
	(Note :- Cement content considered in this item is @ 330 kg/cum. Excess/less cement used as per design mix is payable/recoverable separately).				
a	All works upto plinth level.	10145	cum	6446.45	65399235
b	All works above plinth level upto floor V level.	21484	cum	7250.05	155760074
3.7	Extra for providing richer mixes at all floor levels.				
	Note:- Excess/less cement over the specified cement content used is payable /recoverable separately.				
a	Providing M-30 grade concrete instead of M-25 grade BMC/RMC. (Note:- Cement content considered in M-30 is @ 340 kg/cum).	3345	cum	69.5	232478
3.8	Add (or deduct) for using extra (or less) cement in the items of design mix over and above the specified cement content therein.	3149	quintal	672.75	2118490
3.9	Extra for R.C.C./ B.M.C/ R.M.C. work above floor V level for each four floors or part thereof.	12460	cum	232.3	2894458
3.10	Providing and fixing parallel threaded couplers conforming to IS code on "Reinforcement Couplers for Mechanical Splices of Bars for Concrete Reinforcement - Specification", to reinforcement bars including threading, enlargement at connection by forging, protecting the prepared reinforcement bars and related operations as required to complete the works per direction of Engineer-in-Charge.				
a	Coupler for 20 mm diameter reinforcement bar	12396	each	164.65	2041001
b	Coupler for 25 mm diameter reinforcement bar	7952	each	227.95	1812658
c	Coupler for 32 mm diameter reinforcement bar	2425	each	364.85	884761

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

3.11	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 centering 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-centering arrangement that freely rotates / moves in all directions. The Self – centering arrangement shall exhibit circular sphere ends that lock and slide inside the corresponding aluminum 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 manufacturer's design and as approved by Engineer -in- Charge . (Material shall confirm to ASTM 6063.)				
	Floor Joint of 200 mm gap	540	metre	7499.6	4049784
3.12	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 aluminum base members, self aligning / centering 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 light weight aluminum profiles exhibiting minimal exposed aluminum surfaces mechanically snap locking the multicellular to facilitate movement. (Material shall confirm to ASTM 6063.)				
	Wall Joint of 150 mm gap	225	metre	4436.15	998134

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

3.13	Providing and fixing of expansion joint system of approved make and manufactures for various roof locations as per approved drawings and direction of Engineer-In-Charge. The joints shall be of extruded aluminum base members with, self aligning and self centering arrangement support plates as per ASTM B221-02. The system shall be such that it provides watertight roof to roof/roof to corner joint cover expansion control system that is capable of accommodating multidirectional seismic movement without stress to its components. System shall consist of metal profile that incorporates a universal aluminum base member designed to accommodate various project conditions and roof treatments. The cover plate shall be designed of width and thickness required to satisfy movement and loading requirements and secured to base members by utilizing manufacturer's pre-engineered self-centering arrangement that freely rotates / moves in all directions. The Self centering arrangement shall exhibit circular sphere ends that lock and slide inside the corresponding aluminum extrusion cavity to allow freedom of movement and flexure in all directions including vertical displacement. The Joint System shall resist damage or deterioration from the impact of falling ice, exposure to UV, airborne contaminants and occasional foot traffic from maintenance personnel. Provision of Moisture Barrier Membrane in the Joint System to have water tight joint is mandatory requirement. Material shall conform to ASTM 6063.				
	Roof Joint of 200 mm gap	60	metre	5873.5	352410
3.14	Core cutting in R.C.C. slab/beams of required size by core cutting machine to insert upto 200 mm dia pipes including finishing complete so as to make it leak proof after insertion of pipes as per direction of Engineer-in-charge.	1432	each	758.95	1086816
	Sub- Head IV - Brick Work				
4.1	Brick work with common burnt clay F.P.S. (non modular) bricks of class designation 7.5 in foundation and plinth in:				
	Cement mortar 1:6 (1 Cement : 6 coarse sand)	236	cum	4751.65	1121389
4.2	Brick work with common burnt fly ash bricks in super structure above plinth level up to floor V level in :				
	Cement mortar 1:6 (1 Cement : 6 coarse sand)	3047	cum	5582.85	17010944
4.3	Extra for brick work / AAC block masonry / Tile brick masonry in superstructure above floor V level for each four floors or part thereof by mechanical means.	8000	cum	205.45	1643600

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

4.4	Half brick masonry with common burnt clay F.P.S. (non modular) bricks of class designation 7.5 in foundation and plinth in.				
	Cement mortar 1:4 (1 cement : 4 coarse sand)	205	sqm	593.5	121668
4.5	Half brick masonry with common burnt clay F.P.S. (non modular) bricks of class designation 7.5 in superstructure above plinth level up to floor V level.				
	Cement mortar 1:4 (1 cement : 4 coarse sand)	17800	sqm	684.2	12178760
4.6	Extra for half brick masonry in superstructure, above floor V level for every four floors or part thereof by mechanical means.	11850	sqm	18.2	215670
4.7	Extra for providing and placing in position 2 Nos. 6 mm dia. M.S. bars at every third course of half brick masonry.	18005	sqm	56.85	1023584
4.8	Brick edging 7cm wide 11.4cm. deep to plinth protection with common burnt clay F.P.S. (non modular) bricks of class designation 7.5 including grouting with cement mortar 1:4 (1 cement : 4 coarse sand).	794	metre	39.2	31125
4.9	Providing and laying autoclaved aerated cement blocks masonry with 150mm/230mm/300 mm thick AAC blocks in super structure above plinth level up to floor V level with RRC band at sill level and lintel level with approved block laying polymer modified adhesive mortar all complete as per direction of Engineer-in-Charge. (The payment of RCC band and reinforcement shall be made for seperately).	8400	cum	5687.1	47771640
4.10	Providing and fixing upto plinth level, factory made precast CBC Brick substitute 230x110x70mm(M7.5) made of C&D waste from approved manufacturer, including hoisting and setting in position with cement mortar 1:6 (1 cement:6coarse sand) etc complete , as approved by Engineer-in-charge.	740	cum	6450.2	4773148
4.11	Providing and fixing in superstructure above plinth and upto floor V level,factory made precast CBC Brick substitute 230x110x70mm(M7.5) made of C&D waste from approved manufacturer, including hoisting and setting in position with cement mortar 1:6 (1 cement:6coarse sand) etc complete , as approved by Engineer-in-charge.(a)Cement mortar 1:6 (1 cement : 6 coarse sand)	2938	cum	7860.85	23095177
	Sub Head - V Stone Work				
5.1	Providing and fixing dry cladding upto 10 metre heights with 30 mm thick gang saw cut stone with (machine cut edges) of uniform colour and size upto 1mx1m, fixed to structural steel frame work and/ or with the help of cramps, pins etc. and sealing the joints with approved weather sealant as per Architectural drawing and				

No. of Correction –C NIL
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	direction of Engineer-in-charge.(The steel frame work, stainless steel cramps and pins etc. shall be paid for separately).				
a	Red sand stone	2582	sqm	1439.75	3717435
b	White sand stone	23238	sqm	1500.7	34873267
5.2	Providing and fixing structural steel frame (for dry cladding with 30 mm thick gang saw cut with machine cut edges sand stone) on walls at all heights using M.S. square/ rectangular tube in the required pattern as per architectural drawing, including cost of cutting, bending, welding etc. The frame work shall be fixed to the wall with the help of M.S. brackets/ lugs of angle iron/ flats etc. which shall be welded to the frame and embedded in brick wall with cement concrete block 1:2:4 (1 cement :2 coarse sand :4graded stone aggregate 20 mm nominal size) of size 300x230x300 mm, including cost of necessary centring and shuttering and with approved expansion hold fasteners on CC/RCC surface, including drilling necessary holes. Approved cramps/ pins etc. shall be welded to the frame work to support stone cladding, the steel work will be given a priming coat of Zinc primer as approved by Engineerin-charge and painted with two or more coats of epoxy paint (Shop drawings shall be submitted by the contractor to the Engineer-in-charge for approval before execution). The frame work shall be fixed in true horizontal & vertical lines /planes. (Only structural steel frame work shall be measured for the purpose of payment, stainless steel cramps shall be paid for separately and nothing extra shall be paid).	25820 0	kg	134.75	34792450
5.3	Providing and fixing adjustable stainless steel cramps of approved quality, required shape and size, adjustable with stainless steel nuts, bolts and washer (total weight not less than 260 gms), for dry stone cladding fixed on frame work at suitable location, including making necessary recesses in stone slab, drilling required holes etc complete as per direction of the Engineer-in-charge.	41570	each	217.15	9026926
5.4	Extra for stone work for wall lining on exterior walls of height more than 10 m from ground level for every additional height of 3 m or part thereof.	18388	sqm	85.9	1579529
5.5	Providing and fixing copper pins 7.5 cm long 6 mm diameter for securing adjacent stones in stone wall lining in cement mortar 1:2 (1 cement : 2 coarse sand) including making the necessary chases.	9200	each	29.8	274160

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5.6	Stone work, plain in copings, cornices, string courses and plinth courses, upto 75 mm thick in Cement mortar 1:6 (1 cement : 6 coarse sand) including pointing with white cement mortar 1:2 (1 white cement : 2 stone dust) with an admixture of pigment matching the stone shade.				
	White sand stone	27	cum	41803.55	1128696
5.7	Providing and fixing cramps of required size & shape in RCC/ CC / Brick masonry backing with cement mortar 1:2 (1 cement :2 coarse sand) including drilling necessary hole in stones and embedding the cramp in the hole (fastener to be paid separately).				
	Stainless steel cramps.	2024	kg	521.1	1054706
5.8	Providing and fixing expansion hold fasteners on C.C. /R.C.C./Brick masonry surface backing including drilling necessary holes and the cost of bolt etc complete.				
	Wedge expansion type				
	Fastener with threaded dia 10 mm.	9200	each	25.55	235060
	Sub Head - VI Marble Work				
6.1	Providing and fixing 18mm thick gang saw cut mirror polished premoulded and prepolished) for wall lining (veneer work), /bands 200mm wide backing filled with a grout of average 12 mm thick in cement mortar 1:3 (1 cement : 3 coarse sand) including pointing with white cement mortar 1:2 (1 white cement : 2 marble dust) with an admixture of pigment to match the marble shade: (To be secured to the backing by means of cramps, which shall be paid for separately).				
	Granite of any colour and shade				
a	Area of slab upto 0.50 sqm.	2300	sqm	6356.55	14620065
6.2	Providing and fixing 18mm thick gang saw cut mirror polished premoulded and prepolished) machine cut for kitchen platforms, vanity counters, window sills , facias and similar locations of required size of approved shade, colour and texture laid over 20mm thick base cement mortar 1:4 (1 cement : 4 coarse sand) with joints treated with white cement, mixed with matching pigment, epoxy touch ups, including rubbing, curing, moulding and polishing to edges to give high gloss finish etc. complete at all levels.				
a	Granite of any colour and shade				
	Area of slab over 0.50 sqm.	1236	sqm	3351.95	4143010

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6.3	Extra for fixing marble /granite stone over and above corresponding basic item, in facia and drops of width upto 150 mm with epoxy resin based adhesive including cleaning etc. complete.	450	metre	266.25	119813
6.4	Extra for providing opening of required size & shape for wash basins/ kitchen sink in kitchen platform, vanity counters and similar location in marble/Granite/stone work including necessary holes for pillar taps etc. including moulding, rubbing and polishing of cut edges etc. complete.	475	each	427.95	203276
6.5	Mirror polishing on kota /marble stone/ granite work/stone work where ever required to give high gloss finish complete.	26200	sqm	231.5	6065300
6.6	Providing and fixing stone slab table rubbed, edges rounded and polished of size 75x50 cm deep and 1.8 cm thick fixed in urinal partitions by cutting a chase of appropriate width with chase cutter and embedding the stone in the chase with epoxy grout or with cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 6 mm nominal size) as per direction of Engineer-in-charge and finished smooth.				
	Granite Stone of approved shade.	110	sqm	2831.95	311515
	Sub- Head - VII Wood Work & PVC Work				
7.1	Providing wood work in frames of false ceiling, partitions etc. sawn and fixed in position :				
	Kiln seasoned and chemically treated hollock wood	20	cum	49465.1	989302
7.2	Providing and fixing ISI marked flush door shutters conforming to IS : 2202 (Part I) non-decorative type, core of block board construction with frame of 1st class hard wood and well matched commercial 3 ply veneering with vertical grains or cross bands and face veneers on both faces of shutters:				
	35 mm thick including ISI marked Stainless Steel butt hinges with necessary screws.	4961	sqm	1559.75	7737920
7.3	Extra for providing lipping with 2nd class teak wood battens 25 mm minimum depth on all edges of flush door shutters (over all area of door shutter to be measured).	4961	sqm	365.85	1814982
7.4	Extra for providing vision panel not exceeding 0.1 sqm in all type of flush doors (cost of glass excluded) (overall area of door shutter to be measured) :				
	Rectangular or square.	3360	sqm	162.6	546336
7.5	Extra for cutting rebate in flush door shutters (Total area of the shutter to be measured).	3367	sqm	127.75	430134

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7.6	Providing and fixing aluminium extruded section body tubular type universal hydraulic door closer (having brand logo with ISI, IS : 3564, embossed on the body, door weight upto 36 kg to 80 kg and door width from 701 mm to 1000 mm) with double speed adjustment with necessary accessories and screws etc. complete.	2320	each	388.4	901088
7.7	Providing and fixing 250x16mm Stainless steel (Grade 316) satin finish sliding door bolts superior quality with necessary SS screws etc. complete:Heavy Duty (Make - kich or equivalent).	1814	each	1264.7	2294166
7.8	Providing and fixing stainless steel tower bolts with necessary accessories and SS screws etc. complete.				
a	300 x10 mm	2726	each	506.05	1379492
b	150 x 10 mm	1825	each	254.7	464828
7.9	Providing and fixing 25mm dia , 300 mm long in cranked / square shape stainless steel (Grade 316) satin finish pull handle with necessary screws etc. complete (Make - kich or equivalent).	3642	each	1064.35	3876363
7.10	Providing and fixing aluminium hanging floor door stopper, ISI marked, anodised (anodic coating not less than grade AC 10 as per IS : 1868) transparent or dyed to required colour and shade, with necessary screws etc. complete.				
	Twin rubber stopper	2726	each	38	103588
7.11	Providing and fixing M.S. grills of required pattern in frames of windows etc. with M.S. flats, square or round bars etc. including priming coat with approved steel primer all complete.				
	Fixed to openings /wooden frames with rawl plugs screws etc.	3152	kg	112.45	354442
7.12	Providing & Fixing decorative high pressure laminated sheet of plain /wood grain in gloss / matt / suede finish with high density protective surfacelayer and reverse side of adhesive bonding quality conforming to IS :2046 Type S, including cost of adhesive of approved quality.				
	1.0 mm thick	9772	sqm	518	5061896

No. of Correction –C NIL
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7.13	Providing and fixing factory made uPVC white colour casement/ casemnt cum fixed glazed windows comprising of uPVC multichambered frame, sash and mullion (where ever required)extruded profile duly reinforced with 1.60 ± 0.2 mm thick galvanized mild steel section made froN.S.oll forming process of required lenth (shape & size according to uPVC profile), Upvc extruded glazing beads of appropriate dimension, EPDM gasket, stainless steel (ss304 grade) friction hinges, zinc alloy (white power coated) casement handles, G.I fasters 100 *8 mm size for fixing frame to finished wall, plastic packers, plastic caps and necessary stainless steel screws etc. profile of frame & sash shall be mitred cvut and fusion welded at all corners. mullion (if required) shall be also fusion welded including drilling of holes for fixing hardware's and drainage of water etc. After fixing frame the gap between frame and adjacent finished wall shall be filled with weather proof silicon sealant over backer rod of required size and of approved quality, all complete as per approved drawing & direction of Engineer-in Charge. (Single/double glass panes and silicon sealant shall be paid separately)				
	Note: For uPVC frame , sash and mullion extruded profiles minus 5% tolerance in dimension i.e. in depth & width of profile shall be acceable				
	Casement cum fixed panel window having both end single casement panel, middle fixed panels and at top completely fixed ventilator with S.S friction hinges (350 x 19 x 1.9) made of (big series) frame 67 x 60 mm, sash 67 x 80 mm , & mullion 67 x 80 mm all having wall thickness of 2.3 ± 0.2 mm and single glazing bead/ double glazing bead of appropriate dimension . (Area of window above 3.00 sqm upto 5.00 sqm).	690	sqm	6270.45	4326611

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No. of Insertions –I NIL

7.14	Providing and fixing factory made uPVC white colour fixed glazed windows/ventilators comprising of uPVC multi-chambered frame and mullion (where ever require) extruded profiles duly reinforced with 1.60 ± 0.2 mm thick galvanized mild steel section made from roll forming process of required glazing beads of appropriate dimension, EPDM gasket, G.I fasteners 100 * 8 mm size for fixing frame to finished wall, plastic caps and necessary stainless steel screws etc. Profile of frame shall be mitred cut and fusion welded at all corners, mullion (if required) shall be also fusion welded including drilling of holes for fixing hardware's and drainage of water etc. After fixing frame the gap between frame and adjacent finished wall shall be filled with weather proof silicon sealant over backer rod of required size and of approved quality, all complete as per approved drawing & direction of Engineer-in-Charge. (Single / double glass panes and silicon sealant shall be paid separately).				
	Note: For uPVC frame, sash and mullion extruded profiles minus 5% tolerance in dimension i.e. in depth & width of profile shall be acceptable.				
	Fixed window / ventilator made of (small series) frame 47 x 50 mm & mullion 47 x 68 mm both having wall thickness of 1.9 ± 0.2 mm and single glazing bead of appropriate dimension. (Area upto 0.75 sqm.)	490	sqm	5399.7	2645853
7.15	Providing and fixing factory made uPVC white colour sliding glazed window upto 1.50 m in height dimension comprising of uPVC multi-chambered frame with in-built roller track and sash extruded profiles duly reinforced with 1.60 ± 0.2 mm thick galvanized mild steel section made from roll forming process of required length (shape & size according to uPVC profile), appropriate dimension of uPVC extruded glazing beads and uPVC extruded interlocks, EPDM gasket, wool pile, zinc alloy (white powder coated) touch locks with hook, zinc alloy body with single nylon rollers (weight bearing capacity to be 40 kg), G.I fasteners 100 x 8 mm size for fixing frame to finished wall and necessary stainless steel screws etc. Profile of frame & sash shall be mitred cut and fusion welded at all corners, including drilling of holes for fixing hardware's and drainage of water etc. After fixing frame the gap between frame and adjacent finished wall shall be filled with weather proof silicon sealant over backer rod of required size and of approved quality, all complete as per approved drawing & direction of Engineer-in-Charge. (Single / double glass panes, wire mesh and silicon sealant shall be paid separately)				

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	Note: For uPVC frame and sash extruded profiles minus 5% tolerance in dimension i.e. in depth & width of profile shall be acceptable.				
a	Three track three panels sliding window with fly proof SS wire mesh (Two nos. glazed & one no. wire mesh panels) made of (small series) frame 92 *44 mm & sash 32 * 60 mm both having wall thickness of 1.9 ± 0.2 mm and single glazing bead of appropriate dimension (Area of window upto 1.75 sqm).	360	sqm	7494.7	2698092
b	Three track three panels sliding window with fly proof SS wire mesh (Two nos. glazed & one no. wire mesh panels) made of (big series) frame 116 *45 mm & sash 46 * 62 mm both having wall thickness of 2.3 ± 0.2 mm and single glazing bead / double glazing bead of appropriate dimension (Area of window upto 1.75 sqm).	3650	sqm	7261.2	26503380
7.16	Providing and fixing fire resistant door frame of section 50*60 mm on horizontal side & 35* 60 mm on vertical sides having built in rebate made out of 1.6 mm thick GI sheet (Zinc coating not less than 120gm/m ²) suitable for mounting 120 min Fire Rated Glazed Door Shutters. The frame shall be filled with Mineral wool Insulation having density min 96kg/m ³ . The frame will have a provision of G.I. Anchor fastners 14 nos (5 each on vertical style & 4 on horizontal style of size M10*80) suitable for fixing in the opening along with Factory made Template for SS Ball Bearing Hinges of Size 100*89*3mm for fixing of fire rated glazed shutter. The frame shall be finished with a approved fire resistant primer or Powder coating of not less than 30 micron in desired shade as per the directions of Engineer - in -charge. (Cost of SS ball bearing hinges is excluded).	4366	metre	1260	5501160
7.17	Providing and fixing 60 mm thick glazed fire resistant door shutters of 120 min Fire Rating confirming to IS:3614 (Part II) or EN1634-1:1999, tested and certified as per laboratory approved by Engineer-in-charge, with suitable mounting on door frame, consisting of vertical styles, top rail & side rail 60 mm x 60 mm wide and bottom rail of 110 mm x 60 mm made out of 1.6mm thick G.I. sheet (zinc coating not less than 120gm/m ²) duly filled mineral wool insulation having density min 96 kg/m ³ and fixing with necessary stainless steel ball bearing hinges of size 100*89*3mm of approved make, including applying a coat of approved fire resistant primer or powder coating not less than 30 micron etc all complete as per direction of Engineer-in-charge (panelling to be paid for separately).	2526	sqm	6839.35	17276198

No. of Correction –C NIL
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7.18	Providing and fixing glazing in fire resistant door shutters, fixed panels & partitions etc., with G.I. beading made out of 1.6 mm thick G.I. sheet (zinc coating not less than 120 gm/m ²) of size 20 x 33 mm screwed with M4 x 38 mm SS screws at distance 75 mm from the edges and 150 mm c/c, including applying a coat of approved fire resistant primer/powder coating of not less than 30 micron on G.I. beading, & special ceramic tape of 5 X20 mm size etc complete in all respect as per direction of Engineer-in-charge. The glass shall be clear, toughened, interlayered, non-wired fire resistant having 11 mm thickness of approved brand with 120 minutes of fire resistance both integrity & radiation control (EW120) and minimum 15 min of insulation (EI15) and having a sound reduction of 37 dB and LT of 86%. Glass shall be compliant to class 2 (B) 2 category of Impact Resistance as per EN 12600. The glass should be manufactured in UL & TUV audited Facility and including UL-EU Certification. The maximum glazing size cannot be more than 1100 mm x 2200 mm (w x h) or 2.42 sq mts in total area. The test report for the complete system (Glazed Door or Partition) will be considered valid only if it contains the stamp and signature of the authorized signatory from the glass manufacturer. (Actual glass size is be measured at site for payments).	2526	sqm	34058.9	86032781
7.19	PANIC BAR: Providing & fixing of stainless steel 304 grade fire rated touch type Panic Bar tested in accordance with –CE/UL, European Standards, Certification Standard EN1125, S.S finish having 5 years mechanical warranty. The Panic Bar should have been tested along with the fire rated door from CBRI Roorkee for 2 hrs. fire rating.				
	For Double Leaf shutters	778	each	6143.3	4779487
7.20	Providing and fixing ISI marked oxidised M.S. sliding door bolts with nuts and screws etc. complete :				
	250x16 mm	102	each	142.05	14489
7.21	Providing and fixing ISI marked oxidised M.S. tower bolt black finish, (Barrel type) with necessary screws etc. complete :				
	250x10 mm	204	each	64	13056
7.22	Providing and fixing ISI marked oxidised M.S. handles conforming to IS:4992 with necessary screws etc. complete :				
	125 mm	204	each	28.6	5834

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7.23	Providing and fixing partition upto ceiling height consisting of G.I. frame and required board, including providing and fixing of frame work made of special section power pressed/ roll form G.I. sheet with zinc coating of 120gms/sqm (both side inclusive), consisting of floor and ceiling channel 50mm wide having equal flanges of 32 mm and 0.50 mm thick, fixed to the floor and ceiling at the spacing of 610 mm centre to centre with dash fastener of 12.5 mm diameter 50 mm length or suitable anchor fastener or metal screws with nylon plugs and the studs 48 mm wide having one flange of 34mm and other flange 36 mm and 0.50 mm thick fixed vertically within flanges of floor and ceiling channel and placed at a spacing of 610 mm centre to centre by 6 mm dia bolts and nuts, including fixing of studs along both ends of partition fixed flush to wall with suitable anchor fastener or metal screws with nylon plugs at spacing of 450 mm centre to centre, and fixing of boards to both side of frame work by 25 mm long dry wall screws on studs, floor and ceiling channels at the spacing of 300 mm centre to centre.				
	The boards are to be fixed to the frame work with joints staggered to avoid through cracks, M.S. fixing channel of 99 mm width (0.9 mm thick having two flanges of 9.5 mm each) to be provided at the horizontal joints of two boards, fixed to the studs using metal to metal flat head screws, including jointing and finishing to a flush finish with recommended jointing compound, jointing tape, angle beads at corners (25 mm x 25 mm x 0.5 mm), joint finisher and two coats of primer suitable for board as per manufacture's specification and direction of engineer in charge all complete.				
	66mm overall thickness partition using 8mm thick double skin non-asbestos multipurpose cement board reinforced with cellulose fibre manufactured through autoclaving process (High pressure steam cured) as per IS : 14862 with suitable fibre cement screws	757	sqm	1228.35	929861
7.24	Providing and fixing glazing in aluminium door, window, ventilator shutters and partitions etc. with EPDM rubber / neoprene gasket etc. complete as per the architectural drawings and the directions of engineer-in-charge. (Cost of aluminium snap beading shall be paid in basic item):				
	With float glass panes of 8 mm thickness	600	sqm	1153.9	692340
	Sub- Head - VIII , Steel Work				

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

8.1	Providing and fixing 1mm thick M.S. sheet door with frame of 40x40x6mm angle iron and 3mm M.S. gusset plates at the junctions and corners, all necessary fittings complete, including applying a priming coat of approved steel primer.				
	Using M.S. angles 40x40x6 mm for diagonal braces.	161	sqm	2870.25	462110
8.2	Supplying and fixing rolling shutters of approved make, made of required size M.S. laths, interlocked together through their entire length and jointed together at the end by end locks, mounted on specially designed pipe shaft with brackets, side guides and arrangements for inside and outside locking with push and pull operation complete, including the cost of providing and fixing necessary 27.5 cm long wire springs manufactured from high tensile steel wire of adequate strength conforming to IS: 4454 – part 1 and M.S. top cover of required thickness for rolling shutters.				
	80x1.20 mm M.S. laths with 1.20 mm thick top cover.	36	sqm	1841.4	66290
8.3	Providing and fixing ball bearing for rolling shutters	8	each	379.3	3034
8.4	Providing and fixing T-iron frames for doors, windows and ventilators of mild steel Tee-sections, joints mitred and welded, including fixing of necessary butt hinges and screws and applying a priming coat of approved steel primer.				
	Fixing with 15x3 mm lugs 10 cm. long embedded in cement concrete block 15x10x10 cm of C.C. 1:3:6 (1 Cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size).	2300	kg	74.05	170315
8.5	Steel work in built up tubular (round, square or rectangular hollow tubes etc.) railing etc. including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer, including welding and bolted with special shaped washers etc. complete.				
	Electric resistance or induction butt welded tubes.	98956.4	kg	112.2	11102908
8.6	Providing and fixing M.S. fan clamp type I or II of 16 mm dia M.S. bar, bent to shape with hooked ends in R.C.C. slabs or beams during laying, including painting the exposed portion of loop, all as per standard design complete.	4048.539	each	112.15	454044

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8.7	Providing and fixing circular / Hexagonal cast iron or M.S sheet box for ceiling fan clamp of internal dia 140mm, 73mm height, top lid of 1.5mm thick M.S. sheet with its top surface hacked for proper bonding, top lid shall be screwed into the cast iron/ M.S sheet box by means of 3.3 mm dia. round headed screws, one lock at the corners. Clamp shall be made of 12 mm dia M.S bar bent to shape as per standard drawing.	4048.539	each	130.1	526715
8.8	Steel work welded in built up sections/ framed work including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer using structural steel etc. as required.				
	In gratings, frames, guard bar, ladder, railings, brackets, gates and similar works.	42037	kg	85.95	3613080
8.9	Providing and Fixing of sky lights consisting of Multi cell/tight cell Polycarbonate Panel System of approved uniform colour, 16mm thick (minimum) having uniform in color with an integral Tight-Cells not to exceed 4mm x 4mm, Vertical Standing Seam manufactured at both sides of the panel. Snap-on connector to interlock the panels shall have a grip-lock double tooth locking mechanism to ensure maximum uplift capability & shall be of same color as that of panel. Panel shall be factory sealed/end welded panels with additional End- cap / Aluminium U-Profile (mill finish) for ends. Panel shall be co-extruded with special anti glare compound and both side UV protected. The full system shall be secured using T - fastners having minimum three points for fastening with self drilling on MS purlins perpendicular to direction of sheeting with purlin spacing as specified by Manufacturer.				
	The rate includes cost of all the operations, labour & all materials and tests (as applicable) involved such as bolts nuts and screws etc. and labour for cutting bending to required profile, necessary scaffolding, hoisting in position etc. for proper completion of the work etc. complete as per specification drawings and direction of Engineer in charge . Finished surface area of roofing fixed over steel tubular structure shall be measured for payment. MS tabular frame work shall be measured seperately for payment)	1165	sqm	3377.95	3935312

No. of Correction –C NIL
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8.10	Providing and fixing carbon steel galvanised (minimum coating 5 micron) dash fastener of 10 mm dia double threaded 6.8 grade (yield strength 480 N/mm ²), counter sunk head, comprising of 10 mm dia polyamide PA 6 grade sleeve, including drilling of hole in frame , concrete/ masonry, etc. as per direction of Engineer-in-charge.				
	10 x80 mm	24702	each	74.75	1846475
8.11	Providing and fixing stainless steel (Grade 304) railing made of Hollow tubes, channels, plates etc. including welding, grinding, buffing, polishing and making curvature (wherever required) and fitting the same with necessary stainless steel nuts and bolts complete i/c fixing the railing with necessary accessories & stainless steel dash fasteners , stainless steel bolts etc., of required size, on the top of the floor or the side of waist slab with suitable arrangement as per approval of Engineer-in-charge. (for payment purpose only weight of stainless steel members shall be considered excluding fixing accessories such as nuts, bolts, fasteners etc.)	39186	kg	472.4	18511466
8.12	Providing and fixing G.I. chain link fabric fencing of required width in mesh size 50x50mm including strengthening with 2mm dia wire or nuts, bolts and washers as required complete as per the direction of Engineer-in-charge.				
	Made of G.I. wire of dia 4mm.	46	sqm	561.7	25838
	Sub- Head - IX Flooring				
9.1	Cement concrete flooring 1:2:4 (1 cement : 1 coarse sand : 1 M sand : 4 graded stone aggregate) finished with a floating coat of neat cement, including cement slurry, but excluding the cost of nosing of steps etc. complete.				
	40 mm thick with 20 mm nominal size stone aggregate	5370	sqm	362.6	1947162
9.2	62 mm thick cement concrete flooring with concrete hardener topping, under layer 50 mm thick cement concrete 1:2:4 (1 cement : 1 coarse sand : 1 M sand : 4 graded stone aggregate 20mm nominal size) and top layer 12mm thick cement hardener consisting of mix 1:2 (1 cement hardener mix : 2 graded stone aggregate, 6mm nominal size) by volume, hardening compound mixed @ 2 litre per 50kg of cement or as per manufactures specifications. This includes cost of cement slurry, but excluding the cost of nosing of steps etc. complete.	312	sqm	609.05	190024
9.3	Providing and fixing glass strips in joints of terrazo/ cement concrete floors.				

No. of Correction –C NIL
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	40 mm wide and 4 mm thick	9666	metre	52.5	507465
9.4	Marble stone flooring with 18 mm thick marble stone, as per sample of marble approved by Engineer-in-charge, over 20 mm (average) thick base of cement mortar 1:4 (1 cement : 4 coarse sand) laid and jointed with grey cement slurry, including rubbing and polishing complete with :				
a	Agaria White	5185	sqm	2190.5	11357743
b	Udaipur green marble	5185	sqm	1589.4	8241039
9.5	Kota stone slab of size 1.2mx0.6m flooring over 20mm (average) thick base laid over and jointed with grey cement slurry mixed with pigment to match the shade of the slab including rubbing and polishing complete with base of cement mortar 1 : 4 (1 cement : 4 coarse sand):				
	25 mm thick & of size 1.2m x0.6m	34607	sqm	1158.1	40078367
9.6	Kota stone slabs 20 mm thick in risers of steps, skirting, dado and pillars laid on 12 mm (average) thick cement mortar 1: 3 (1 cement : 3 coarse sand) and jointed with grey cement slurry mixed with pigment to match the shade of the slabs, including rubbing and polishing complete.	5192	sqm	1238.2	6428734
9.7	Extra for pre finished nosing in treads of steps of granite stone	7476	metre	306.25	2289525
9.8	Extra for Granite stone in treads of steps and risers using single length up to 2.0 metre .	3364	sqm	357.95	1204144
9.9	Providing and fixing 1st quality ceramic glazed wall tiles (rectified edges , 300x200mm size) conforming to IS : 15622 (thickness to be specified by the manufacturer) of approved make in all colours, shades except burgundy, bottle green, black of any size as approved by Engineer-in-Charge, in skirting, risers of steps and dados over 12 mm thick bed of cement Mortar 1:3 (1 cement : 3 coarse sand) and jointing with grey cement slurry @ 3.3kg per sqm including pointing in white cement mixed with pigment of matching shade complete.	10877	sqm	744.8	8101190
9.10	Providing and laying Ceramic glazed floor tiles of size 300x300 mm (thickness to be specified by the manufacturer) of 1st quality conforming to IS : 15622 of approved make in colours such as White, Ivory, Grey,Fume Red Brown, laid on 20 mm thick cement mortar 1:4 (1 Cement : 4Coarse sand), including pointing the joints with white cement and matching pigment etc, complete.	3659	sqm	688.35	2518673

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

9.11	Providing and laying gang saw cut 18 mm thick, mirror polished pre moulded and pre polished machine cut granite stone of required size and shape of approved shade, colour and texture in footpath, flooring in road side plazas and similar locations, laid over 20mm thick base of cement mortar 1:4 (1cement : 4 coarse sand) including grouting the joints with white cement mixed with matching pigment, epoxy touch ups etc. complete as per direction of Engineer-in-Charge. With granite stone of area less than 0.50 sqm.	18507	sqm	3034.7	56163193
9.12	Providing and laying gangsaw cut 18 mm thick mirror polished prepolished machine cut granite stone of required size and shape of approved shade, colour and texture in risers of steps, skirting, dado and pillars laid on 12 mm (average) thick cement mortar 1: 3 (1 cement : 3 coarse sand) and jointed with grey cement slurry mixed with pigment to match the shade of the slabs, including rubbing and polishing complete.	1850	sqm	4135.8	7651230
9.13	Providing and laying flamed finish Granite stone flooring in required design and patterns, in linear as well as curvilinear portions of the building all complete as per the architectural drawings with 18 mm thick stone slab over 20 mm (average) thick base of cement mortar 1:4 (1 cement : 4 coarse sand) laid and jointed with cement slurry and pointing with white cement slurry admixed with pigment of matching shade including rubbing, curing and polishing etc. all complete as specified and as directed by the Engineer-in-Charge :				
	Flamed finish granite stone slab Jet Black, Cherry Red, Elite Brown, Cat Eye or equivalent.	934	sqm	2887.85	2697252
9.14	Providing and fixing removable raised/ false access flooring with system and its components of approved make for different plenum height with possible height adjustment upto 50 mm, comprising of modular load bearing floor panels supported on G.I. rectangular stinger frame work and G.I. Pedestal etc. all complete, as per the architectural drawings, as specified and as directed by Engineer-in-charge consisting of :				
	a) Providing at required spacing to form modular framework, pedestals made out of GI tube of thickness minimum 2 mm and 25 mm outer diameter, fully welded on to the G.I. Base plate of size 100mm x100mmx3mm at the bottom of the pedestal tube, G.I. pedestal head of size 75mmx75mmx3.5 mm welded with GI fully threaded stud 16mm outer diameter with two GI Check nuts screwed on the stud for level adjustment upto 50mm, locking and stabilizing the pedestal head in position at the required				

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	level. The pedestals shall be fixed to the subfloor (base) through base plate using epoxy based adhesive of approved make or the machine screw with rawl plug.				
	b) Stringers system in all steel construction hot dipped galvanized of rectangular size 570x20x30x0.80mm thick having holes at both ends for securing the stringers on to the pedestal head using fully threaded screws ensuring maximum lateral stability in all directions, the grid formed by the pedestal and stringer assembly shall receive the floor panel, this system shall provide adequate solid, rigid support for access floor panel, the system shall provide a minimum clear uninterrupted clearance between the bottom of the floor for electrical conduits and wiring etc. all complete as per the architectural drawings, as specified and as directed by the Engineer-in-charge.				
	c) Providing and fixing Access Floor panel of 600x600x32 mm medium grade Filled Steel anti static high pressure Lamination of 800H grade (FS800H). Access Floor panel shall be steel welded construction with an enclosed bottom pan with uniform pattern of 64 hemispherical cones. The top and bottom plates of Steel Gauges: top 0.6 mm and bottom 0.7 mm fused spot welded together (minimum 64 welds in each dome and 20 welds along each flange). The panel should be Corroresist epoxy coated for lifetime rust protection and cavity formed by the top and bottom plate is filled with Pyrogrip noncombustible Portland cementitious core mixed with lightweight foaming compound. The access floor shall be factory finished with Anti-static High Pressure laminate with Non Warp technology upto 1mm thickness for superior adhesion and Surface flatness within 0.75mm. The panel is to withstand a Concentrated Load of 363 kgs applied on area 25mm x 25mm without collapse in the centre of the panel which is placed on four steel blocks.				
	The panel will withstand and Uniformly Distributed Load (UDL) minimum 1250 kg/sqm and an impact load of 50kg all complete as per the approved manufacturers specification and as per the direction of Engineer-in-charge. All specification must be printed on the side of the panel to ensure the quality of the product.				
	450 mm Finished Floor Height (FFH).	1575	sqm	4275.4	6733755
9.15	Extra for making edge chamfered of kota stone skirting as per drawing	34566	metre	50	1728300
	Sub- Head - X Roofing				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

10.1	Making khurras 45 x 45 cm with average minimum thickness of 5 cm cement concrete 1:2:4 (1 cement: 2 coarse sand : 4 graded stone aggregate of 20 mm nominal size) over P.V.C. sheet 1mx1mx400 micron, finished with 12 mm cement plaster 1:3 (1 cement : 3 coarse sand) and a coat of neat cement rounding the edges and making and finishing the outlet complete.	53.32 517	each	187.6	10004
10.2	Providing and fixing on wall face unplasticised Rigid PVC rain water pipes conforming to IS : 13592 Type A including jointing with seal ring conforming to IS : 5382 leaving 10 mm gap for thermal expansion.(i) Single socketed pipes.				
	110 mm diameter	1978	metre	236.35	467500
10.3	Providing and fixing on wall face unplasticised - PVC moulded fittings/ accessories for unplasticised Rigid PVC rain water pipes conforming to IS : 13592 Type A including jointing with seal ring conforming to IS : 5382 leaving 10 mm gap for thermal expansion.				
a	Bend 87.5°				
	110 mm bend	72	each	113.1	8143
b	Shoe				
	110 mm shoe	72	each	98	7056
10.4	Providing and fixing unplasticised -PVC pipe clips of approved design to unplasticised - PVC rain water pipes by means of 50x50x50mm hard wood plugs, screwed with M.S. screws of required length including cutting brick work and fixing in cement mortar 1:4 (1 cement : 4 coarse sand) and making good the wall etc. complete.				
	110 mm	1628	each	181.4	295319
10.5	Providing and fixing to the inlet mouth of rain water pipes cast iron grating 15 cm diameter and weighing not less than 440 grams.	72	each	40.9	2945
10.6	Providing and fixing GI Clip in Metal Ceiling System of 600x600 mm module which includes providing and fixing 'C' wall angle of size 20x30x20 mm made of 0.5 mm thick pre painted steel along the perimeter of the room with help of nylon sleeves and wooden screws at 300 mm center to centre, suspending the main C carrier of size 10x38x10 mm made of G.I steel 0.7 mm thick from the soffit with help of soffit cleat 37x27x25x1.6 mm, rawl plugs of size 38x12 mm and C carrier suspension clip and main carrier bracket at 1000 mm c/c. Inverted triangle shaped Spring Tee having height of 24 mm and width of 34 mm made of GI steel 0.45 mm thick is then fixed to the main C carrier and in direction perpendicular to it at 600 mm centers with help of suspension brackets. Wherever the main C carrier and spring T have to join, C				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	carrier and spring T connectors have to be used. All sections to be galvanized @ 120 gms/sqm (both side inclusive), fixing with clip in tiles into spring 'T' with :				
	GI Metal Ceiling Clip in plain Beveled edge global white color tiles of size 600x600 and 0.5 mm thick with 25 mm height, made of G I sheet having galvanizing of 100 gms/ sqm (both sides inclusive) and 20% perforation area with 1.8 mm dia holes and having NRC of 0.5, electro statically polyester powder coated of thickness 60 microns (minimum), including factory painted after bending and perforation.	21801	sqm	1527.25	33295577
10.7	Providing and Fixing 15 mm thick densified tegular edged eco friendly light weight calcium silicate false ceiling tiles of approved texture spintone/cosmos / Hexa or equivalent of size 595 x 595 mm in true horizontal level, suspended on inter locking metal grid of hot dipped galvanised steel sections (galvanising @ 120 grams per sqm including both side) consisting of main 'T' runner suitably spaced at joints to get required length and of size 24x38 mm made from 0.33 mm thick (minimum) sheet, spaced 1200 mm centre to centre, and cross 'T' of size 24x28 mm made out of 0.33 mm (Minimum) sheet, 1200 mm long spaced between main 'T' at 600 mm centre to centre to form a grid of 1200x600 mm and secondary cross 'T' of length 600 mm and size 24 x28 mm made of 0.33 mm thick (Minimum) sheet to be inter locked at middle of the 1200x 600 mm panel to from grid of size 600x600 mm, resting on periphery walls /partitions on a Perimeter wall angle pre-coated steel of size(24x24X3000 mm made of 0.40 mm thick (minimum) sheet with the help of rawl plugs at 450 mm centre to centre with 25 mm long dry wall screws @ 230 mm interval and laying 15 mm thick densified edges calicum silicate ceiling tiles of approved texture				
	(Spintone / Cosmos/hexa) in the grid, including, cutting/ making opening for services like diffusers, grills, light fittings, fixtures, smoke detectors etc., wherever required. Main 'T' runners to be suspended from ceiling using G.I. slotted cleats of size 25x35x1.6 mm fixed to ceiling with 12.5 mm dia and 50 mm long dash fasteners, 4 mm G.I. adjustable rods with galvanised steel level clips of size 85 x 30 x 0.8 mm, spaced at 1200 mm centre to centre along main 'T' , bottom exposed with 24 mm of all T-sections shall be pre-painted with polyster baked paint, for all heights, as per specifications, drawings and as directed by engineer-in-charge.				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	Note :- Only calcium silicate false ceiling area will be measured from wall to wall. No deduction shall be made for exposed frames/opening (cut outs) having area less than 0.30 sqm. The calcium silicate ceiling tile shall have NRC value of 0.50 (Minimum), light reflection > 85%, non-combustible as per B.S. 476 part IV, 100% humidity resistance and also having thermal conductivity < 0.043 w/mK.	15485	sqm	1497.9	23194982
10.8	Providing and fixing thermal insulation with Resin Bonded rock wool conforming to IS: 8183, having density 48 kg/m ³ , 50 mm thick, wrapped in 200 G Virgin Polythene Bags fixed to wall with screws, rawl plug & washers and held in position by criss crossing GI wire etc. complete as per directions of Engineer-in-Charge.	25465	sqm	255.75	6512674
10.9	Providing and laying roof insulation with 40 mm thick impervious sprayed, closed cell free Rigid Polyurethane foam over deck insulation conforming to IS - 12432 Pt. III (density of foam being 40-45 kg/ cum), over a coat of polyurethane primer applied @ 6-8 sqm per litre, laying 400 G polythene sheet over PUF spray and providing a wearing course of 40 mm thick cement screed 1: 2 : 4 (1 cement : 2 coarse sand : 4 stone aggregate 20 mm nominal size) in chequered rough finish, in panels of 2.5 m x 2.5 m and embedding with 24 G wire netting and sealing the joints with polymerized mastic, all complete as per direction of Engineer-in-Charge.	14795	sqm	1151.05	17029785
	Sub- Head - XI Finishing				
11.1	Providing and applying 12 mm thick (average) premixed formulated one coat gypsum lightweight plaster having additives and light weight aggregates as vermiculite/ perlite respectively conforming to IS: 2547 (Part - 1 & II) 1976, applied on hacked / uneven background such as bare brick/ block/ RCC work on walls & ceiling at all floors and locations, finished in smooth line and level etc. complete.	14221 2	sqm	217.35	30909778
11.2	15 mm cement plaster on the rough side of single or half brick wall of mix:				
	1 : 6 (1 cement : 6 fine sand)	35423	sqm	185.2	6560340
11.3	15 mm cement plaster 1 : 3 (1 cement : 3 coarse sand) finished with a floating coat of neat cement on the rough side of single or half brick wall.	703	sqm	265.95	186963

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

11.4	Providing and applying 6 mm thick (average) premixed formulated one coat gypsum lightweight plaster having additives and light weight aggregates as vermiculite/ perlite respectively conforming to IS: 2547 (Part - 1 & II) 1976, applied on hacked / uneven background such as bare brick/ block/ RCC work on walls & ceiling at all floors and locations, finished in smooth line and level etc. complete.	87154	sqm	143.8	12532745
11.5	Wall painting with premium acrylic emulsion paint of interior grade, having VOC (Volatile Organic Compound) content less than 50 grams/ litre of approved brand and manufacture, including applying additional coats wherever required to achieve even shade and colour.				
	Two coats.	22792 5.8	sqm	71	16182734
11.6	Painting with synthetic enamel paint, having VOC (Volatile Organic Compound) content less than 150 grams/ litre, of approved brand and manufacture, including applying additional coats wherever required to achieve even shade and colour.				
	Two coats	596	sqm	75	44700
11.7	Providing and applying of "Decosil Finenze" eco friendly water based exterior texture paint formulated with siloxanic resin and quartz powder with a maximum grain size of 0.3mm of "Oikos Paint" or equivalent having UV resistant, anti fungal, antimould, anti algal, water repellent and vapour permeability properties, suitable for green building applicayion applied one or more coats of Decosil Finenze siloxanic base texture paint (@2.14 sqm per litre) on one coat of appropriate exterior primer(@8.36 sqm per litre) of approved colour and shade to achieve desired finish complete as per manufacturer specifications with the direction of Engineer in charge.	14945	sqm	150.65	2251464
	Sub- Head - XII , Aluminium Work				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

12.1	Providing and fixing aluminium work for doors, windows, ventilators and partitions with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS: 733 and IS: 1285, fixing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with required EPDM.S.ubber/ neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, Aluminium snap beading for glazing / paneling, C.P. brass / stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-charge. (Glazing, paneling and dash fasteners to be paid for separately) :				
a	For fixed portion				
	Powder coated aluminium (minimum thickness of powder coating 50 micron)	61386.42	kg	384.5	23603077
b	For shutters of doors, windows & ventilators including providing and fixing hinges/ pivots and making provision for fixing of fittings wherever required including the cost of EPDM.S.ubber / neoprene gasket required (Fittings shall be paid for separately)				
	Powder coated aluminium (minimum thickness of powder coating 50 micron)	29399	Kg	444.9	13079615
12.2	Providing and fixing glazing in aluminium door, window, ventilator shutters and partitions etc. with PVC/ neoprene gasket etc. complete as per the Architectural drawings and the direction of Engineer - in - Charge (Cost of aluminium snap beading shall be paid in basic item) :				
a	With float glass panes of 5.50 mm thickness	363	sqm	1003.95	364434
12.3	Providing and fixing double glazed hermetically sealed glazing in aluminium windows, ventilators and partition etc. with 6 mm thick clear float glass both side, having 12 mm air gap, including providing EPDM gasket, perforated aluminium spacers, desiccants, sealant (Both primary and secondary sealant) etc. as per specifications, drawings and direction of Engineer-in-charge complete.	4250	sqm	3176.2	13498850
12.4	Providing and fixing double action hydraulic floor spring of approved brand and manufacture conforming to IS : 6315, having brand logo embossed on the body / plate with double spring mechanism and door weight upto 125 kg., for doors, including cost of cutting floors , embedding in floors as required and making good the same matching to the existing floor finishing and cover plates with brass pivot and single piece M.S. sheet outer box with slide plate				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	etc. complete as per the direction of Engineer-in-charge.				
	With stainless steel cover plate minimum 1.25 mm thickness.	1059	each	2054.4	2175610
12.5	Filling the gap in between aluminium frame & adjacent RCC/ Brick/ Stone work by providing weather silicon sealant over backer rod of approved quality as per architectural drawings and direction of Engineer-in-charge complete.				
	Upto 5mm depth and 5 mm width	20938	metre	62.45	1307578
12.6	Providing and fixing stainless steel (SS 304 grade) adjustable friction windows stays of approved quality with necessary stainless steel screws etc. to the side hung windows as per direction of Engineer-in-charge complete.				
a	355 X 19 mm		each	237.15	
b	510 X 19 mm		each	613.45	
12.7	Providing and fixing 100 mm brass locks (best make of approved quality) for aluminium doors including necessary cutting and making good etc. complete.	25	each	359	8975
12.8	Providing and fixing anodised aluminium (anodised transparent or dyed to required shade according to IS : 1868 Minimum anodic coating of grade AC 15) sub frame work for windows and ventilators with extruded built up standard tubular sections of approved make conforming to IS : 733 and IS : 1285 fixed with rawl plugs and stainless steel screws etc.	26031	kg	315.1	8202368
12.9	Providing and fixing anodised aluminium grill (anodised transparent or dyed to required shade according to IS: 1868 with minimum anodic coating of grade AC 15) of approved design/pattern, with approved standard section and fixed to the existing window frame with C.P. brass/ stainless steel screws @ 200 mm centre to centre, including cutting the grill to proper opening size for fixing and operation of handles and fixing approved anodised aluminium standard section around the opening, all complete as per requirement and direction of Engineer-in-charge. (Only weight of grill to be measured for payment).	22250	kg	408.85	9096913
12.10	Providing and fixing 12 mm thick frameless toughened glass door shutter of approved brand and manufacture, including providing and fixing top & bottom pivot & spring type fixing arrangement and making necessary holes etc. for fixing required door fittings, all complete as per direction of Engineer-in-charge (Door handle, lock and stopper etc. to be paid separately).	116	sqm	4608.85	534627

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

12.1 1	Providing and supplying aluminium extruded tubular and other aluminium sections as per the architectural drawings and approved shop drawings, the aluminium quality as per grade 6063T5 or T6 as per BS 1474 including super durable powder coating of 60-80 microns conforming to AAMA 2604 of required colour and shade as approved by the Engineer -in-Charge				
	The item includes cost of material such as cleats, sleeves, screws etc. necessary for fabrication extruded aluminium frame work, Nothing extra shall be paid on this account	29056	kg	338.25	9828192
12.1 2	Designing, fabricating, testing, protection, installing and fixing in position semi(grid) unitized system of structural glazing (with open joints) for linear as well as curvilinear portions of the building for all heights and all levels including:				
	(a) Structural analysis, design and preparation of shop drawings for the specified design loads conforming to IS 875 part III (the system must pass the proof test at 1.5 times design with pressure without any failure including functional design of the aluminium sections for fixing glazing panels of various thickness, aluminium cleats, sleeves and splice plates etc. gaskets, screws, toggles, nuts, bolts, clamps etc. structural and weather silicone sealants, flashings, fire stop (barrier)-cum smoke seats, microwave cured EPDM gaskets for water tightness, pressure equalisation & drainage and protection against fire hazard including :				
	(b) Fabricating and supplying serrated M.S. hot dip galvanized/ aluminium alloy of 6005 T5 brackets of required sizes, sections and profiles etc. to accommodate 3 Dimensional movement for achieving perfect vertically and proper fixing of structural glazing system with the RCC/masonry/structural steel framework of building structure using stainless steel anchor fasteners/bolts, nylon separator to prevent bimetallic contacts with nuts and washers etc. of stainless steel grade 316, of the required capacity and in required numbers.				
	(c) Providing and filling, two part pump filled, structural silicone sealant and one part weather silicone sealant compatible with the structural silicone sealant of required bite size in a clean and controlled factory/work shop environment, including double sided spacer tape, setting blocks and backer rod, all of approved grade brand and manufacturer, as per the approved sealant design, within and all around the perimeter for holding glass.				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	(d) Providing and fixing in position flashings of solid aluminium sheet 1mm thick and of sizes, shapes and profiles, as required as per the site conditions, to seal the gap between the building structure and all its interfaces with curtain glazing to make it watertight.				
	(e) making provision for drainage of moisture/water that enters the curtain glazing system to make it watertight, by incorporating principles of pressure equalization, providing suitable gutter profiles at bottom (if required), making necessary holes of required sizes and of required numbers etc. complete.				
	This item includes cost of all inputs of designing labour for fabricating and installation of aluminium grid, installation of glazed units T&P scaffolding and other incidental charges including wastage etc. enabling temporary structures and services, cranes or cradles etc. as described above and as specified. The item includes the cost of getting all the structural and functional design checked and all the shop drawings vetted by the Principals of the structural glazing system.				
	The item also includes the cost of all mock ups at site, cost of all samples of the individual components for testing in an approved laboratory field tests on the assembled working structural glazing as specified, cleaning and protection till the handing over the building for occupation. In the end the Contractor shall provide a water tight structural glazing having all the performance characteristics etc. all complete as required as per the Architectural drawings as per item description as specified as per the approved shop drawings and as directed as specified as per the approved shop drawings and as directed by the Engineer-in-charge.				
	Note :-				
	1- The cost of providing extruded aluminium frames, shadow boxes, fire stop (barrier)-cum-smoke seals, extruded aluminium section capping for fixing in the grooves of the curtain glazing and vermin proof stainless steel wire mesh shall be paid for separately under relevant items under this sub-head. However, for the purpose of payment, only the actual area of structural glazing (including width of grooves) on the external face shall be measured in sqm. up to two decimal places.				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	2- The following performance test are to be conducted on structural glazing system if area of structural glazing exceeds 2500 sqm from the certified laboratories accredited by NABL(National Accreditation Board for Testing and Calibration laboratories) Department of Science & Technologies, India. The NIT approving authority will decide the necessity of testing on the basis of cost of the work, cost of the test and importance of the work.				
	Performance Testing of Structural glazing system :				
	Tests to be conducted in the NABL certified laboratories				
	1-Performance laboratory Test for air Leakage Test (-50pa to 300pa) & (+50pa to +300pa) as per ASTM E-283-04 testing method for a range of testing limit 1to 200mVhr"l.				
	2- Static Water Penetration Test (50pa to 1500pa) as per ASTM E-331-09 testing method for a range upto 2000ml"				
	3- Dynamic Water penetration (50pa to 1500pa) as per AAMA 501.01-05 testing method for a range upto 2000ml				
	4- Structural Performance Deflection and deformation by static air pressure test (1.5 times design wind pressure without any failure) as per ASTM E-330-10 testing method for a range upto 50mm"				
	5- Seismic Movement Test (Upto 30mm) as per AAMA 501.4-09 testing method for Qualitative test;				
	Tests to be conducted on site				
	6- On site Test for Water leakage for a pressure range 50 kpa to 240kpa (35psi) upto 2000ml'	3291	sqm	2409.9	7930981
12.1 3	Providing, assembling and supplying vision glass panels (IGUs) comprising of hermetically-sealed 6-12- 6 mm insulated glass (double glazed) vision panel units of size and shape as required and specified, comprising of an outer heat strengthened float glass 6mm thick, of approved colour and shade with reflective soft coating on surface # 2 of approved colour and shade, an inner Heat strengthened clear float glass 6mm thick, spacer tube 12mm wide, dessicants, including primary seal and secondary seal (structural silicone sealant) etc. all complete for the required performances, as per the Architectural drawings, as per the approved shop drawings, as specified and as directed by the Engineer-in-Charge. The IGUs shall be assembled in the factory/ workshop of the glass processor. For payment, only the actual area of				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	glass on face # 1 of the glass panels (excluding the areas of the grooves and weather silicone sealant) provided and fixed in position, shall be measured in sqm.				
	(i) Coloured tinted float glass 6mm thick substrate with reflective soft coating on face # 2, + 12mm Airgap + 6mm Heat Strengthened clear Glass of approved make having properties as visible Light transmittance (VLT) of 25 to 35 %, Light reflection internal 10 to 15%, light reflection external 10 to 20 %, shading coefficient (0.25- 0.28) and U value of 3.0 to 3.3 W/m ² degree K etc. The properties of performance glass shall be decided by technical sanctioning authority as per the site requirement.	2465	sqm	3730.7	9196176
12.1 4	Designing, fabricating, testing, installing and fixing in position Curtain Wall Aluminium composite Panel cladding with with open grooves for linear as well as curvilinear portions of the building for all heights and all levels etc. including:				
	(a) Structural analysis, design and preparation of shop drawings for , pressure equalisation or rain screen principle as required, proper drainage of water to make it watertight including checking of all the structural and functional design				
	(b) Providing, fabricating and supplying and fixing panels of aluminium composite panel cladding in pan shape in metallic colour of approved shades made out to 4mm thick aluminium composite panel material consisting of 3mm thick FR grade mineral core sandwiched between two aluminium sheets (each 0.5mm thick). The aluminium composite panel cladding sheet shall be coil coated, with Kynar 500 based PVDF/Lumiflon based fluoropolymer resin coating on approved colour and shade on face # 1 and polymer (service) coating on face#2 as specified using stainless steel screws, nuts, bolts, washers, cleats, weather silicone sealant, backer rod etc..				
	(c) The fastening brackets of aluminium alloy 6005 T5/MS with Hot DIP Gal vanished with serrations and serrated washers to arrest the wind load movement, fasteners, SS 316 Pins and anchor bold of approved make in SS 316 nylon separators to prevent bi-metallic contacts all complete required to perform as per specification and drawing.				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	The item includes cost of all material & labour component, the cost of all mock ups at site, cost of all samples of the individual components for testing in an approved laboratory, field tests on the assembled working curtain wall with aluminium composite panel cladding cleaning and protection of the curtain wall with aluminium composite panel cladding till the handing over of the building for occupation. Base frame work for ACP cladding is payable under the relevant aluminium item.				
	The contractor shall provide curtain wall with aluminium composite panel cladding, having all the performance characteristics all complete as per the architectural drawings as per item description as specified as per the approved shop drawings and as directed by the Engineer-in-Charge.				
	However, for the purpose of payment, only the actual area on the external face of the curtain wall with aluminium composite panel Cladding (including width of groove) shall be measured in sqm up to two decimal places	1167	sqm	3405.9	3974685
12.15	Design, manufacture, supply and installation at site Glass Fiber Reinforced concrete (GRC) screens, produced in accordance with Pre Cast Institute (U S A) Manual 128 EDN 4, conforming to size & Thickness as per drawing. Product manufactured using composition of alkali Resistant Glass Fiber of Make NES Japan or CEMFIL, High silica sand and white cement as raw materials conforming to relevant Indian and ASTM Standards, fixing with 6 inch Hilti Fastner with every 2 feet gap as required. (M S frame if required will be paid separately)	3623.68	sqm	12208.05	44238067
12.16	Roller blind (roller blind decorative fabric should be made up of 20% polyester, 75% to 80% PVC), it should have specific low emissivity treatment and lead free with Greenguard certification. It should have 3% - 5% openness, including antimicrobial additive preferably Microban. The thickness of fabric should be 0.90mm - 0.95mm, weight of fabric should be 650g/sqm - 705g/sqm and UV blockage should be 95% - 97%. Flame retardant with 10 years of warranty against any distortion in fabric due to any reason. Roller Blind tube is made of Aluminum with a diameter of 38mm Anodized, bottom N.S. rail is power coated & mechanism of plastic with chain and metal bracket, sturdy fixing arrangement as per direction of Engineer in charge. Approved Make Deck/Hunter Douglas/ D Decor or equivalent.	1200	sqm	1841.3	2209560
	Sub- Head - XIII , Water Proofing				

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

13.1	Providing and laying integral cement based treatment for water proofing on horizontal surface at all depth below ground level for under ground structures as directed by Engineer-in-Charge and consisting of : i) Ist layer of 22mm to 25mm thick approved and specified rough stone slab over a 25mm thick base of cement mortar 1:3 (1 cement : 3 coarse sand) mixed with water proofing compound of Pedilite or equivalent conforming to IS:2645 in the recommended proportion over the leveling course (leveling course to be paid separately). Joints sealed and grouted with cement slurry mixed with water proofing compound. ii) 2nd layer of 25mm thick cement mortar 1:3 (1 cement: 3 coarse sand) mixed with water proofing compound in recommended proportions. iii) Finishing top with stone aggregate of 10mm to 12mm nominal size spreading @ 8 cudm/sqm thoroughly embedded in the 2nd layer.				
	Using rough Kota stone.	7812	sqm	1017.55	7949101
13.2	Providing and laying integral cement based treatment for water proofing on the vertical surface by fixing specified stone slab 22 mm to 25mm thick with cement slurry mixed with water proofing compound of Pedilite or equivalent conforming to IS:2645 in recommended proportions with a gap of 20mm (minimum) between stone slabs and the receiving surfaces and filling the gaps with neat cement slurry mixed with water proofing compound and finishing the exterior of stone slab with cement mortar 1:3 (1 cement : 3 coarse sand) 20mm thick with neat cement punning mixed with water proofing compound in recommended proportion complete at all levels and as directed by Engineer-in-charge :				
	Using rough Kota stone	3775	sqm	1253.3	4731208
13.3	Providing and laying water proofing treatment to vertical and horizontal surfaces of depressed portions of W.C kitchen and the like consisting of :				
a	Ist course of appying cement slurry @ 4.4 Kg/sqm mixed with water proofing compound of Pedilite or equivelent conforming to IS 2645in recommended proportions including rounding off junction of vertical and horizontal surface.				
b	IInd course of 20 mm cement plaster 1: 3 (1 cement :3 coarse sand) mixed with water proofing compound in recommended proportion including roudnign off junction of vertical and horizontal surface				

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c	IIIrd course of applying blown or residual bitument applied hot at 1.7 kg. per sqm of area.				
d	IVth course of 400 micron thick PVC sheet. (Overlaps at joints of PVC sheet should be 100 mm wide and pasted to each other with bitument @ 1.7 kg/sqm.)	4833	sqm	505.9	2445015
13.4	Providing and laying integral cement based water proofing treatment including preparation of surface as required for treatment of roofs, balconies, terraces etc consisting of following operations :				
	Applying a slurry coat of neat cement using 2.75 kg/sqm. of cement admixed with water proofing compound of Pedilite or equivalent conforming to IS. 2645 and approved by Engineer-in-charge over the RCC slab including adjoining walls upto 300 mm height including cleaning the surface before treatment.				
	Laying brick bats with mortar using broken bricks /brick bats 25 mm to 115 size with 50 % of cement mortar 1:5 (1 cement : 5 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer -in-charge over 20 mm thick layer of cement mortar of mix 1:5 (1 cement : 5 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge to required slope and treating similarly the adjoining walls upto 300 mm height including rounding of junctions of walls and slabs.				
	After two days of proper curing applying a second coat of cement slurry using 2.7 kg/sqm of cement admixed with water proofing compound conforming to SI : 2645 and approved by Engineer -in-charge.				
	Finishing the surface with 20 mm thick jointless cement mortar of mix 1:4 (1 cement : 4 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer -in-charge including laying glass fibre cloth of approved quality in top layer of plaster and finally finishing the surface with trowel with neat cement slurry and making pattern of 300 x 300 mm square 3 mm deep.				
	The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test. All above operations to be done in order and as directed and specified by the Engineer -in- charge.				
	With average thickness of 120mm and minimum thickness at khurra as 65 mm.	6257	sqm	1034.65	6473805

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13.5	Providing and mixing integral crystalline admixture for waterproofing treatment to RCC structures like basement raft, retaining walls, reservoir, sewage & water treatment plant, tunnels / subway and bridge deck etc. at the time of transporting of concrete into the drum of the ready-mix truck, using integral crystalline admixture @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 at site of work. The material shall meet the requirements as specified in ACI-212-3R-2010 i.e. by reducing permeability of concrete by more than 90%, compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure. The crystalline admixture shall be capable of self-healing of cracks up to a width of 0.50mm. 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.	3924	kg	376.4	1476994
	Sub- Head - XIV Acoustical Treatment				
14.1	Stone tile work for wall lining up to 10m ht. with special adhesive over 12mm thick cement bed mortar 1:3 including pointing in white cement with an admixture of pigment to match the stone shade.Stone slat tiles approved stone 8mm thick.	2361	sqm	2760.3	6517068
14.2	Providing and fixing in position wall panelling of channelled Wood panels of width 128mm, thickness of 16mm and length 2440 mm esto made up of high density fiber board with minimum density of 800 Kg/m3 substrate with a laminated facing / wood veneer as per the approved shade / species & finish with melamine balancing layer on the reverse side. The boards shall have a special perforation pattern of 2mm groove & 14mm pitch. The panels shall have fire resistance of Class I, BS 476 part 7. The edges of the panels shall be "tongued-and-grooved" to receive special clips for installation. The back of the perforated panel shall have sound absorbing non-woven acoustical fleece and backed with 50mm thick glass wool layer as directed by the Engineer-in-Charge. The panel shall be mounted on special channels using clips as approved by the Engineer -in-charge. Install G.I stud of section 48X34X36 mm or as approved by the Engineer - in- Charge on the solid wall horizontally using screws and plugs at spacing of 600mm centre-to-centre. Screw the aluminium channel (keel)				

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	vertically on channelled G.I stud 600mm centre to centre. Install the first set of wooden panels by inserting the clips.				
	For border channel insert the groove of the panel in to the projecting flange of the aluminium clip. Continue installing rows of panels by inserting the tongue into the groove of the earlier inserted panel and progressively installing clips for inside channel into the next aluminium channel (keel) and simultaneously fill the gap between wall & panel by 50 mm thick glass wool having density of 48 kg/m ³ . Continue the process till the actual height is achieved. Use clips for border channel to finish off the installation, finish the edges using wood moulding of matching colour as approved by Engineer-in- Charge. The installed panels should give an NRC minimum of 0.9.	3935	sqm	7134.9	28075832
14.3	Providing & fixing in position wall panelling at all heights of thickness 25 mm with Fiber Glass Acoustical Wall Panels of size 600 x 1200 mm, resin bonded square edges creda having NRC of 0.9 minimum. The panels should be manufactured from high density bio-soluble resin bonded glass wool absorber having density of 96 Kgs/m ³ and wrapped on the front side with an acoustically transparent fabric having option of colours and fabric options like jute, mars, etc. as per approved by architect/engineer-in-charge, plain tissue backer and fabric wrapped hardened edges. Panels should have humidity resistance up to 90 %, thermal conductivity ≤ 0.03 (m ² k / w) thermal resistance ≥ 0.9 (m ² k / w) & moisture rate $\leq 1\%$ (JC/T670 – 2005). The panel should be fully recycled and fire retardant as per Class A. The installation comprises a GI framework for acoustic wall panelling as per design drawing (made from especially fabricated galvanized iron sheets 0.55 mm thick pressed section galvanizing @ 120 grams per sqm including both sides) consisting of floor channel of size 50X32X32X0.55 mm thick bottom and top fixed with nylon sleeves and screw.				0

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	Further vertical GI studs of size 48X34X36X0.55 mm thick are placed at 600 mm center to center vertically on the wall using 12 mm dia 50 mm long wedged type expanded zinc alloy dash fastener with 10 mm bolt, to avoid any undulations on the wall. The extra channel must be used at openings and junctions as required. Further, wooden batten of 6mm thickness and a width of 5" to be placed at 600 mm center to center horizontally on the vertical GI Studs. Surface impalers of size 3"X4" having projecting element called spikes shall be fixed on the wooden batten surface at 1200 mm center to center horizontally and 600 mm center to center vertically, using self tapping screws. Silica based construction adhesive to be dabbed on to the projecting elements (spikes) of the impalers. Wall Panels shall be pierced through the spikes of the impalers ensuring line & level of panel are maintained. The panels should be mounted on the impalers horizontally or vertically as per the approved design or as per the directions of the engineer-in-charge.	1574	sqm	7214.5	11355623
	Sub Head XV - External development				
15.1	Preparation and consolidation of sub grade with power road roller of 8 to 12 tonne capacity after excavation earth to an average of 22.5cm depth dressing to camber and consolidating with road roller including making good the undulations etc. and re-rolling the sub grade and disposal of surplus earth lead upto 50 metres.	12420.2	sqm	90.1	1119060
15.2	Supplying and stacking at site				
a	90 mm to 45 mm size stone aggregate	2329	cum	1336.05	3111660
b	63 mm to 45 mm size C & D Waste Material (Aggregate)	1130	cum	1449.3	1637709
c	53 mm to 22.4 mm size C & D Waste Material (Aggregate)	1130	cum	1542.25	1742743
d	Stone screening 13.2 mm nominal size (Type A).	699	cum	1505.6	1052414
e	Stone screening 11.2 mm nominal size (Type B).	475	cum	1462.05	694474
f	Mooram	373	cum	643.2	239914
15.3	Laying, spreading and compacting stone aggregate / C & D Waste Material (Aggregate) of specified sizes to WBM specifications in uniform thickness, hand picking, rolling with 3 wheeled road / vibratory roller 8-10 tonne capacity in stages to proper grade and camber, applying and brooming requisite type of screening / binding material to fill up interstices of coarse aggregate, watering and compacting to the required density .	3726	cum	449.1	1673347

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15.4	Providing and laying C.C. pavement of 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-incharge. (The panel shuttering work shall be paid for separately).	807	cum	6912.15	5578105
	(Note:- Cement content considered in this item is @ 330 kg/cum. Excess/less cement used as per design mix is payable/ recoverable separately).				
15.5	Providing and laying 60mm thick factory made C & D recycled interlocking paver block of M -30 grade made by block making machine with strong vibratory compaction, of approved size, design & shape, laid in required colour and pattern over and including 50	4354	sqm	815.95	3552646
15.6	Providing and laying at or near ground level factory made kerb stone of M-25 grade made of C & D waste from approved manufacturer in position to the required line, level and curvature jointed with cement mortar 1:3 (1 cement :3 coarse sand) including making joints with or without grooves (thickness of joints except at sharp curve shall not to more than 5 mm) including making drainage opening wherever required complete etc. as per direction of Engineer -in -charge (Length of finished kerb edging shall be measured for payment). (Precast C & D recycled kerb stone shall be approved by Engineer -in -charge.	83	cum	7314.5	607104
15.7	Providing and fixing 10x10x7.50 cm Granite stone block hand cut and chisel dressed on top, for paving in floors, drains etc. laid over 20mm thick base mortar 1:4 (1cement:4 coarse sand) with joints 10mm wide filled with same mortar including ruled pointing etc. complete as per direction of engineer-in charge.	550	sqm	1395.25	767388
15.8	Supplying and stacking of good earth at site including royalty and carriage up to 1 km (earth measured in stacks will be reduced by 20% for payment).	1350	cum	320.9	433215
15.9	Supplying and stacking at site dump manure from approved source, including carriage up to 1 km (manure measured in stacks will be reduced by 8% for payment) :				
	Screened through sieve of I.S. designation 20mm	169	cum	170.65	28840
15.10	Fine dressing of the ground	45	100 sqm	194.05	8732

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15.1 1	Spreading of sludge, dump manure and / or good earth in required thickness as per direction of Officer-in-charge (Cost of sludge, dump manure and / or good earth to be paid separately).	1519	cum	27.85	42304
15.1 2	Mixing earth and sludge or manure in the required proportion specified or directed by the Officer-in-charge..	1519	cum	19.1	29013
15.1 3	Grassing with selection No.1 grass including watering and maintenance of the lawn for 30 days or more till the grass forms a thick lawn, free from weeds and fit for mowing including supplying good earth, if needed (the grass and good earth shall be paid for separately).				
	In rows 5 cm apart in both directions	45	100 sqm	931.1	41900
15.1 4	Preparation of beds for hedging and shrubbery by excavating 60 cm deep and trenching the excavated base to a further depth of 30 cm, refilling the excavated earth after breaking clods and mixing with sludge or manure in the ratio of 8:1 (8 parts of stacked volume of earth after reduction by 20% : one part of stacked volume of sludge or manure after reduction by 8%), flooding with water, filling with earth if necessary, watering and finally fine dressing, leveling etc.including stacking and disposal of materials declared unserviceable and surplus earth by spreading and leveling as directed, within a lead of 50 m, lift up to 1.5 m complete (cost of sludge, manure or extra earth to be paid for separately).	1519	cum	116.55	177039
15.1 5	Supply and stacking of selection No.1 grass at site fresh and free from weeds having proper roots	4500	sqm	50.8	228600
	Sub Head - XVI Sanitary Installation				
16.1	Providing and fixing white vitreous china pedestal type water closet(European type W.C. pan) with seat and lid, 10 litre low level white P.V.C. flushing cistern, including flush pipe, with manually controlled device (handle lever), conforming to IS : 7231, with all fittings and fixtures complete including cutting and making good the walls and floors wherever required :				
	W.C. pan with ISI marked white solid plastic seat and lid	4	each	3418.7	13675

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16.2	Providing, fixing, testing and commissioning of vitreous china wall mounted water closet with dual flush fitting, of flushing capacity 2 litre/ 4 litre including flush pipe [Hindware-Constellation cat no. 20040(S-22.2) Pastel or equivalent], concealed cistern with lid (Hindware CONCEALO 80 mm or equivalent), conforming to IS : 7231 with all fittings and fixtures complete, including cutting and making good the wall and floors wherever required. Gap between fixtures and walls shall be filled up with approved polysulphide sealant.	758	each	14193.45	10758635
16.3	Providing and fixing white vitreous china battery/electric based infrared sensor operated urinal of approx. size 610 x 390 x 370 mm having pre & post flushing with water (250 ml & 500 ml consumption), having water inlet from back side, including fixing to wall with suitable brackets all as per manufacturers specification and direction of Engineer-in-charge	295	each	5162.2	1522849
16.4	Providing and fixing frameless urinal partition with 8 mm glass (Jaquar, JSE-CHR-810UC450X, HSN code 70134900 or equivalent) & SS fittings approved make all complete as directed by the Engineer-in-Charge.	240	each	3637.2	872928
16.5	Providing and fixing wash basin with C.I. brackets, 15 mm C.P. brass pillar taps, 32 mm C.P. brass waste of standard pattern, including painting of fittings and brackets, cutting and making good the walls wherever require :				
	White Vitreous China Wash basin size 550x400 mm with a pair of 15 mm C.P. brass pillar taps	4	each	2095.3	8381
16.6	Providing and fixing white glazed Vitreous China wash basin under counter basin, with C.I. concealed type brackets fixed to walls with GI rag bolts or approved fasteners etc., including 32 mm CP brass waste coupling inlet connection, including painting of fittings and brackets, cutting and making good the walls wherever required all complete (Granite counter top will be measured and paid separately under relevant item):	695	each	6984.05	4853915

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16.7	Providing and fixing Stainless Steel A ISI 304 (18/8) kitchen sink as per IS : 13983 with C.I. brackets and stainless steel plug 40 mm, including painting of fittings and brackets, cutting and making good the walls wherever required :				
	Kitchen sink with drain board				
	510x1040 mm bowl depth 250 mm	38	each	4120.8	156590
16.8	Providing and fixing P.V.C. waste pipe for sink or wash basin including P.V.C. waste fittings complete.				
	Flexible pipe				
	40 mm dia	38	each	75.6	2873
16.9	Providing and fixing 600x450 mm beveled edge mirror of superior glass (of approved quality) complete with 6 mm thick hard board ground fixed to wooden cleats with C.P. brass screws and washers complete.	575	each	817.95	470321
16.10	Providing and fixing toilet paper holder:				
	C.P Brass	758	each	385.35	292095
16.11	Providing and fixing soil, waste and vent pipes :				
	100 mm dia.				
a	Hubless centrifugally cast (spun) iron pipe epoxy inside & outside IS: 15905	4171.2	metre	925.55	3860654
b	150 dia Hubless centrifugally cast (spun) iron pipe epoxy inside & outside IS: 15905	1160.4	metre	1037.9	1204379
16.12	Providing and fixing M.S. holder-bat clamps of approved design to Sand Cast iron/cast iron (spun) pipe embedded in and including cement concrete blocks 10x10x10cm of 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) including cost of cutting holes and making good the walls etc. :				
a	For 100 mm dia. Pipe	1556	each	167.35	260397
b	For 150 mm dia. Pipe	1162	each	378.57	439898
16.13	Providing and fixing bend of required degree with access door, insertion rubber washer 3 mm thick, bolts and nuts complete.				
	100 mm				
a	Hubless centrifugally cast (spun) iron epoxy coated inside & outside I.S. 15905	816	each	489.45	399391

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16.1 4	Providing and fixing plain bend of required degree.				
a	100 mm				
b	Hubless centrifugally cast (spun) iron pipe epoxy inside & outside IS: 15905	2334	each	307.1	716771
16.1 5	Providing and fixing heel rest sanitary bend				
a	100 mm dia				
	Hubless centrifugally cast (spun) iron heel rest bend as per IS:15905	30	each	408	12240
b	150 mm dia				
	Sand cast iron S&S as per IS - 15905	22	each	520.2	11444
16.1 6	Providing and fixing single equal plain junction of required degree with access door, insertion rubber washer 3 mm thick, bolts and nuts complete.				
a	100x100x100 mm				
	Hubless centrifugally cast (spun) iron epoxy coated inside & outside 'as per IS:15905	792	each	553.8	438610
b	150x150x100 mm				
	Sand cast iron S&S as per IS - 15905	792	each	1591.05	1260112
16.1 7	Providing and fixing single equal plain junction of required degree				
	100x100x100 mm				
	Hubless centrifugally cast (spun) iron epoxy coated inside & outside I.S. 15905	600	each	503.4	302040
16.1 8	Providing and fixing terminal guard:				
a	100 mm				
	Hubless centrifugally cast (spun) iron epoxy coated inside & outside I.S. 15905	30	each	355.85	10676
b	150 mm				
	Hubless centrifugally cast (spun) iron epoxy coated inside & outside I.S. 15905	22	each	803.4	17675
16.1 9	Providing and fixing shielded coupling for hubless centrifugally cast iron pipes				
a	100 mm				
	S S 304 grade coupling with EPDN.S.rubber gasket	5996	each	360.5	2161558
b	150 mm				
	S S 304 grade coupling with EPDN.S.rubber gasket	1160. 4	each	541	627776

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16.20	Providing and fixing M.S. stays and clamps for sand cast iron/centrifugally cast (spun) iron pipes of diameter :				
a	100 mm	30	each	62	1860
b	150 mm	22	each	216.45	4762
16.21	Providing and fixing trap of self cleansing design with screwed down or hinged grating with or without vent arm complete, including cost of cutting and making good the walls and floors :				
	100 mm inlet and 100 mm outlet				
	Hubless centrifugally cast (spun) iron pipe epoxy inside & outside IS: 15905	859	each	677.6	582058
16.22	Painting sand cast iron/ centrifugally cast (spun) iron soil, waste vent pipes and fittings with two coats of synthetic enamel paint of any colour such as chocolate grey, or buff etc. over a coat of primer (of approved quality) for new work :				
a	100 mm diameter pipe	1066.8	metre	40.65	43365
b	150 mm diameter pipe	1426.8	metre	74	105583
16.23	Providing and fixing 32mm C.P brass bottle Trap of approved quality & make as per the direction of engineer-in-charge.	695	each	795.15	552629
16.24	Providing and fixing G.I floor drain consisting of 100x50mm G.I elbow (grating and G.I pipe to be paid separately), complete as per instructions.	572	each	527.75	301873
16.25	Providing and fixing 100mm dia S.S grating grade AISI-304 (with or without hole) (Jayana Model No NRG 140 - Glossy or equivalent) for , floor or Nahani trap.	1431	each	404	578124
16.26	Providing and fixing stainless steel soap dispensser (heavy traffic) (Euronics - KINOX (KSD1) or equivalent) with all complete as directed by the Engineer-in-Charge.	267	each	7210.55	1925217
16.27	Providing and fixing CP brass auto closing system basin pillar tap of Jaquar PRS - 031 or Equivalent as approved by Engineer- In Charge	695	each	1977	1374015
16.28	Providing and fixing of 600mm long towel rail Jaquar Cat No. AKP-35711P or equivalent) , all complete with required accessories as directed by the Engineer-in-Charge.	300	each	2242	672600

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16.29	Providing and fixing 600 mm long stainless steel grab bar (Cat euronics EGR (502) or equivalent) all complete as directed by the Engineer-in-Charge.	78	each	8168.7	637159
16.30	Providing and fixing stainless steel hand dryer (Heavy Traffic) all complete as directed by the Engineer-in-Charge. -in-Charge.	114	each	17570.7	2003060
16.31	Providing and fixing of G.I soil / waste pipe wall/ under floor , cutting chases and making good with complete.				
a	32 mm dia. nominal bore	695	metre	308.35	214303
b	40 mm dia. nominal bore	334	metre	394.15	131646
c	50 mm dia. nominal bore	572	metre	472.4	270213
16.32	Providing and fixing 100mm dia G.I. inlet fitting consisting of 100mm dia main G.I pipe with multiple G.I. sockets (Inlets) of required diameter welded to it (as per site requirement) and fixing the same to C.I trap and setting in cement concrete, complete as per instructions of the Engineer in charge.	859	each	406.95	349570
	Sub Head - XVII Water Supply				
17.1	Providing and fixing G.I. pipes complete with G.I. fittings and clamps, i/c cutting and making good the walls etc.				
	Internal work – Exposed on wall.				
a	20 mm dia. nominal bore	525	metre	224.15	117679
b	25 mm dia. nominal bore	665	metre	247.85	164820
c	32 mm dia. nominal bore	755	metre	308.35	232804
d	40 mm dia. nominal bore	1230	metre	394.15	484805
e	50 mm dia. nominal bore	750	metre	472.4	354300
f	65 mm dia. nominal bore	150	metre	919.65	137948
g	80 mm dia. nominal bore	120	metre	1132.82	135938
17.2	Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes, having thermal stability for hot & cold water supply, including all CPVC plain & brass threaded fittings, i/c fixing the pipe with clamps at 1.00 m spacing. This includes jointing of pipes & fittings with one step CPVC solvent cement and the cost of cutting chases and making good the same including testing of joints complete as per direction of Engineer in Charge.:				
a	15 mm nominal outer dia Pipes	6825	metre	246.2	1680315

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b	20 mm nominal outer dia Pipes	2645	metre	284.85	753428
c	25 mm nominal outer dia Pipes	1850	metre	333.6	617160
17.3	providing and fixing Gun metal gate valve with C.I. wheel of approved quality (screwed end)				
a	20 mm nominal bore	108	each	396.55	42827
b	25 mm nominal bore	108	each	428.2	46246
c	32 mm nominal bore	54	each	500.75	27041
d	40 mm nominal bore	30	each	584.7	17541
e	50 mm nominal bore	15	each	749.9	11249
17.4	Providing and fixing ball valve (brass) of approved quality, High or low pressure, with plastic floats complete :				
	25 mm nominal bore	15	each	331.95	4979
17.5	Supply and fixing 15mm S.S braided connection pipe 450 mm long with wall flange / brass union of approved make (CAT No. CSS-01 , Chilly or Equivalent)	1650	each	283	466950
17.6	Providing and fixing C.P. brass overhead shower 105 mm dia round shape multi flow with air effect (ABS Body & face chrome plated) with rubit cleaning system including shower arm casted 190 mm long flat shap for wll mounted shower with wall flange etc	300	each	283.2	84960
17.7	Providing and fixing 32mm C.P single lever telephonic wall mixer of approved quality & make as per the direction of engineer-in-charge.				
	15 mm nominal dia	300	each	4715.75	1414725
17.8	Painting G.I. pipes and fittings with synthetic enamel white paint with two coats over a ready mixed priming coat, both of approved qualityfor new work :				
a	20 mm diameter pipe	525	metre	11.8	6195
b	25 mm diameter pipe	665	metre	15.5	10308
c	32 mm diameter pipe	755	metre	18.4	13892
d	40 mm diameter pipe	1230	metre	21.75	26753
e	50 mm diameter pipe	750	metre	25.75	19313
17.9	Providing and fixing 8 mm dia C.P/S.S Jet with flexible tube upto 1.0M long S.S tringular plate to European type of approved quality & make as per the direction of engineer-in-charge.	758	each	254.8	193138

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17.10	Providing and fixing hand held ablution fitting (health faucet) (jaquar cat no.ALD-CHR-585 approved equivalent) with one meter long flexible tube and wall hook, all complete approved engineer-in-charge	758	each	999.3	757469
17.11	Supply and fixing of 15mm CP brass 2 Way Bib Cock with wall flange and suitable length CP brass extension pipe all of approved make (CP fittings CAT No. CON-041KN of Jaquar or equivalent) all complete as per direction of Engineer-In-Charge.	758	each	884.25	670262
17.12	Providing and fixing C.P. brass stop cock (concealed) of approved quality conforming to IS standards 8931.				
	15 mm nominal bore	295	each	545.95	161055
17.13	Providing and fixing C.P. brass long body bib cock of approved quality conforming to IS standards and weighing not less than 690 gms.				
	15 mm nominal bore	52	each	492.55	25613
17.14	Providing and fixing C.P. brass angle valve for basin mixer and geyser points of approved quality conforming to IS:8931				
	15mm nominal bore	1650	each	475.7	784905
17.15	Supply and fixing 15mm CP brass Sink Cock with swinging casted spout wall flange and suitable length CP brass extension pipe all of approved make ("Jaquar" Contentent cat. No.LYR-38165 or equivalent)) all complete as per direction of Engineer-In-Charge.	38	each	3411.1	129622
17.16	Providing and fixing C.P. brass wall mounting drinking water fountain tap with wall flange (Jaquar cat. No. LYR - 38037 or equivalent.	112	each	1278.35	143175
17.17	Providing and placing on terrace (at all floor levels) polyethylene water storage tank, ISI : 12701 marked, with cover and suitable locking arrangement and making necessary holes for inlet, outlet and over flow pipes but without fittings and the base support for tank	113550	per litre	7.25	823238
	Sub Head – XVIII Drainage				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

18.1	Providing and fixing square-mouth S.W. gully trap class SP-1 complete with C.I. grating brick masonry chamber with water tight C.I. cover with frame of 300 x300 mm size (inside) the weight of cover to be not less than 4.50 kg and frame to be not less than 2.70 kg as per standard design :				
	180x150 mm size P type				
	With common burnt clay . (non modular) bricks of class designation 7.5	28	each	1706.55	47783
18.2	Providing and laying non-pressure NP2 class (light duty) R.C.C. pipes with collars jointed with stiff mixture of cement mortar in the proportion of 1:2 (1 cement : 2 fine sand) including testing of joints etc. complete :				
a	150 mm dia. R.C.C. pipe	730	metre	356.7	260391
b	250 mm dia. R.C.C. pipe	450	metre	482.05	216923
c	300 mm dia. R.C.C. pipe	1100	metre	518.55	570405
18.3	Constructing brick masonry manhole in cement mortar 1:4 (1 cement :4 coarse sand) with R.C.C. top slab with 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size), foundation concrete 1:4:8 mix (1 cement : 4 coarse sand : 8 graded stone aggregate 40mm nominal size), inside plastering 12mm thick with cement mortar 1:3 (1 cement : 3 coarse sand) finished with floating coat of neat cement and making channels in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) finished with a floating coat of neat cement complete as per standard design :				
	Inside size 90x80 cm and 45 cm deep including C.I. cover with frame (light duty) 455x610 mm internal dimensions, total weight of cover and frame to be not less than 38 kg (weight of cover 23 kg and weight of frame 15 kg) :				
	With common burnt clay (non modular) bricks of class designation 7.5	20	each	8634.1	172682

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

18.4	Constructing brick masonry circular type manhole 0.91m internal dia at bottom and 0.56m dia at top in cement mortar 1:4 (1 cement : 4 coarse sand), in side cement plaster 12 mm thick with cement mortar 1:3 (1 cement : 3 coarse sand) finished with a floating coat of neat cement, foundation concrete 1:3:6 mix (1 cement : 3 coarse sand : 6 graded stone aggregate 40mm nominal size), and making necessary channel in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) finished with a floating coat of neat cement, all complete as per standard design :				
	0.91 m deep with S.F.R.C. cover and frame (heavy duty, HD-20 grade designation) 560mm internal diameter conforming to I.S. 12592, total weight of cover and frame to be not less than 182kg., fixed in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) including centering, shuttering all complete. (Excavation, foot rests and 12mm thick cement plaster at the external surface shall be paid for separately)				
	With common burnt clay F.P.S. (non modular) bricks of class designation 7.5	64	each	8683.75	555760
18.5	Extra depth for circular type manhole 0.91m internal dia (at bottom) beyond 0.91m to 1.67m				
	With common burnt clay F.P.S. (non modular) bricks of class designation 7.5	16	metre	5020.95	80335
18.6	Providing M.S. foot rests including fixing in manholes with 20x20x10 cm cement concrete blocks 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size) as per standard design :				
	With 20x20 mm square bar	208	each	267.95	55734
18.7	Constructing brick masonry road gully chamber 50x45x60 cm with bricks in cement mortar 1:4 (1 cement : 4 coarse sand) including 500x450 mm pre-cast R.C.C. horizontal grating with frame complete as per standard design :				
	With common burnt clay d.P.S. (non modular) bricks of class designation 7.5	130	each	4043.1	525603

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	SH: Furniture work				
19	Classrooms Bench				
19.1	<p>Design, fabrication, supply and installation of class room modular bench and desk system to be fixed in assembly of 3-5 seat modules on rows in classroom. The bench & desk system consist of following: The supporting system for fixing seat, back, desk shall be made of SS AIST 304 stainless steel sections (flats, plate, tubes, etc.). The support consist of tubular cantilever module made of pipe having cantilever brackets and cleats and base plate. (a) The tubular leg bent into ergonomic shape for sitting comfort is to be fixed to the base plate by inserting the pipe through the full thickness of base plate and welding it from both the faces of base plate all along the periphery of tube.(b) Base plate shall have three countersunk holes for fixing it to the ground with three numbers 10mm dia countersunk type SS304 grade expandable dash fasteners of 150mm length (c) The brackets for supporting seat & desk shall be fixed by making slots on both front and back wall of pipe and inserting the bracket through both the slots and welding on both outer ends all along the periphery of bracket. (d) The cleats with oval shape hole for fixing seat and desk shall be fixed to the bracket after making a slot in bracket such that the top surface of cleat and bracket remain in same plane and welding it all round the length of joint from both sides. (e) The cleats with oval shape hole for fixing back shall be fixed in the tube by making a slot in the tube, inserting the cleat in the slot fro a depth of at least 5mm and welding all around the periphery of the slot. (f) The welding at all the places shall be properly grounded, cleaned, polished to make surface seamless and uniform with brush finish. (g) The modular supports shall be fixed to the ground in the assembly and in steps as per the layout drawing.(h) Fixing any other member required to make the whole system shall form a rigid and stable assembly and shall be aesthetically acceptable as per architectural image details and as per directions of Engineer-in-Charge. The above furniture should be as per specification and sample approved by Engineer-in-charge.</p>	50900	kg	747.15	38029935

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

19.2	Modular seat, back, desk & modesty panels made of 15mm thick lacquer polished, hot pressed plywood of required size, geometrical shape moulded into ergonomic/waterfall curvature on front and top edges, with countersunk holes, sanded and polished edges to be fixed on stainless steel frame work with the nuts/bolts (countersunk) to make the seat, desk and back complete and aesthetically acceptable as per architectural drawings and direction of Engineer-in-charge (cost of SS frame work, nuts and bolts to be paid under item no.1.1) (Refer drawings for arrangements). One side teak veneered hot pressed moulded factory lacquer polished plywood.	2964	sqm	2705.1	8017916.4
19.3	Both side teak veneered hot pressed moulded factory lacquer polished plywood.	1482	sqm	23000	34086000
20	HOD Table - 1650mm L X 750mm W X 750mm H				
	Providing and placing in position of Office Table as per photograph. Primary Work Surface shall be 1650mmx750mm and Made of 25mm thick ply-board one side pre-laminate ply-board confirming to IS-14587:1998 with 0.4mm PVC membrane pressed on to top Softclosing access flap with in-build power box are provided on work surface for wire management. Secondary Work Surface shall be 1200x500 and Made of 25mm thick ply-board one side pre-laminate ply-board confirming to IS-14587:1998 with 0.4mm PVC membrane pressed on to top. Modesty Panel Made of 25mm thick ply-board one side pre-laminate ply-board confirming to IS-14587:1998 with 0.4mm PVC membrane pressed on to top. Understructure Made of 25mm Thick Pre-laminated twin ply-board of E1-P2 grade and approved shade confirming to IS-12823:1990, Edge banded with matching 2 mm thick PVC lipping. Integrated Pedestal Made of 25mm Thick Pre-laminated twin ply-board of E1-P2 grade and approved shade confirming to IS-12823:1990, Edge banded with matching 2 mm thick PVC lipping. Drawer fronts made of 25mm thick ply-board one side pre-laminate ply-board confirming to IS-14587:1998 with 0.4mm PVC membrane pressed on to top Pedstal construction is BOX-BOX-FILE type which Uses powder coated 400 MM long metal Panel Drawer Slides. Drawer extension is 325 MM. Drawers have a soft closing & anti slam mechanism.Handles are provided for ease of opening.Pedestals are provided with lock for	4	each	64800	259200

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	security.. Prodcut shall be meeting the minimum desired specifications.. and as per directions of Engineer-in-charge. The above furniture should be as per specification and sample approved by Engineer-in-charge.				
21	Meeting Room Table 6000mm L x 2400mm W				
	Providing & Fixing of Conference table of desired shape and size. The top of Conference table shall be 25 mm thick base material shall be 25 mm ply-board ply-board plus Post - laminated work surface with 0.6 mm laminate on top and on bottom also 2 mm thick PVC edge banding on straight edges . The Squeeze Leg Assembly shall be nickel chrome plated made from Dia 50.8 x 1.6 mm thick MS ERW tube . Leg Assembled together with a plastic glide at bottom and a powder coated leg connector made from aluminium alloy at top . Cross Member and connectors shall be powder coated cross member made from 1.5 mm thick aluminium extrusion fixed with work surface by plastic moulded table support connector . Powder coated connectors made from Aluminium alloy fixed at both ends of cross members . Squeeze Leg Assembly and connectors are assembled together to strengthen complete understructure . Laminate Modesty shall be 18 mm thick base material shall be 16 mm Plain ply ply-board . Post - Laminated with 0.6 mm Top laminate on either side also there shall be 2 mm thick PVC edge banding of matching colour on outer edges of modesty . Work surface and Modesty are assembled together with powder coated Modesty bracket made from 2 mm thick MS sheet . Metal Perforated Modesty shall be 18 mm thick Powder coated metal perforated modesty with stiffener made from 0.8 mm thick MS sheet . Work surface and Modesty are assembled together with powder coated Modesty bracket made from 2 mm thick MS sheet . The Access Flap and Switch Mounting Tray shall be made from Matt silver anodized aluminium extrusion and plastic moulded components to facilitate access of electrical/ data /voice sockets access from top . Powder coated switch mounting tray made from 0.8 mm and 1.5 mm MS sheet .Switches to be mounted on tray as per requirement . Prodcut shall be meeting the minimum desired specifications.. The above furniture should be as per specification and sample approved by Engineer-in-charge.	4	each	253464	1013856

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

22	HOD Cabin 3 Seater Sofa - 2060 x 905 x 855 ht				
	<p>Providing & Fixing of sofa 3 Seater of Dimensions 2060 x 905 x 855. SEAT FOAM: The seat is made of PU foam with Density 28 ± 2 kg/cu.mtr having an additional top layer of super soft PU foam in Density 32 ± 2 kg/cu. upholstered with fabric or leatherette. BACK FOAM: The back is made of PU foam with Density 28 ± 2 kg/cu. mtr with two additional top layer of supersoft foam of density 32 ± 2 kg/cu. mtr, upholstered with fabric or leatherette. UNDERSTRUCTRE : Understructure is made up of 1.2 ± 0.1 cm. thick hot pressed plywood (moisture resistance & termite proof as per IS: 303) & pinewood of cross section devoid of major knots & surface defects 6 nos. per seat & 3.8 mm Dia zigzag spring assembly is mounted over understructure for cushioning purpose 6 nos. per seat & 3.8 mm Dia zigzag spring assembly is mounted over understructure for cushioning purpose. LEG ASSEMBLY: It is a welded assembly made in Stainless steel (grade SS 202) tube & plate with plastic endcap. (W) 206.0* (D) 90.5(H) 85.5 cm seat (H) 45.0 cm.. Prodcut shall be meeting the minimum desired specifications.. The above furniture should be as per specification and sample approved by Engineer-in-Charge as per image.</p>	4	each	33512	134048
23	HOD Cabin 2 Seater Sofa - 1460 x 945 x 850ht				

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

	<p>Providing & Fixing of sofa 2 Seater of Dimensions 1460 x 945 x 850. SEAT FOAM: The seat is made of PU foam with Density 28 ± 2 kg/cu.mtr having an additional top layer of super soft PU foam in Density 32 ± 2 kg/cu. upholstered with fabric or leatherette. BACK FOAM: The back is made of PU foam with Density 28 ± 2 kg/cu. mtr with two additional top layer of supersoft foam of density 32 ± 2 kg/cu. mtr, upholstered with fabric or leatherette .UNDERSTRUCTRE : Understructure is made up of 1.2 ± 0.1 cm. thick hot pressed plywood (moisture resistance & termite proof as per IS: 303) & pinewood of cross section devoid of major knots & surface defects 6 nos. per seat & 3.8 mm Dia zigzag spring assembly is mounted over understructure for cushioning purpose 6 nos. per seat & 3.8 mm Dia zigzag spring assembly is mounted over understructure for cushioning purpose.LEG ASSEMBLY: It is a welded assembly made in Stainless steel (grade SS 202) tube & plate with plastic endcap. (W) 206.0* (D) 90.5(H) 85.5 cm seat (H) 45.0 cm.. Prodcut shall be meeting the minimum desired specifications.. The above furniture should be as per specification and sample approved by Engineer-in-charge as per image.</p>	4	each	27376	109504
24	HOD Cabin Centre Table				
	<p>Supply and placing centre table in position with sizes 900mm(W)x500 - 600mm(D)x400mm(H) with top made of 10mm thick glass top supported on SS Studs on understructure of Prelaminated Ply Board. The Table shall have another shelf at lower level The work shall be carried out as per the instructions received from engineer-incharge as per image.</p>	4	each	10000	40000
25	PROFESSOR ROOM TABLE				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	Professor Room Table:-Providing and placing in position of Office Table as per photograph. Modular table size 1650mm (L) X 750mm (W) X 750mm (H), Table top and side panels shall be made of 25mm thick ply board shall be finished with laminate side unit size 900x450x750mm. Table modesty panel shall be made out of 18mm thick ply board shall be finished with laminate approved with shade. The working or nonworking edges shall be provided with matching machine pressed 2mm thick PVC edge bending using with special hot melt glue at hot temperature. all as per instruction of Engineer-in-charge.	68	each	28000	1904000
26	ASSISTANT PROFESSOR TABLE/HODPA Table.				
	Providing and placing Main Table 1500mm x 750mm, completely made up of 18mm Prelaminated Ply Board with PVC edge banding. Top are with 25mm thk boards . Table top is supported on 25mm thick Gable ends and 18mm thk Modesty panels. exposed edges are in 2mm thk PVC edge banding & sealed edges are in 0.8mm thk PVC edge banding. Separate provision for mounting switches on the wall adjoining the tables shall be made by customer as the tables do not come with switch mounting facility.Side table of size 900mm L x450mm D x725mm Ht with completely made up of Prelaminated Ply Board with PVC edge banding. Top is supported on 25mm thk. Gable ends and 18mm thk. Modesty panel. Exposed edges are in 2mm thk PVC edge banding & sealed edges are in 0.8mm thk PVC edge banding .Table also has a 3 Drawer Metal Pedestal unit of size 390mm L x 450mm D x 640mm made out of SS of 304 grade with castors .	118	each	26000	3068000
27	COMPUTER LAB TABLE BACK TO BACK 4 PERSON CLUSTER				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	Suppling & Placing position of Computer Lab Table (sharing) 4 person as per photograph. The table of size:- L-2400mm x D-1200mm x H-1050 mm Shall be made out of with the combination of ply with laminated top and MS powder coated legs. The table top of 18mm thick ply board shall be finished with laminate. The working and non working edges shall be finished with 2mm thick PVC edge banding. The table top shall be supported with C-shaped leg of 50mmx50mm thickness and shall be powder coated with 50 microns. The table shall be provisioned with 18mm thick ply board shall be finished with laminte for modesty panel. Provision of wire tray and juntion box for wire management. Provision of mobile pedestal with two drawer.	305	each	41615	12692575
28	RESEARCH SCHOLAR CABIN TABLE				
	Research Scholar Cabin Table Providing and placing Office Table having Dimension 1350mm L x 750mm W x 750mm Ht. Worktop is made of 25 mm thick Prelaminated Ply Board having 2mm thick pvc edge lipping, Under structure is made of 18mm thick Prelaminated Ply Board and having 2mm thick pvc edge lipping . Table also has a 3 Drawer Metal Pedestal unit of size 390mm L x 450mm D x 640mm made out of duly powder coated CRCA Steel with castors . The above furniture should be as per specification and sample approved by Engineer-in-charge.	66	each	16000	1056000
29	EXECUTIVE CHAIRS - REVOLVING HIGH BACK				

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

	<p>Supplying and placing in position of 360 degrees revolving high back chair as per photograph. The seat and back shall be made up of 1.2 ±0.1cm. thick hot-pressed plywood measured as per QA method described in OCP-QLTA-P14-18 and upholstered with fabric upholstery covers and moulded Polyurethane foam. The back foam shall be designed with contoured lumbar support for extra comfort. The seat shall be extra thick foam on front edge to give comfort to popliteal area. The dimensions of back shall be 47.5 cm(W) x 69.5 cm(H) and of seat shall be 47.0 cm (W) x 48.0 cm (D). The HR polyurethane foam shall be moulded with density= 45±2 kg/m³ and hardness load 16 ± 2 kgf as. per IS:7888 for 25% compression. The one-piece armrests shall be injection moulded from black Co.polymer Polypropylene. The mechanism shall be designed with 360° revolving type, Upright-position locking, Tilt tension adjustment, Seat/back tilting ratio of 1:3. The pneumatic height adjustment shall has an adjustment stroke of 12.0 ±0.3cm. The bellow shall be 3 piece telescopic type and injection moulded in black Polypropylene. The pedestal shall be injection moulded in black 33% glass-filled Nylon-66 and fitted with 5 nos. twin wheel castors. The pedestal shall be 66.3 ±0.5cm. pitch-center dia. (76.3 ±1.0cm with castors). The twin wheel castors shall be injection moulded in Black Nylon. Overall Dimensions of Chair shall be Seat Height - min 42.5 to max 54.5cm, Height - min97.0 to max 109.0cm, Width & Depth of Chair as measured from pedestal - Width-76.3 cm and Depth-76.3 cm. Complete as per image, and specifications and as per directions of Engineer in Charge. The above furniture should be as per specification and sample approved by Engineer-in-charge.</p>	72	each	9264.18	667020.96
30	VISITORS CHAIRS - REVOLVING MEDIUM BACK				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	Supplying and placing in position of 360 degrees revolving high back chair as per photograph. The Chaste chair of Size :- (W)560mm X (D)480mm X (H)980mm. The chair shall be ergonomically design contour lumbar back design made of 10-12mm thick BWP plywood upholstered with fabric and cut foam. The chair shall have fixed arm rest design for single look in single loop piece. The chair have deep cushioned back and seat conform to body contours for proper alignment, posture and all day comfort and pneumatic height adjustment which shall have stroke of 10.0 +/- 0.3 cm . Five star crom base with nylon castors . The seat and back are made up of 10- 12 mm thick hot pressed BWR plywood (IS Grade - 303) upholstered with poly urethane foam. The chair seat has foam of density 30-35 (+/-2kg /m3) and the backrest has a foam of 28 (+/-2kg /m3) . Dimensions tolerance / variations shall be within +/- 1 cm. Complete as per image, and specification under the guidance of Engineer in charge.	2082	each	8000	16656000
31	Hostel Block Study Table				
	Supplying & placing in position of writing table as per photograph. The table of size :- L-750mm x D-600mm x H-750mm shall be made with combination of plywood with laminate. The table top shall be made out of 25mm thick ply board with laminate over it. The table top shall be supported with 18mm thick plyboard with liminate finish. The working and non working edges shall be finished with 2mm thick PVC edge banding. The table shall be provisioned with 1 no. pencil drawer of size :- L- 300mm x D-450mm x H-100mm made with 18mm thick plyboard with laminate finish. The drawer shall be sliding with telescopic channels along with open shelf size 600x500x300mm with two partitions fixed over the table on walls all as per instructions of Engineer-in-charge.	1005	each	13878	13947390
32	Hostel Block Study Chair				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	Supplying and placing in position of cantilever medium back chair as per photograph. The Chaste chair of Size :- (W)590mm X (D)490mm X (H)980mm. The chair shall be ergonomically design contour lumbar back design made of 10-12 mm thick BWP plywood upholstered with fabric and cut foam. The chair shall have fixed arm rest design for single look in single loop piece. The tubular visitor frame shall be Crome Base (DFT 40-60 microns) cantilever structure and made of dia 2.54+/-0.03cm x 0.2+/-0.016cm thick MSERW tube with a connecting M.S spine welded to it. Chair seat has foam of density 30-35 (+/-2kg /m3) Dimensions tolerance / variations shall be within +/- 1 cm.. . Complete as per image, and specification under the guidance of Engineer in charge.	1005	each	7500	7537500
33	Hostel Block Beds				
	Suppling & Placing in Position of Single bed as per photograph. Single bed Size :-W-950mm x L-1900mm. The top of bed is 25mm thick plyboard fixed on support frame made out of 25x25x1.6mm thick MS tube powder coated. The side of bed to be in 50x25x1.4mm thick MS tube powder coated . The fixed head top & foot rest to be made up of 18mm thick ply board with lamination. The legs are made out of 50x25x1.6mm thick MS tube powder coated. All metal parts are of powder coated with 45microns ,fixed with necessary self drilling SS screws/ nut bolts etc complete in all respect as per instruction of Engineer-in-charge.	1005	each	11030.64	11085793.2
34	Hostel Block Wooden Storage Cabinet				
	Providing & Placing Prelaminated Ply Board storage with openable doors of size 1900ht x600d x700mm, made up of 18mm thick prelaminate Ply Board with PVC edge banding with hinged door Height 1800mm. It should Have Hanging Rod Shelves. Lockable Doors with SS Fininsh Handles.All complete as per instructions of Engineer-in-charge.	1005	each	20000	20100000
35	Bed Mattress				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	Providing single bed mattress of size 1900mm(L) x 900mm(W) x 125mm (Thick) having combination of Hard Foam and Soft Foam with Mid layer of Bonded Foam of density =45+/- 2 kg/cum for sturdiness and support, in Different colours and Embossed with a hard side and soft side with Self Quilted Fabric for extra comfort and softness. Mid layer of Bonded foam lends balance and strength to the mattress structure and give the user the flexibility of use by being usable on both sides. Contrasting fabrics make the mattress aesthetically pleasant and complete in all respect as per the direction of Engineer in Charge .	1005	each	7865	7904325
				Total	1818772751
	Add 12.74% cost index on DSR items (as per OM no. DG/Cost Index/10 dated 05.02.2018)				189171233
				Total	2007943984
	Less 9.5% as per PWD Delhi Circular on DSR 2016 items (1484860542+189171233) x9.5%			(-)	159033019
				Total (A)	1848910965
	Part-B ELECTRICAL				
	Sub-Head - I - Internal Electrical Installation				
1	Wiring for light point/ fan point/ exhaust fan point/ call bell point with 1.5 sq. mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit, with modular switch, modular plate, suitable GI box and earthing the point with 1.5 sq.mm. FRLS PVC insulated copper conductor single core cable etc as required.				
a	Group A (Hostel - 3389)	3389	point	845	2863705
b	Group C (Academics - 3454)	3454	point	1213	4189702
2	Wiring for group controlled (looped) light point/fan point/exhaust fan point/ call bell point (without independent switch etc.) with 1.5 sq. mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit, and earthing the point with 1.5 sq. mm FRLS PVC insulated copper conductor single core cable etc. as required.				
a	Group A (Hostel - 580)	580	point	547	317260
b	Group C (Academics - 3620)	3620	point	707	2559340
3	Wiring for light/power plug with 2x4 sq. mm FRLS PVC insulated copper conductor single core cable in surface/recessed steel conduit alongwith 1 No 4 sq. mm FRLS PVC insulated copper conductor single core cable for loop earthing as required. (Hostel - 22700, Academics - 23050)	45750	metre	265	12123750

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

4	Wiring for light/power plug with 4x4 sq. mm FRLS PVC insulated copper conductor single core cable in surface/recessed steel conduit alongwith 2 No 4 sq. mm FRLS PVC insulated copper conductor single core cable for loop earthing as required. (Hostel - 2680, Academics - 11450)	14130	metre	392	5538960
5	Supplying and drawing following sizes of FRLS PVC insulated copper conductor, single core cable in the existing surface / recessed steel / PVC conduit/ cable racewayetc. as required.				
a	6 x 4 sq. mm (Academics - 1800)	1800	metre	221	397800
b	9 x 4 sq. mm (Academics - 2300)	2300	metre	318	731400
6	Wiring for circuit/ submain wiring alongwith earth wire with the following sizes of FRLS PVC insulated copper conductor, single core cable in surface/ recessed steel conduit as required.				
a	2 X 1.5 sq. mm + 1 X 1.5 sq. mm earth wire (Hostel - 6550, Academics - 15159)	21708.57	metre	208	4515382.9
b	2 X 6 sq. mm + 1 X 6 sq. mm earth wire (Hostel - 1000)	1000	metre	356	356000
c	4 X 6 sq. mm + 2 X 6 sq. mm earth wire (Hostel - 1150, Academics - 5340)	6490	metre	529	3433210
d	4 X 10 sq. mm + 2 X 6 sq. mm earth wire (Hostel - 1200, Academics - 1150)	2350	metre	670	1574500
e	4 X 16 sq. mm + 2 X 6 sq. mm earth wire (Hostel - 100)	100	metre	946	94600
7	Supplying & fixing Two Module stepped type electronic fan regulator on the existing modular plate switch box including connections but excluding modular plate etc. as required. (Hostel - 773, Academics - 1377)	2150	each	342	735300
8	Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 6 pin 5/6 & 15/16 amps modular socket outlet and 15/16 amps modular switch, connection etc. as required. (Hostel - 227, Academics - 1231)	1458	each	495	721710
9	Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 2 nos. 3 pin 5/6 A modular socket outlet and 2 nos. 5/6 A modular switch, connections etc. as required. (For light plugs to be used in non residential buildings). (Hostel - 1032, Academics - 1739)	2771	each	582	1612722
10	SITC of following size/ modules, GI box alongwith modular base & cover plate for modular switches in recess etc as required.				
a	1 or 2 Module (75mm X 75mm) (Hostel - 104, Academics - 2306)	2410	each	243	585630
11	Supplying and fixing following modular switch/ socket on the existing modular plate & switch box including connections but excluding modular plate etc. as required.				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

a	TV antenna socket outlet (Hostel - 11, Academics - 6)	17	each	119	2023
12	Supplying and laying co-Axial Cable RG-6 grade, 0.7 mm solid copper conductor PE Insulated, shielded with fine tinned copper braid and protected with PVC sheath in the existing surface/recessed steel/PVC conduit as required. (Hostel - 550, Academics - 300)	850	meter	33	28050
13	Supplying and fixing 20 amps, 240 volts, SPN industrial type, socket outlet, with 4 pole and earth, metal enclosed plug top alongwith 20 amps "C" curve, SP MCB, in sheet steel enclosure, on surface or in recess, with chained metal cover for the socket outlet and complete with connections, testing and commissioning etc. as required. (Hostel - 44)	44	each	1232	54208
	Lift Panel & DB'S				
14	Fabrication, supply, installation, testing and commissioning of wall/floor mounted cubicle panels made out of 2 mm thick CRCA MS sheet steel, all incomngs/outgoings shall be arranged in suitable size compartments, locking arrangement for each compartments, including interconnection with 1100 V grade PVC insulated copper conductor bus bar labelling, earthing, brass compression glands for incoming and outgoing cables, powder coated painting etc. as required.				
	LIFT PANEL -				
	Incoming:				
	100 A, TPN MCCB 36 KA - 1 No.				
	200 A TPN AL. bus bar with coloured heat shrinkable PVC sleeve-1 Set				
	Outgoings:				
	63 A 4P MCCB, 36 KA - 4 Nos.				
	Instruments:				
	Ammeter -1no.				
	Voltmeter -1no.				
	Indication lamp RYB with selector switch etc as req. (Hostel - 3, Academics - 4)	7	each	74855	523985
15	Providing and fixing following rating and breaking capacity and pole MCCB with thermomagnetic release and terminal spreaders in existing cubicle panel board including drilling holes in cubical panel, making connections, etc. as required.				
a	400 A, 35 KA,TP MCCB (For Rising Mains-UPS) (Academics -4)	4	each	21512	86048
b	100/63 Amp, 30 KA, FP MCCB (For Tap Off Box & VTPN DB Incomer) (Hostel - 58, Academics - 44)	102	each	7377	752454
c	125 Amp, 36 KA, FP MCCB (For Tap Off Box & VTPN DB Incomer-Girls Hostel)	2	each	7504	15008

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

d	200 Amp, 36 KA, FP MCCB (For Tap Off Box & VTPN DB Incomer) (Academics - 82)	82	each	15149	1242218
e	400 Amp, 36 KA, FP MCCB (For Rising Mains-Boys Hostel) (Hostel - 1)	1	each	26182	26182
f	630 Amp, 36 KA, FP MCCB (For Rising Mains-Girls Hostel) (Hostel - 1)	1	each	32506	32506
16	Supplying and fixing following way, horizontal type Single pole and neutral, sheet steel, MCB distribution board, 240 V, on surface / recess, complete with tinned copper bus bar, neutral bus bar, earth bar, din bar, interconnections, powder painted including earthing etc. as required. (But without MCB /RCCB / Isolator)				
a	6 way Double door (For Hostel Rooms) (Hostel - 335)	335	each	1661	556435
17	Supplying and fixing of following way Horizontal Type three pole & Neutral sheet steel, MCB distribution board 415 V on surface/recess, complete with tinned copper bus bar, neutral bus bar, earth bar, interconnections powder painted including earthing etc. as required. (but without MCB / RCCB / isolator)				
a	4 way (4 + 12), Double door (Hostel - 35, Academics - 32)	67	each	3068	205556
b	6 way (4 + 18), Double door (Hostel - 46, Academics - 40)	86	each	3693	317598
c	8 way (4 + 24), Double door (Hostel - 1, Academics - 113)	114	each	4601	524514
	Remarks:-DB should have provision for fixing RCCB				
18	Supplying and fixing of following ways surface / recess mounting, vertical type, 415 V, TPN MCB distribution board of sheet steel, dust protected, duly powder painted, inclusive of 200 A, tinned copper bus bar, common neutral link, earth bar, base for mounting MCCBs (but without MCBs and incomer MCCB) as required. (Note : Vertical type MCB TPDB is normally used where 3 phase outlets are required).				
a	4 way (4 + 12), Double door (Hostel - 11, Academics - 54)	65	each	5651	367315
b	8 way (4 + 24), Double door (Hostel - 12, Academics - 10)	22	each	7744	170368
c	12 way (4 + 36), Double door (Hostel - 1)	1	each	9828	9828
19	Supplying and fixing 5 amps to 32 amps rating, 240/415 volts, "C" curve, MCB suitable for inductive load of following poles in the existing MCB DB complete with connections, testing and commissioning etc. as required.				
a	Single pole (Hostel - 2186, Academics - 3816)	6002	each	199	1194398
b	Double Pole (Hostel - 335)	335	each	556	186260
c	Triple pole (Hostel - 72, Academics - 145)	217	each	826	179242
d	Triple pole and neutral (Hostel - 46, Academics - 145)	191	each	1092	208572

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

20	Supplying and fixing following rating, four pole, 415 volts, isolator in the existing MCB DB complete with connections, testing and commissioning etc. as required.				
a	63 amps (Hostel - 36, Academics - 40)	76	each	839	63764
21	Supplying and fixing following rating, double pole, (single phase and neutral), 240 volts, residual current circuit breaker (RCCB), having a sensitivity current upto 300 milliamperes in the existing MCB DB complete with connections, testing and commissioning etc. as req.				
a	25 amps (Hostel - 440)	440	each	1927	847880
b	63 amps (Hostel - 108)	108	each	2640	285120
22	Supplying and fixing following rating, four pole, (three phase and neutral), 415 volts, residual current circuit breaker (RCCB), having a sensitivity current 30 mA in the existing MCB DB complete with connections, testing and commissioning etc. as required.				
a	40 amps (Academics - 145)	145	each	2626	380770
b	63 amps (Academics - 40)	40	each	2777	111080
23	Supplying and fixing following rating, Three pole, 415 volts, MCB in the existing MCB DB complete with connections, testing and commissioning etc. as required.				
a	63 amps (Hostel - 88, Academics - 151)	239	each	1466	350374
24	Providing and fixing M.V. danger plate of 200 mm X 150 mm, made of mild steel, at least 2 mm thick, and vitreous enameled white on both sides, and with inscription in single red colour on front side as required. (Hostel - 30, Academics - 80)	110	each	226	24860
	Rising Mains, Bus Trunking, Cable Tray, Raceway & Cables				
25	Supplying, installing by suspension on ceiling, testing and commissioning of following capacity Sandwich Type Rising Mains for use on 3 phase 4 wire 415 volts, 50Hz A.C. supply with metal clad enclosure having IP-54 rating after fixing the tap off boxes and all accessories, made of 1.6mm thick steel sheet duly powder coated in convenient sections complete with 4 Nos aluminium bus bars having current density of 130 A/ sq cm at nominal current rating, necessary joints, elbow joints & expansion joints and bends, fire barrier at each floor, provision of tapping at every metre, adopter box and copper flexible for joints, continuous earthing with 2 Nos aluminium strip of suitable size (one on each side) including, G.I. clamping brackets, suspenders, angle iron bracket, steel fasteners, connecting to earthing system etc. as required				
a	400 A 25kA SC for 1 sec (Hostel - 38, Academics - 240)	278	metre	12022	3342116

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

b	500 A 30kA SC for 1 sec (For Girls hostel - 38)	38	metre	12837	487806
26	Supplying, installing, connecting to existing Air Insulated Compact Type bus trunking/ rising mains, testing and commissioning of following capacity End Feed Unit for use on 3 phase 4 wire 415 volts, 50 Hz A.C. supply made with 1.6 mm thick steel sheet enclosure duly powder coated with provision of MCCB/ACB (but without MCCB/ACB) complete with necessary joints including clamping brackets, angle iron bracket, steel fasteners, connecting to earthing system etc. as required.				
a	200 amps 15 KA SC for 1 sec (Academics - 2)	2	each	5513	11026
b	400 amps 30 KA SC for 1 sec (Hostel - 1, Academics - 4)	5	each	7307	36535
c	500 amps 35 KA SC for 1 sec (Hostel - 1)	1	each	9344	9344
27	Supplying, installing, connecting to existing Air Insulated Compact Type bus trunking/ rising mains, testing and commissioning of following capacity Plug In/Tap Off Box for use on 3 phase 4 wire 415 volts, 50 Hz A.C. supply with 1.6 mm thick steel sheet enclosure duly powder coated with provision of MCCB (but without MCCB) complete etc. as required.				
a	125 amps 15 KA SC for 1 sec (Hostel - 24, Academics - 20)	44	each	6358	279752
b	200 amps 25 KA SC for 1 sec (Academics - 40)	40	each	8048	321920
28	Supplying & installing following size of perforated pre-painted M.S. cable trays with perforation not more than 17.5% in convenient sections, joined with connectors, suspended from the ceiling with M.S. suspenders including bolts & nuts, painting suspenders etc as required.				
a	150 mm width X 50 mm depth X 1.6 mm thickness (Hostel - 80, Academics - 400)	480	metre	531	254880
b	300 mm width X 50 mm depth X 1.6 mm thickness (Academics - 2000)	2000	metre	621	1242000
29	Providing and fixing 2 mm thick steel sheet factory fabricated post galvanized raceway of the following sizes including providing removable 3 mm thick GI cover, knock out holes and fixing accessories earthing with 8 SWG copper earth wire complete as required including floor supports, bends, access boxes, tap off boxes and cross over as per specification and site requirement.				
a	100 mm wide x 38 mm deep raceway (Academics - 5400)	5400	metre	1039	5610600
	SUPPLY OF 1.1 KV XLPE CABLES				
30	Supplying of PVC insulated XLPE copper conductor unarmoured cable of 1.1 KV grade of following sizes confirming to IS: 7098 (Part I).				
	4 x 16 sq mm (Academics - 60) + FF 150	210	metre	550	115500

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No. of Insertions –I NIL

	4 x 35 sq mm (Hostel - 80, Academics - 120)	200	metre	1198	239600
31	Supplying of PVC insulated XLPE aluminium conductor armoured cable of 1.1 KV grade of following sizes confirming to IS: 7098 (Part I).				
	4 x 35 sq mm (Academics - 550)	550	metre	207	113850
	3.5 x 50 sq mm (Hostel - 600)	600	metre	241	144600
	LAYING OF 1.1 KV XLPE CABLES				
32	Laying and fixing of one number PVC insulated and PVC sheathed /XLPE power cable of 1.1 KV grade of following size on wall/ surface/ cable tray as required.				
a	Upto 35 sq. mm (clamped with 1 mm thick saddle) (Hostel - 80, Academics - 730)	810	metre	39	31590
b	Above 35 sq. mm and upto 95 sq. mm (clamped with 25x3mm MS flat clamp) (Hostel - 560)	560	metre	104	58240
	END TERMINATIONS :				
33	Supplying and making end termination with brass compression gland and aluminium lugs for following size of PVC insulated and PVC sheathed / XLPE aluminium conductor cable of 1.1 KV grade as required.				
a	3½ X 50 sq. mm (35mm) (Hostel - 18)	18	each	329	5922
b	4 X 16 sq. mm (28mm) (Academics - 40)	40	each	250	10000
c	4 X 35 sq. mm (32mm) (Hostel - 48, Academics - 102)	150	each	302	45300
	Installation of Light Fitting, Fans and Fixtures				
34	Installation, testing and commissioning of prewired, fluorescent fitting / LED fittings of all types , complete with all accessories and tube etc. directly on ceiling/wall, including connections with 1.5 sq.mm. PVC insulated, copper conductor, single core cable etc. as required. (Hostel - 3187, Academics - 5689)	8876	each	168	1491168
35	Installation, testing and commissioning of ceiling fan /wall fan including wiring the down rods of standard length (upto 30 cm) with 1.5 sq.mm FRLS PVC insulated, copper conductor, single core cable etc. as required. (Hostel - 773, Academics - 1377)	2150	each	171	367650
36	Installation of exhaust fan in the existing opening, including making good the damage, connection, testing, commissioning etc. as required.				
a	Upto 450 mm sweep (Hostel - 9, Academics - 8)	17	each	363	6171
37	Extra for fixing the louvers / shutters complete with frame for a exhaust fan of all sizes. (Hostel - 9, Academics - 8)	17	each	168	2856
	Supply of Light Fitting, Fans and Fixtures				
38	Supplying of following Surface / Recessed LED light Fittings of Wattage as specified below. The fixture should be complete with driver and suitable mounting accessories etc as required. :-				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

39	8W-10 W BULK HEAD LED (HAVELLS - ENDURA RUGBY NEO - CAT NO.- RUGBYNEONFT10WLED760SSYMBOPC / PHILIPS - CAT NO.- ENDURALED BULKHEAD "WT202W LED6S CW PSU S1 PC" / SURYA - SLE BH - 10W / WIPRO- LW-07-141-XXX-57-XX)(Hostel - 127, Academics - 107)	234	each	1026.034	240091.9
40	9W-10W LED BATTEN LIGHT (MIRROR) (HAVELLS - LUMILINE - BS9WLED865SPCWH / PHILIPS - CAT NO.- BN 021 LED10S- 6500 PSU GR S1 / WIPRO - CAT NO.- TRIM LED LL20-111-XXX-65NE) (Hostel - 1236, Academics - 35)	1275	each	332.2395	423605.36
41	Integral round shaped surface mounted - 15W - 18 W LED D/L SURFACE (HAVELLS - INTEGRA NEO (SURFACE) - CAT NO.- INTEGRANEOSUIRFACEDLS15WLED857S / OSRAM - Cat no: LUXSMART LED-AM0710100GS-Luxsmart Ceiling light 16 W 865 / PHILIPS - CAT NO.- SM251C LED16S- 6500 PSU WH / WIPRO - CAT NO.- IRIS LED SLIM RO-SM-LD80-171-XXX-60-SM) (Hostel - 1096, Academics - 687)	1783	each	908.7728	1620341.8
42	Integral round shaped recessed mounted -15W-18 W LED D/L (HAVELLS - EDGEPRO ROUND - CAT NO.- EDGEPRODLR15WLED857S / LIGHTING TECHNOLOGY -CAT NO.-Recessed Mounted LED D/L MOON V2 MV1557RL00 / PHILIPS - CAT NO.- DN 395B LED20S-6500 PSU WH / WIPRO - CAT NO.- IRIS LED LD80-131-XXX-60-XX / OSRAM - 4052899495395- KIT LUXSMART LED DL 15 W 865)(Academics - 562)	562	each	879.4575	494255.12
43	Integral sqare shaped recessed mounted - 15W - 18 WLED D/L RECESSED (300X300) (HAVELLS - PLUTO RECESSED - CAT NO. - PLUTO1X1PLR15WLED857S / LIGHTING TECHNOLOGY -CAT NO.- Dice -D01557R000 / WIPRO - CAT NO.- IRIS LED SLIM SQ-SM - LD80-171-XXX-60-SM) (Hostel - 165, Academics - 630)	795	each	1371.302	1090185.3
44	20W - 22W LED TUBE BATTEN (HAVELLS - ENDURA LINEAR NEO CAT NO.- ENDURALINEARNEOBS20WLED865SPCWH / OSRAM - 4052899509658- LUXSMART LED BAT 22 W 865 / PHILIPS - CAT NO.- ENDURALED BATTEN "BN 021LED 20S PSU CW GR S2 / WIPRO - CAT NO.- TRIM LED LLD-281-XXX-65-AL1) (Hostel - 315, Academics - 412)	727	each	553.7325	402563.53
45	36 W - 40 W LED SQUARE FIXTURE RECESSED (600X600) (HAVELLS - VENUS NEO HE - CAT NO.-VENUSNEOHE2X2PLR18-42WLED865MOD / SURYA ULTRA SLIM - SLE FP 36 R22 / PHILIPS - CAT NO.- RC380B LED36S -6500 G4 L60 W60 PSU OD / WIPRO - CAT NO.- ELATE LED CRC010R038HP57GL-36 / OSRAM - 4052899431515 LUXPOWER -	3161	each	2371.278	7495609.8

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	FGHE 36 W 865 / REGENT - Zen22LED-LED0816RW4005950040J7) (Hostel - 28, Academics - 3133)				
46	40W LED Batten LED (HAVELLS - STOUT PLUS - CAT NO.- STOUT PLUS1200BS40 WLED840SPCWH / LIGHTING TECHNOLOGY - CAT NO.-CANE SURFACE LG7- C04357000 / PHILIPS - CAT NO.-ENDURALED BATTEN "BN 308C LED 40S 6500 L120 PSU WH / OSRAM - 4052899491533 LUXPOWER - BATTEN 40W 865) (Hostel - 29, Academics - 119)	148	each	2084.64	308526.72
47	36 W - 40 W LED SQUARE FIXTURE RECESSED (600X600) (REGENT - NUANCE-LED0702RW4005950040J7 / LIGHTING TECHNOLOGY -CAT NO.-FULL LIT LOW DEPTH 35W 5700K LED F03557ROLO / PHILIPS - POWERBALANCE-RC600B LED40S/865 PSU W60L60 IN) FOR HOD, DEAN , CONFERENCE Rooms only. (Academics - 48)	48	each	4909.327	235647.71
48	25-28W LED Suspended Light with Aluminium extruded suitable for ceiling suspension (Suspension system included). (Havells-DESTELLO SUSPENDEED - DESTELLO070LP/S25WLED857SPMMAWH / REGENT - SLASH LED - LED0571PA2811780028J7 / PHILIPS - Pureline Slim Surface & Suspended-SP780 P LED26S-6500 PSU W6L112 OD SI) FOR HOD, DEAN , CONFERENCE Rooms only. (Academics - 12)	12	each	4983.593	59803.11
49	Integral round shaped surface mounted 6W LED D/L SURFACE (HAVELLS - COMET ROUND - CAT NO.- LHEAAVP7IL1W006 / PHILIPS - CAT NO. - DN091B LED6S-6500 PSU WH / LIGHTING TECHNOLOGY - LUNAR MIN - CAT NO.- L00657S000 / WIPRO - IRIS LED SLIM RO/SQ - CAT NO.- SM-LD80-350-XXX-60-SM) (Hostel - 44)	44	each	684	30096
50	Integral round shaped surface mounted 10/12W LED D/L SURFACE (HAVELLS - COMET ROUND - CAT NO.- LHEAAVP7IL1W012 / PHILIPS - CAT NO. - DN092B LED10S-6500 PSU WH / LIGHTING TECHNOLOGY -LUNAR MID - CAT NO.- L001257S00 / WIPRO - IRIS LED SLIM RO/SQ - CAT NO.-LD80-101-XXX-60-SM) (Hostel - 140)	140	each	844	118160
51	15W FANCY WALL BRACKET - (HAVELLS - CITY 1-CAT NO.- LHDL02160099 & LHLDEREEMK8X015 / KLITE-WALL CYLIN VIVID CAT NO. 3694 GU10 HOLDER W2) (Hostel - 7)	7	each	993	6951
52	Supplying of Ceiling fans suitable for 230 Volt, 50 Hz, Single phase, A.C. supply and complete without speed regulator all standard accessories such as blades & capacitor etc. Crompton-Cat no. Aura Plus-5 Star Rating or similar from approved makes. (Havells -ES-50 -5 star rating				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	& Bajaj- Cat No. 250524-Electra 50)				
a	3 Blade-1200 mm Ceiling fan (Hostel - 773, Academics - 1377)	2150	each	1623	3489450
53	Supplying of Exhaust fans suitable for 230 Volt, 50 Hz, Single phase, A.C. supply and complete with all standard accessories required. Crompton- Heavy Duty Exhaust Fans-Cat no.- EXHD450-6-1 or similar from approved makes. (Havells-Heavy Duty Exhaust Fans Turbo Force SP & Bajaj - Cat no. 70060 Industrial Exhaust fans Supreme Dlx 450mm)				
a	450 mm dia. (Hostel - 9, Academics - 8)	17	each	3910	66470
	Lighting Control				
54	Supplying, installation, testing and commissioning of Microwave technology based occupancy sensor having high performance, non regulating programmable type, suitable for connected load upto 10 A, for mounting height up to 2.6 meter and for 5m X 20m coverage area along with necessary fixing arrangements i/c programming at site etc. complete as required. (Hostel - 74, Academics - 80)	154	each	8615	1326710
	Sub Head - II - Fire Detection & PA System				
55	Supplying, installation, testing & commissioning of intelligent analog addressable photothermal detector complete with mounting base complete as required. (Hostel - 30, Academics - 2368)	2398	each	2846	6824708
56	Supplying, installation, testing & commissioning of intelligent addressable thermal detector with rate of rise cum fixed temperature thermister complete with base as required.(Academics - 80)	80	each	2713	217040
57	Supplying, installation, testing & commissioning of addressable fire control module complete as required.(Hostel - 45, Academics - 75)	120	each	2990	358800
58	Supplying, installation, testing & commissioning of addressable horn cum strobe complete as required.(Hostel - 92, Academics - 71)	163	each	3494	569522
59	Supplying, installation, testing & commissioning of addressable manual call point complete as required.(Hostel - 94, Academics - 91)	185	each	3859	713915
60	Supplying, installation, testing & commissioning of intelligent interface unit BACnet/ Modbus protocol i.e. supplying communication links between building management system and fire alarm control panel complete as required.(Hostel - 2, Academics - 2)	4	each	187732	750928
61	Supplying, installation, testing & commissioning of response indicator on surface / recessed MS Box having two LED, metallic cover complete with all connections etc as required. (Academics - 1191)	1191	each	263	313233
62	Supplying, installation, testing & commissioning of fire fighter telephone handset complete as	40	each	5727	229080

No. of Correction –C NIL
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No. of Insertions –I NIL

	required.(Academics - 40)				
63	Supplying, installation, testing & commissioning of fire fighter phone jack complete as required. complete with base as required.(Academics - 40)	40	each	1587	63480
64	Supplying, installation, testing & commissioning of fault isolator complete with base as required.(Hostel - 6, Academics - 125)	131	each	3257	426667
65	Supplying, installation, testing & commissioning of central graphical fire alarm management system to centrally monitor and operate the fire alarm system complete as required.(Hostel - 2, Academics - 2)	4	each	200148	800592
66	Supplying, installation, testing and commissioning of micro processor based intelligent addressable main fire alarm panel, central processing unit with the following loop modules and capable of supporting not less than 240 devices (including detectors) and minimum 120 detectors per loop and loop length up to 2 km, network communication card, minimum 320 character graphics/ LCD display with touch screen or other keypad and minimum 4000 events history log in the non volatile memory (EPROM), power supply unit (230 \pm 5% V, 50 hz), 48 hrs back-up with 24 volt sealed maintenance free batteries with automatic charger. The panel shall have facility to connect printer to printout log and facility to have seamless integration with analog/digital voice evacuation system (which is part of the schedule of work under SH: PA System) and shall be complete with all accessories . The panel shall be compatible for IBMS system with open protocol BACnet/ Modbus over IP complete as per specifications.				
a	10 loop Panel (Academics - 3)	3	each	454896	1364688
b	2 loop Panel (Hostel - 2)	2	each	238907	477814
67	Supplying, installation, testing & commissioning of 6 zone, voice alarm controller with USB, MP3 player (including 6 zone button paging station) with seamless integration facility with main fire alarm panel for voice evacuation complete as required. (Hostel - 2)	2	each	126399	252798
68	Supplying, installation, testing & commissioning of 3W metal box ceiling/wall speakers complete as required. (Hostel - 129, Academics -445)	574	each	1780	1021720
69	Supplying, installation, testing & commissioning of ceiling/wall mounted loud speaker, 3/1.5 Watt in ABS enclosure complete as required. (Hostel - 6)	6	each	2416	14496
70	Supplying, installation, testing & commissioning of digital audio amplifier 75 Watt, 25V rms operating at 240 Volt AC Supply complete as required. (Hostel - 6, Academics - 20)	26	each	145780	3790280
71	Supplying and drawing of cable Fire Retardant PVC insulated copper conductor cable in the				

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No. of Insertions –I NIL

	existing surface / recessed steel conduit of following pairs, cores and size including connections and interconnections etc. as required.				
a	speaker cable Two pair, 2-core, 1.5 sqmm (Hostel - 2200, Academics - 2800)	5000	each	85	425000
72	Supplying and fixing of following sizes of steel conduit along with accessories in surface/recess including painting in case of surface conduit, or cutting the wall and making good the same in case of recessed conduit as required.				
a	25 mm (Hostel - 6200, Academics - 16800)	23000	metre	165	3795000
73	Supplying and drawing following sizes of FR PVC insulated copper conductor, single core cable in the existing surface/ recessed steel/PVC as required.				
a	2 x 1.5 sq. mm (Hostel - 4000, Academics - 14000)	18000	metre	41	738000
	Sub Head - III - Cabling & LAN, EPABX System				
	PASSIVE LAN SYSTEM				
74	Supplying and fixing of following sizes of steel conduit along with accessories in surface/recess including painting in case of surface conduit, or cutting the wall and making good the same in case of recessed conduit as required.				
a	25 mm (Hostel - 15300, Academics - 5800)	21100	metre	165	3481500
75	Supplying and drawing of UTP 4 pair CAT 6 LAN Cable in the existing surface/ recessed Steel/ PVC conduit/Raceway as required				
a	1 run of cable (Hostel - 15300, Academics - 74000)	89300	metre	49	4375700
76	Supply , Installtion , Testing and comissioning of CAT6 information outlet (I/O) for Data, Voice & Wi-Fi rack end. (Hostel - 93, Academics - 2300)	2393	Nos	337	806441
77	Supply , Installtion , Testing and comissioning of loaded 24 port CAT6 jack panel for CAT6 cable termination. (Hostel - 13, Academics - 105)	118	Nos	8157	962526
78	Supply , Installtion , Testing and comissioning of CAT6 patch cord 3 feet for rack side switch termination for user End. (Hostel - 93, Academics - 2300)	2393	Nos	275	658075
79	Supply , Installtion , Testing and comissioning of CAT6 patch cord 7 feet for user termination to information outlet Rack End. (Hostel - 300, Academics - 2516)	2816	Nos	289	813824
80	Supply , Installtion , Testing and comissioning of 1, 2 and 4 port face plate white for I/O fixing at user side. (Hostel - 93, Academics - 2300)	2393	Nos	112	268016
81	Supply , Installtion , Testing and comissioning of 42 U (600W/1000D) floor mount rack with fans , 2 cable managers , satationary shelf , 2 Nos of hardware pkts. (Academics - 2)	2	Nos	63188	126376
82	SITC of 600 mm x 800 mm 22 U Free standing cabinet with front locable door, side panels, 230	10	each	19261	192610

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No. of Insertions –I NIL

	V AC 90 CFM fan 2 , three Hardware packet 1 set (containing 20 Nos each of 3), AC power strip. Cantilever Tray 1U 225D, one earthing Strip 150 mm H,1 Cable manager 1U height nominal size. (Academics - 10)				
83	Supply , Installtion , Testing and comissioning of 15U wall mount rack with fans , 2 cable managers , satationary shelf , 2 Nos of hardware pkts. (Hostel -3, Academics - 20)	23	Nos	12956	297988
84	Supply , Installtion , Testing and comissioning of armoured 6 core Multimode OM3 OFC cable for interfloor switch connectivity. (Hostel - 250, Academics - 600)	850	Mtr	286	243100
85	Supply , Installtion , Testing and comissioning of 6 port loaded LIU with adaptor plates , pigtel cables for connections. (Hostel - 2, Academics - 20)	22	Nos	10286	226292
86	Supply , Installtion , Testing and comissioning of 24 port loaded LIU for core switch to access switch connectivity over fiber. (Academics - 6)	6	Nos	22341	134046
87	Supply , Installtion , Testing and comissioning of LC-LC Multimode fiber patch cord. (Hostel - 4, Academics - 40)	44	Nos	1736	76384
	IP-PBX SYSTEM				
88	Supply, Installation, Testing & Commissioning of IP at Core Pure Server based IP-PABX in Active-Active (1+1) mode & expandible upto 20000 users with below configuration. 50 IP extentions. 450 Analog extentions) 02 x PRI trunk gateway with CLI (30 Channel) 08 Port Analog trunk gateway with CLI 04 Port In-skin Voice Mail for each user 01- IP based Operator console 120 Party conference bridge In-built Music on hold Speed dial facility (Internal & External) Call Forwarding Call Pickup Call barring Remote Maintenance Internal/ External ring difference DID/DOD Facility Approved Makes: Tadiran/Cisco /Polycom (Academics - 1)	1	Set	3282264	3282264
89	Supply, Installation, Testing & Commissioning of CLI Base Analog Phone for user end. (Academics - 400)	400	Nos	2115	846000
90	Supply, Installation, Testing & Commissioning of Type 2 IP Phone 1 VoIP account , Full duplex speaker phone, IPV6, 2xLAN, PoE. (Academics - 11)	11	Nos	15956	175516
	LOCAL AREA NETWORK (LAN)	0			
91	Supply, Installation, Testing & Commissioning of Core Switch with switching capacity of 1.4Tbps,	2	Nos	779577	1559154

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	forwarding performance of 1Bpps with 32x 1/10G SFP+ ports plus 4x 40G QSFP+ ports from day 1, dual hot swappable internal power supply, 60K IPv6 routes and 48K IPv6 multicast routes. Should support advance layer 3 (RIPng, OSPF, BGP and MPLS) with 1 year support. Stack Module/40 Gig Optics and all other Cables should be included in Day 1. (Academics - 2)				
92	Supply, Installation, Testing & Commissioning of 48 Port POE+ Access Switches with switching capacity of 300Gbps, forwarding performance 230Mpps, having 48x 10/100/1000BASE-T PoE-plus(RJ45) with minimum PoE budget of 740W and 4x 10G SFP+ uplink ports, should have separate Stacking ports with min 128Gbps stacking bandwidth stackable up to minimum 9 units. Should support min 2GB internal DRAM, 2GB internal Flash memory, 30K MAC address, 2K IPv6 Multicast Routes, Should have RIPng from day 1 and support OSPF, BFD and VRRP with 1 year support. (Academics - 10)	10	Nos	326992	3269920
93	Supply of fiber Modules 10GBASE Multi Mode fiber Module support Upto 220 & 550 meters long Distance , LC connector, Industrial Temp. (Hostel - 2, Academics - 40)	42	Nos	56851	2387742
94	Supply, Installation, Testing & Commissioning of 24 Port POE+ Access Switches with switching capacity of 300Gbps, forwarding performance 230Mpps, having 24x 10/100/1000BASE-T PoE-plus(RJ45) with minimum PoE budget of 370W and 4x 10G SFP+ uplink ports, should have separate Stacking ports with min 128Gbps stacking bandwidth stackable up to minimum 9 units. Should support min 2GB internal DRAM, 2GB internal Flash memory, 30K MAC address, 2K IPv6 Multicast Routes, Should have RIPng from day 1 and support OSPF, BFD and VRRP with 1 year support. (Hostel - 13, Academics - 85)	98	Nos	237843	23308614
95	Supply , Installation , Testing and Comissioning of 3X3 MIMO , 802.11 a/b/g/n Indoor Wi-Fi-Access point ,dynamic radio management . (Hostel - 70, Academics - 149)	219	Nos	38281	8383539
96	Supply , Installation , Testing and comissioning of wireless LAN Controller supportable for AP upgradable for Aps in standalone and 100 Aps in high availability mode. (Hostel - 2, Academics - 2)	4	Nos	569786	2279144
	Sub Head - IV - UPS System				
97	SITC of microprocessor based UPS System, at 0.8 power factor true online double conversion UPS using PWM IGBT technology, 3 Phase input 430 V + 10 % - 15% and input frequency 50 Hertz plus minus 5%, 3 phase output fixed setting at 380,415 and 430 V, UPS operating in				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	parallel redundancy mode and each comprising of the following.				
	125% rated rectifier cum charger unit + 100% rated inverter, integrated in UPS module.				
	Anit harmonic filter at rectifier input for achieving THD < 5% and input power factor of greater than 0.9.				
	100% rated inbuilt galvanic isolation transformer of H-class delta/ Zigzag type at the inverter output.				
	100% rated inbuilt static switch at the inverter output.				
	100% rated inbuilt static switch at the static bypass line.				
	100% rated inbuilt Maintenance bypass.				
	100% rated MCCB having I Thermal, magnetic and automatic U/V trip mechanics.				
	Web-enabled monitoring and management through SNMP protocols for multi-OS environment.				
	RS232/ RS486 BMS connectivity with software.				
	Built in circulating fan.				
	Supply, Installation, Testing & commissioning of sealed valve regulated lead Acid batteries (minimum life 5 years) for UPS system, for providing 30 minutes backup.				
	Supply/ fixing of matching racks to house batteries for the UPS system.				
	UPS incoming and outgoing LT panels as required including interconnection with copper conductor cabling.				
	2 X 60 KVA (Academics - 2)	2	set	1865165	3730330
	Sub Head : V - CCTV SYSTEM				
98	Supply, installation, testing, Commissioning of IR VANDAL DOME CAMERA 1/3" Progressive CMOS, ICR, 0.01lux/F1.4 4MP 2560x1440:25 fps(P) / 30fps(N), 2.7 -12 mm / F2.0 motorized VF lens, H.265, H.264/MJPEG, Triple-stream IP67, DC12V & PoE, True WDR upto 120dB, 3D DNR, BLC, IR: up to 30m, On-board card slot (up to 128GB), Audio In/Out : 1/1, Alarm In/Out 1/1, ONVIF, CE, FCC, UL LISTED, Motion based recording. (For Indoor Use). (Hostel - 128, Academics - 207)	335	each	11525	3860875
99	Supply, installation, testing, Commissioning of IR BULLET CAMERA 1/3" Progressive CMOS, ICR, 0.01lux/F1.4 4MP 2560x1440:25fps(P)/30fps(N), 2.7 -12 mm/F2.0 motorized VF lens, H.265, H.264/MJPEG, Triple-stream, IP67, DC12V & PoE, True WDR upto 120dB, 3D DNR, BLC, IR: up to 60m, On-board card slot (up to 128GB), Audio In/Out : 1/1, Alarm In/Out 1/1, ONVIF, CE, FCC, UL LISTED, Motion based recording and mounted	87	each	11525	1002675

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	on wall or any other available supports above ground level including all Ancillary Equipment & accessories complete as per specifications. (For Outdoor Use). (Hostel - 79, Academics - 8)				
100	Supply, Installation, testing and commissioning of 32 CH NVR with 30 TB storage (min 30 days recording @ 4MP, 25fps), 8 SATA Interfaces (up to 8TB capacity per Slot), Connectable to the third-party network cameras, alarm I/O: 16/6, 19" HDMI/VGA output at up to 4K (3840*2160). support live view, storage and playback at up to 12 MP resolution, total throughput 640 Mbps, H.265/H.264/MJPEG/MPEG4 codec decoding, 2xHDMI, 1xVGA, 1x eSATA port, 1x RS485, 1x RS232, 4x USB Ports, 2x Giga Ethernet Ports, Should support Raid 0/1/5/6/10 ON VIF, UL LISTED. CERTIFICATE CE & FCC. (Hostel - 8, Academics - 8)	16	each	107300	1716800
101	Supply, Installation, Testing and commissioning of Monitor, 55" LED high resolution monitor with high performance 240VAC, 50 Hz. 24x7 for spot display including all accessories as per specifications and as required to complete the system. (Hostel - 2, Academics - 2)	4	each	59611	238444
102	Supply, Laying, Commissioning of 24 channel POE switch (located in shaft / field) (Hostel - 11, Academics - 11)	22	each	17632	387904
103	Supply, Laying, Commissioning of 24 Port Jack panel. (Hostel - 11, Academics - 11)	22	each	2634	57948
104	Supply, installing, testing and commissioning of 4th Generation Intel Core i7 processor, 2 x 8 TB HDD, 8 GB DDR 3 RAM, DVD Drive (Reads and Writes DVD) PC with 32" TFT monitor, key board & mouse including OS & all basic software and Suitable Graphic card, network switch etc. This computer shall be used for above CCTV system. (Hostel - 2, Academics - 2)	4	each	90829	363316
105	SITC of microprocessor based UPS System, at 0.8 power factor true online double conversion UPS using PWM IGBT technology, Input 160 V - 260 V, 50 +/- 3% Hz, Single phase, output 230V +/-1% (with alternative setting for 220V +/-1%) and input frequency 50 Hertz plus minus 0.5%, single phase output. UPS operating in parallel redundancy mode and each comprising of the following.				
	125% rated rectifier cum charger unit + 100% rated inverter, integrated in UPS module.				
	Anit harmonic filter at rectifier input for achieving THD < 5% and input power factor of greater than 0.9.				
	100% rated inbuilt galvanic isolation transformer of H-class delta/ Zigzag type at the inverter output.				
	100% rated inbuilt static switch at the inverter				

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

	output.				
	100% rated inbuilt static switch at the static bypass line.				
	100% rated inbuilt Maintenance bypass.				
	100% rated MCCB having I Thermal, magnetic and automatic U/V trip mechanics.				
	Web-enabled monitoring and management through SNMP protocols for multi-OS environment.				
	RS232/ RS486 BMS connectivity with software.				
	Built in circulating fan.				
	Supply, Installation, Testing & commissioning of sealed valve regulated lead Acid batteries (minimum life 2 years) for UPS system, for providing 30 minutes backup.				
	Supply/ fixing of matching racks to house batteries for the UPS system.				
	UPS incoming and outgoing LT panels as required including interconnection with copper conductor cabling.				
	1 X 5 KVA (Hostel - 2, Academics - 2)	4	each	104319	417276
	Sub Head - VI - Solar Hot Water System				
106	Supply, installation, testing and commissioning of solar water heating system of capacity 2000 ltrs suitable for following specifications and capacities, complete with necessary storage tanks, insulation, GI piping, valves ,gaskets, support brackets, CC foundation and accessories complete as required .				
	Technical specifications:				
	System output temperature - 60 degree C				
	The solar panels shall confirm to BIS - 12933 part- I				
	Circulation type / thermosyphon system				
	The stainless steel water tank made of stainless steel of 304 grade and 2mm thick, duly insulated with 100mm thick rockwool of 48Kg /Cum density, duly cladded with aluminium sheet of 24SWG thickness				
	Support stand made of 50x50x5mm angle iron on suitable 1:2:4 CC foundation block.				
	The GI pipes with accessories shall be insulated with 50mm thick rockwool of 48Kg/ cum, and duly cladding with aluminium sheet of 26 SWG thickness (For Hot water lines) (Hostel - 12)	12	Set	304261	3651132
	Sub Head : VII - Lift				
107	Supplying, installation, testing & commissioning of 16 Passenger lifts (1088 Kgs) Machine room type & gearless having contract speed of 1.5 Metres Per Second serving different floor in the lift shaft as per detailed specifications as under (For academic block) :-				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

(i) Speed	: 1.5 MPS				
(ii) Floors	: B+G+8 (Academic Block)				
(iii) Travel	: 36 mtrs (approx.)				
(iv) Stops & opening	: 10 Stops (B+G+8 Floors) & 10 opening on same side.				
(v) Controller:	A.C. variable voltage & variable frequency				
(vi) Automatic rescue device	complete with dry maintenance free batteries as required.				
(vii) Operation	: Microprocessor based single automatic push button Duplex selective collective with / without attendant				
(viii) Power	- 415 V, 3 phase, 50 Hz, 4 wires system				
(ix) Type of doors					
(a) Car Doors:	Automatic Power operated, center opening, horizontal sliding patterned, stainless steel Scratch Resistant hairline finish (Moonrock) frame with fire rated thick glass panel on front				
(b) Landing Doors:	Automatic Power operated, center opening, horizontal sliding patterned, stainless steel Scratch Resistant hairline finish (Moonrock) frame and will have fire resistance rating of one hour glass panel on front.				
(x) Car body	will be of scratch proof SS (Moonrock finish).				
(xi) Full height Infra Red / LAMBDA protection	is to be provided for landing/ car doors.				
(xii) Provision of Toe guards, Fireman's switch etc.					
A Stainless steel hand rail	of full width and length at 900mm above floor level to be fixed on all three sides in the lift car.				
Car Operating Panel	- 2 Nos. for each lift.				
Button in car operating panel & landing operating panel	shall be having Braille Inscription & shall be fixed for the handicapped.				
Voice announcement system	in the car to announce the position of the elevator in the hoistway as the car passes or stops at a floor served by the elevator.				
Car ceiling	SS Mirror finish metal false ceiling with pressure fan and sufficient no. of LED light fittings for minimum 150 Lux				
Car flooring	Granite Tile to be provided of approved shade by Architect.				
Lift installation	shall include all safety & control features as specified in the specifications with BMS compatability i/c providing spare parts such as card etc. required for BMS compatability & nothing extra will be paid in this regard.				
The features required for use of the lift by handicapped persons	easy hand rail, braile	8	each	3286187	26289496

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	signage closing speed of doors etc.				
108	Supplying, installation, testing & commissioning of 16 Passenger lifts (1088 Kgs) Machine room type & gearless having contract speed of 1.5 Metres Per Second serving different floor in the lift shaft as per detailed specifications as under (For Fire Tower academic block) :-				
	(i) Speed : 1.5 MPS				
	(ii) Floors : G+8 (Fire Tower)				
	(iii) Travel : 32 mtrs (approx.)				
	(iv) Stops & opening : 9 Stops (G+8 Floors) & 9 opening on same side.				
	(v) Controller: A.C. variable voltage & variable frequency				
	(vi) Automatic rescue device complete with dry maintenance free batteries as required.				
	(vii) Operation : Microprocessor based single automatic push button Simplex with / without attendant				
	(viii) Power - 415 V, 3 phase, 50 Hz, 4 wires system				
	(ix) Type of doors				
	(a) Car Doors: Automatic Power operated, center opening, horizontal sliding patterned, stainless steel Scratch Resistant hairline finish (Moonrock) frame with fire rated thick glass panel on front				
	(b) Landing Doors: Automatic Power operated, center opening, horizontal sliding patterned, stainless steel Scratch Resistant hairline finish (Moonrock) frame and will have fire resistance rating of two hour glass panel on front.				
	(x) Car body will be of scratch proof SS (Moonrock finish).				
	(xi) Full height Infra Red / LAMBDA protection is to be provided for landing/ car doors.				
	(xii) Provision of Toe guards, Fireman's switch etc.				
	A Stainless steel hand rail of full width and length at 900mm above floor level to be fixed on all three sides in the lift car.				
	Car Operating Panel - 2 Nos. for each lift.				
	Button in car operating panel & landing operating panel shall be having Braille Inscription & shall be fixed for the handicapped.				
	Voice announcement system in the car to announce the position of the elevator in the hoistway as the car passes or stops at a floor served by the elevator.				
	Car ceiling SS Mirror finish metal false ceiling with pressure fan and sufficient no. of LED light fittings for minimum 150 Lux				
	Car flooring Granite Tile to be provided of				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	approved shade by Architect.				
	Lift installation shall include all safety & control features as specified in the specifications with BMS compatability i/c providing spare parts such as card etc. required for BMS compatability & nothing extra will be paid in this regard.				
	The features required for use of the lift by handicapped persons easy hand rail, braile signage closing speed of doors etc.	3	each	3154739	9464217
109	Supplying, installation, testing & commissioning of 10 Passenger lifts (680 Kgs) Machine room type & gearless having contract speed of 1.5 Metres Per Second serving different floor in the lift shaft as per detailed specifications as under (For Fire Tower Girls Hostel 2 Nos. & Boys Hostel 1 No.) :-				
	(i) Speed : 1.5 MPS				
	(ii) Floors : G+11 (Fire Tower Girls Hostel & Boys Hostel)				
	(iii) Travel : 37 mtrs (approx.)				
	(iv) Stops & opening : 12 Stops (G+11 Floors) & 12 opening on same side.				
	(v) Controller: A.C. variable voltage & variable frequency				
	(vi) Automatic rescue device complete with dry maintenance free batteries as required.				
	(vii) Operation : Microprocessor based single automatic push button Simplex with / without attendant				
	(viii) Power - 415 V, 3 phase, 50 Hz, 4 wires system				
	(ix) Type of doors				
	(a) Car Doors: Automatic Power operated, center opening, horizontal sliding patterned, stainless steel Scratch Resistant hairline finish (Moonrock) frame with fire rated thick glass panel on front				
	(b) Landing Doors: Automatic Power operated, center opening, horizontal sliding patterned, stainless steel Scratch Resistant hairline finish (Moonrock) frame and will have fire resistance rating of two hour glass panel on front.				
	(x) Car body will be of scratch proof SS (Moonrock finish).				
	(xi) Full height Infra Red / LAMBDA protection is to be provided for landing/ car doors.				
	(xii) Provision of Toe guards, Fireman's switch etc.				
	A Stainless steel hand rail of full width and length at 900mm above floor level to be fixed on all three sides in the lift car.				
	Button in car operating panel & landing operating panel shall be having Braille Inscription & shall be fixed for the handicaped.				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	Voice announcement system in the car to announce the position of the elevator in the hoistway as the car passes or stops at a floor served by the elevator.				
	Car ceiling SS Mirror finish metal false ceiling with pressure fan and sufficient no. of LED light fittings for minimum 150 Lux				
	Car flooring Granite Tile to be provided of approved shade by Architect.				
	Lift installation shall include all safety & control features as specified in the specifications with BMS compatability i/c providing spare parts such as card etc. required for BMS compatability & nothing extra will be paid in this regard.				
	The features required for use of the lift by handicapped persons easy hand rail, braile signage closing speed of doors etc.	3	each	3212237	9636711
110	Supplying, installation, testing & commissioning of 10 Passenger lifts (680 Kgs) Machine room type & gearless having contract speed of 1.5 Metres Per Second serving different floor in the lift shaft as per detailed specifications as under (For Girls Hostel 3 Nos. & Boys Hostel 1 No.) :-				
	(i) Speed : 1.5 MPS				
	(ii) Floors : B+G+11 (Girls Hostel & Boys Hostel)				
	(iii) Travel : 40 mtrs (approx.)				
	(iv) Stops & opening : 13 Stops (B+G+11 Floors) & 13 opening on same side.				
	(v) Controller: A.C. variable voltage & variable frequency				
	(vi) Automatic rescue device complete with dry maintenance free batteries as required.				
	(vii) Operation : Microprocessor based single automatic push button Duplex selective collective with / without attendant				
	(viii) Power - 415 V, 3 phase, 50 Hz, 4 wires system				
	(ix) Type of doors				
	(a) Car Doors: Automatic Power operated, center opening, horizontal sliding patterned, stainless steel Scratch Resistant hairline finish (Moonrock) frame with fire rated thick glass panel on front				
	(b) Landing Doors: Automatic Power operated, center opening, horizontal sliding patterned, stainless steel Scratch Resistant hairline finish (Moonrock) frame and will have fire resistance rating of two hour glass panel on front.				
	(x) Car body will be of scratch proof SS (Moonrock finish).				
	(xi) Full height Infra Red / LAMBDA protection is to be provided for landing/ car doors.				
	(xii) Provision of Toe guards, Fireman's switch				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	etc.				
	A Stainless steel hand rail of full width and length at 900mm above floor level to be fixed on all three sides in the lift car.				
	Button in car operating panel & landing operating panel shall be having Braille Inscription & shall be fixed for the handicapped.				
	Voice announcement system in the car to announce the position of the elevator in the hoistway as the car passes or stops at a floor served by the elevator.				
	Car ceiling SS Mirror finish metal false ceiling with pressure fan and sufficient no. of LED light fittings for minimum 150 Lux				
	Car flooring Granite Tile to be provided of approved shade by Architect.				
	Lift installation shall include all safety & control features as specified in the specifications with BMS compatability i/c providing spare parts such as card etc. required for BMS compatability & nothing extra will be paid in this regard.				
	The features required for use of the lift by handicapped persons easy hand rail, braile signage closing speed of doors etc.	4	each	3314612	13258448
111	Supplying, installation, testing & commissioning of 20 Passenger cum Stretcher lifts (1360 Kgs) Machine room type & gearless having contract speed of 1.5 Metres Per Second serving different floor in the lift shaft as per detailed specifications as under (For Girls Hostel & Boys Hostel) :-				
	(i) Speed : 1.5 MPS				
	(ii) Floors : B+G+11 (Girls Hostel & Boys Hostel)				
	(iii) Travel : 40 mtrs (approx.)				
	(iv) Stops & opening : 13 Stops (B+G+11 Floors) & 13 opening on same side.				
	(v) Contoller: A.C. variable voltage & variable frequency				
	(vi) Automatic rescue device complete with dry maintenance free batteries as required.				
	(vii) Operation : Microprocessor based double automatic push button Duplex selective collective with / without attendant				
	(viii) Power - 415 V, 3 phase, 50 Hz, 4 wires system				
	(ix) Type of doors				
	(a) Car Doors: Automatic Power operated, center opening, horizontal sliding patterned, stainless steel Scratch Resistant hairline finish (Moonrock) frame with fire rated thick glass panel on front				
	(b) Landing Doors: Automatic Power operated, center opening, horizontal sliding patterned,				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	stainless steel Scratch Resistant hairline finish (Moonrock) frame and will have fire resistance rating of two hour glass panel on front.				
	(x) Car body will be of scratch proof SS (Moonrock finish).				
	(xi) Full height Infra Red / LAMBDA protection is to be provided for landing/ car doors.				
	(xii) Provision of Toe guards, Fireman's switch etc.				
	A Stainless steel hand rail of full width and length at 900mm above floor level to be fixed on all three sides in the lift car.				
	Car Operating Panel - 2 Nos. for each lift.				
	Button in car operating panel & landing operating panel shall be having Braille Inscription & shall be fixed for the handicapped.				
	Voice announcement system in the car to announce the position of the elevator in the hoistway as the car passes or stops at a floor served by the elevator.				
	Car ceiling SS Mirror finish metal false ceiling with pressure fan and sufficient no. of LED light fittings for minimum 150 Lux				
	Car flooring Granite Tile to be provided of approved shade by Architect.				
	Lift installation shall include all safety & control features as specified in the specifications with BMS compatability i/c providing spare parts such as card etc. required for BMS compatability & nothing extra will be paid in this regard.				
	The features required for use of the lift by handicapped persons easy hand rail, braille signage closing speed of doors etc.	2	each	4058441	8116882
	SUB HEAD-VIII :- PART A - SUBSTATION EQUIPMENT & EXTERNAL LIGHTING				
112	SITC of Indoor type floor mounted metal clad, 11KV VCB Panel with 1No. VCB totally enclosed & fully interlocked, horizontal drawout, horizontal/vertical isolation type breaker as per IS:13118, as amended up to date and additional specifications, having capacities as mentioned below, single break, trip free mechanism, manually charged and auto/manually losing breaker suitable for use on 11KV, 3 phase, 50Hz A.C. Supply with short circuit fault level of 350MVA, complete with self contained, fully interlocked, rack-in and rack-out mechanism, air insulated copper busbar of 800A Capacity, breaker featured with mechanical on/off indicator with hand trip device, spring release coil, S/T coil and auxillary switch of 4NO+4NC and equipped with following switchgears and accessories i/c connections suitable for 3X300Sqmm XLPE 11KV Cable (cable entry from bottom/top side) end termination with heat				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	shrinkable jointing material earth bus etc. as required. (Note- Cost of end termination not included in this item and panel shall be suitable for connecting existing HT panel board at ESS-04)				
A	(a) Outgoing- 1no. 630 Amp VCB				
	Each 630A 11KV VCB, outgoing panel shall be provided with following:-				
	a) 1 no. 0-100A dual scale Digital Ammeter with selector switch.				
	1-No Multifunction Digital meter with RS 485 communication port				
	b) 1 no. Microprocessor based numerical relay with O/L, S/C & E/F Protection.				
	c) 1 Set of dual core dual ratio 3 CT's 100/50/5/5A of 15VA burden and accuracy class 1 for metering and Class 5P10 for protection.				
	d) Anti pumping relay				
	e) Master trip relay				
	f) All wiring necessary for the above including interconnections. The size of the conductor should not be less than 2.5 sq.mm. Copper wire where required.				
	g) Test terminal block fuses/2A SPMCB, circuit labels, set of phase, indication lamps etc. as per standard practice for ON, OFF, Auto Trip, Trip Circuit Health and spring charging etc.				
	The Panel shall be with inbuilt DC power Pack for tripping suitable for 220 V AC input and 24 V DC output.				
	11KV VCB PANEL as described above				
	Note : ALL the Panels should be BMS Compatible as per the IO summary of the NIT and for this noting extra will be paid.				
	Supply, Installation, testing and Commissioning of 11 KV HT VCB Panel board of Single panel of details as above and as per specifications. (For substation of Boys Hostel block)	1	set	471450	471450
113	SITC of Indoor type floor mounted metal clad, 11KV VCB Panel with 4Nos. VCB's (2 i/c & 2 o/g), totally enclosed & fully interlocked, horizontal drawout, horizontal/vertical isolation type breaker as per IS:13118, as amended up to date and additional specifications, having capacities as mentioned below, single break, trip free mechanism, manually charged and auto/manually losing breaker suitable for use on 11KV, 3 phase, 50Hz A.C. Supply with short circuit fault level of 350MVA, complete with self contained, fully interlocked, rack-in and rack-out mechanism, air insulated copper busbar of 800A Capacity, breaker featured with mechanical on/off indicator with hand trip				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	device, spring release coil, S/T coil and auxillary switch of 4NO+4NC and equipped with following switchgears and accessories i/c connections suitable for 3X300Sqmm XLPE 11KV Cable (cable entry from bottom/top side) end termination with heat shrinkable jointing material earth bus etc. as required. (Note : cost of end terminations are not included in this item)				
A	Incoming Panels : 2 Nos.				
	Each - 630A 11KV VCB, incoming panel shall be with following				
	a) 1 Nos. 11KV/ 110V PT, Class 0.5 accuracy and 100VA burden with 1 no. Voltmeter (0-15KV), digital type, selector switch for Voltmeter and protection fuses/MCB for HT Metering upto 12KV on incomer.				
	b) 1 no. 0-300A dual scale Digital Ammeter with selector switch.				
	1-No Multifunction Digital meter with RS 485 communication port				
	c) 1 no. Microprocessor based numerical relay with O/L, S/C & E/F Protection.				
	d) 1 Set of dual core dual ratio 3 CT's 300/150/5/5A of 15VA burden and accuracy class 0.5 for metering and Class 5P10 for protection.				
	e) Anti pumping relay				
	f) Master trip relay				
	g) All wiring necessary for the above including interconnections. The size of the conductor should not be less than 2.5 sq.mm. Copper wire where required.				
	h) Test terminal block fuses/2A SPMCB, circuit labels, set of phase, indication lamps etc. as per standard practice for ON, OFF, Auto Trip, Trip Circuit Health and spring charging etc.				
	The Panel shall be with inbuilt DC power Pack for tripping suitable for 220 V AC input and 24 V DC output.				
(II)	OUTGOINGS Panels - 2 Nos.				
	Each 630A 11KV VCB, outgoing panel shall be provided with following:-				
	a) 1 no. 0-100A dual scale Digital Ammeter with selector switch.				
	1-No Multifunction Digital meter with RS 485 communication port				
	b) 1 no. Microprocessor based numerical relay with O/L, S/C & E/F Protection.				
	c) 1 Set of dual core dual ratio 3 CT's 100/50/5/5A of 15VA burden and accuracy class 1 for metering and Class 5P10 for protection.				
	d) Anti pumping relay				

No. of Correction – C NIL
No. of Omissions – O NIL
No. of Insertions – I NIL

	e) Master trip relay				
	f) All wiring necessary for the above including interconnections. The size of the conductor should not be less than 2.5 sq.mm. Copper wire where required.				
	g) Test terminal block fuses/2A SPMCB, circuit labels, set of phase, indication lamps etc. as per standard practice for ON,OFF, Auto Trip, Trip Circuit Health and spring charging etc.				
	The Panel shall be with inbuilt DC power Pack for tripping suitable for 220 V AC input and 24 V DC output.				
	11KV VCB PANEL as described above				
	Note : ALL the Panels should be BMS Compatible as per the IO summary of the NIT and for this noting extra will be paid.				
	Supply, Installation, testing and Commissioning of 11 KV HT VCB Panel board of Four panels (two incoming, two outgoing panels) of details as above and as per specifications. (Hostel - 1, Academics - 1)	2	set	1873239	3746478
114	Supplying, installation, testing and commissioning of 250 KVA, 11/0.433 KV, 3 Phase, 50 Hz, Dyn 11, indoor ONAN type, copper wound transformer with OFF load tap changing arrangement on HV side in steps of +/- 2.5% & - 7.5%, with class F insulation, Maximum allowable losses as per the ECBC compliance, having cable end boxes on HV side suitable for 3x185sqmm XLPE cable of 11 KV grade and 3.5x300sqmm XLPE LT cable arrangement on LV side complete with all accessories i/c first filling of filtered dehydrated oil and confirming to IS 2026 (Part 1 to Part 5) & as per specification attached and as per ECBC norms complete in all respects as required at site. (Boys Hostel - 1)	1	set	717157	717157
115	Supplying, installation, testing and commissioning of 400 KVA, 11/0.433 KV, 3 Phase, 50 Hz, Dyn 11, indoor ONAN type, copper wound transformer with OFF load tap changing arrangement on HV side in steps of +/- 2.5% & - 7.5%, with class F insulation, Maximum allowable losses as per the ECBC compliance, having cable end boxes on HV side suitable for 3x240sqmm XLPE cable of 11 KV grade and 3.5x300sqmm XLPE LT cable arrangement on LV side complete with all accessories i/c first filling of filtered dehydrated oil and confirming to IS 2026 (Part 1 to Part 5) & as per specification attached and as per ECBC norms complete in all respects as required at site. (Girls Hostel - 2)	2	set	1199709	2399418
116	1600 KVA TRANSFORMER (Cast Resin Dry Type)				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

a	Supplying, installation, testing and commissioning of Cast resin, Dry Type, 1600 KVA, 11KV/433V, 3 Phase, 50 Hz, Dyn11 vector group, copper wound, class F insulation associated with winding temperature indicator/controller actuated by means of resistance temperature detector embedded in LV windings, Indoor type Transformer IP 23 protection with approximately 5% impedance, Maximum allowable losses as per ECBC compliance, tappings for OFF Load operation on HV side in steps of +5% to -7.5% in the step of 2.5% having cable end boxes on HV side suitable of 3x300 sqmm XLPE cable of 11KV grade, bottom / top entry and 2500Amp. bus trunking arrangement on LV side with neutral brought out separately, Door limit switch, including Supplying & Laying of multicore copper conductor control cable from transformer to HT breaker for safety tripping, door limit switch to trip the HT breaker in case doors of transformer enclosure are opened, suitably mounted on M.S. channel including supplying and grouting of suitable M.S. channel with all accessories and confirming to IS 11171:1985 & as per specification attached complete in all respects as required at site. (The transformer should be BMS compatible as per the IO summary of the NIT for this nothing extra will be paid.) (Academics - 2)	2	each	2013876	4027752
117	Supplying, installation, testing & commissioning of cubical type MV panel suitable for 415 V, 3 Phase, 4 Wire 50 Hz AC supply system fabricated in compartmentalized (preferably) design from CRCA sheet steel of 2 mm thick for frame work and covers, 3 mm thick for gland, plates i/c cleaning & finishing complete with 7 tank process for powder coating in approved shade, having 630 Amp capacity extensible type TPN aluminium alloy bus bars of high conductivity, DMC / SMC bus bars of high conductivity, DMC/ SMC bus bar supports, with short circuit withstand capacity of 31 MVA for 1 Sec., bottom base channel of MS section not less than 100 mm x 50 mm x 5 mm thick, fabrication shall be done in transportable sections, entire panel shall have a common copper earth bar of size 25 mm x 5 mm at the rear with 2 Nos. earth stud, solid connections from main bus bar to switch gears with required size of Al. bus bars and control wiring with 2.5/4.0 sq. mm. PVC insulated copper conductor S/C cable, cable alleys, cable gland plates in two half, i/c providing following switch gears :-				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

(I)	Incoming :				
	2 Nos. 630 Amps each four pole horizontal drawout type air circuit breaker of fault breaking capacity 50 KA (Ics=Icu upto 433 V) EDO operated, fitted with interlocked door, automatic safety shutters, mechanical ON/ OFF and service/test/isolated position indicators and frame earthing contact, conforming to IS 1397- 2 : 1993 as amended up-to-date complete with following accessories for each ACB				
	(a) Independent Electrical spring closing mechanism - 1 No.				
	(b) Microprocessor release (EMI & EMC Certified) for over current, earth fault & short circuit protection - 1 Set.				
	(d) Digital type Ammeter (0 - 630Amp), with selector switch and one set of 3 nos. CT's of ratio 630 /5A Class I accuracy and 15 VA burden- 1set.				
	(e) 3 Nos. Phase indication LED lamps with 2 Amp back up MCB, breaker 'ON' indicating light with 2 A MCB, test terminal block set, fuses, circuits as per standard practice, auxiliary contacts for positive interlocking of the breakers as required.				
	(f) Shunt trip coil 220 V A.C.				
	BUS COUPLER				
	1 No. 630 Amps each four pole horizontal drawout type air circuit breaker of fault breaking capacity 50 KA (Ics=Icu upto 433 V) EDO operated, fitted with interlocked door, automatic safety shutters, mechanical ON/ OFF and service/test/isolated position indicators and frame earthing contact, conforming to IS 1397- 2 : 1993 as amended up-to-date complete with following accessories for each ACB				
	DG Supply				
	1 No. 630 Amps each four pole horizontal drawout type air circuit breaker of fault breaking capacity 50 KA (Ics=Icu upto 433 V) EDO operated, fitted with interlocked door, automatic safety shutters, mechanical ON/ OFF and service/test/isolated position indicators and frame earthing contact, conforming to IS 1397- 2 : 1993 as amended up-to-date complete with following accessories for each ACB				
	(a) Independent Electrical spring closing mechanism - 1 No.				
	(b) Microprocessor release (EMI & EMC Certified) for over current, earth fault & short circuit protection - 1 Set.				
	(d) Digital type Ammeter (0 - 630Amp), with selector switch and one set of 3 nos. CT's of ratio 630 /5A Class I accuracy and 15 VA burden-				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	1set.				
	(e) 3 Nos. Phase indication LED lamps with 2 Amp back up MCB, breaker 'ON' indicating light with 2 A MCB, test terminal block set, fuses, circuits as per standard practice, auxiliary contacts for positive interlocking of the breakers as required.				
	(f) Shunt trip coil 220 V A.C.				
(II)	Bus Bars :				
	TPN aluminium bus bars of minimum of 630 Amps capacity with heat shrinkable coloured sleeves and i/c DMC/SMC bus bar cross section, size supports & their spacing etc. for withstanding fault level of 31 MVA for 1 Sec.				
(III)	Interlocking :				
	Electrical through advance contacts in ACB's (incomers) and mechanical (castel key) interlocking should be provided to ensure that only one supply is available at a time on section of bus and to eliminate any possibility of accidentally approaching two supplies at one bus section.				
(IV)	Outgoings :				
	NOTE : (i) All outgoing MCCB panels (except spare as per SLD) shall be with rotary operating handle, thermal magnetic release up to 250A & above 250A Shall be microprocessor based for over current and short circuit protection, digital type Ammeter with selector switch CT's and ON/OFF LED indication lamps as per CPWD specifications				
	1 Nos. - 500 Amps. 50KA, 4P, MCCB (Ics = Icu at 415 V)				
	1 No. - 250 Amps. 36KA, TP MCCB (Ics = Icu at 415 V)				
	2 No. - 200 Amps. 36KA, TP MCCB (Ics = Icu at 415 V)				
	4 Nos. - 100 Amps. 36KA, 4P, MCCB (Ics = Icu at 415 V)				
	3 No. - 63 Amps. 36KA, 4P, MCCB (Ics = Icu at 415 V)				
	PLC Panel				
	PLC based panel for Auto Start, Auto Load Sharing and Logic Load Management and Synchronization Panel complete with Control / Power wiring and necessary hardware as required for 2 Nos. 400 KVA T/R, 1 Nos. 380 KVA DG Sets and 1 Couplers. It shall be supervised and integrated to BMS				
	Main LT Panel as per specifications and details above complete as required. (Girls Hostel - 1)	1	set	987894	987894
	LT PANEL BOARD				
118	Supplying, installation, testing & commissioning				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	of cubical type, extensible, bolted construction LT Panel suitable for 415 V, 3 Phase, 4 wire 50 Hz AC supply system of suitable size fabricated in compartmentalized design from CRCA sheet steel of 2mm thick for frame work and covers & doors of 2mm thick sheet, 3mm thick for gland plates i/c cleaning & finishing complete with 8 tank process for powder coating in approved shade, having 400 Amp capacity extensible type TPN Aluminium bus bars of high conductivity, DMC/SMC bus bar supports, with short circuit withstand capacity of 31 MVA for 1 Sec., bottom base channel of MS section not less than 100mm x 50mm x 3mm thick. Fabrication shall be done in trasportable sections, entire panel shall have an common copper earth bar of suitable size at the rear with 2 Nos. earth stud, solid connections from main bus bar to switch gears with required size of aluminium bus bars and control wiring with 2.5 Sq.mm. PVC insulated copper conductor S/C cable for voltage & Current respectively, cable alleys, cable gland plates in two half, i/c providing following switch gears. Panel shall be suitable to recieve busduct entry from Transformer, DG Set & AC panel.				
(I)	Incoming :				
	1Nos. 400 Amps four pole MCCB of fault breaking capacity 50 KA (Ics=Icu upto 433 V) motorized operated, fitted with interlocked door, automatic safety shutters, mechanical ON/ OFF and service/test/isolated position indicators and frame earthing contact, conforming to IS 1397- 2 : 1993 as amended up-to-date complete with following accessories for each MCCB (Motorized)				
	(i) Independent Electrical spring closing mechanism - 1 No.				
	(ii) Microprocessor release (EMI & EMC Certified) for over current, earth fault & short circuit protection - 1 Set.				
	(iii)Intelligent multifunction digital meter to read V, A, KVA, KWH, PF Hz etc. having RS 485 port and compatible to PC with modbus protocol with 3 Nos. resin cast CTs of 1600/5 A class 1.0 accuracy and 15 VA burden. - No.				
	(iv) 3 Nos.- Phase indication LED lamps with 2 Amps.back up MCB, breaker ON/OFF indicating light with MCB, test terminal block set, circuits as per standard practice, auxiliary contacts for positive interlocking of the breakers as required.				
	(v) Shunt trip coil 220 V A.C.				
	(vi) 1No. Over Voltage Relay				
	(vii) 1No. Under Voltage Relay				
	(viii) 1No. Rest. Earth fault relay				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	(ix) 3No. CT's for APFC Relay for each phase				
	DG Supply				
	1No. 400 Amps four pole MCCB of fault breaking capacity 50 KA (Ics=Icu upto 433 V) motorized operated, fitted with interlocked door, automatic safety shutters, mechanical ON/ OFF and service/test/isolated position indicators and frame earthing contact, conforming to IS 1397- 2 : 1993 as amended up-to-date complete with following accessories for each MCCB (Motorized)				
	(i) Independent Electrical spring closing mechanism - 1 No.				
	(ii) Microprocessor release (EMI & EMC Certified) for over current, earth fault & short circuit protection - 1 Set.				
	(iii) Intelligent multifunction digital meter to read V, A, KVA, KWH, PF Hz etc. having RS 485 port and compatible to PC with modbus protocol with 3 Nos. resin cast CTs of 1000/5 A class 1.0 accuracy and 15 VA burden. - No.				
	(iv) 3 Nos.- Phase indication LED lamps with 2 Amps.back up MCB, breaker ON/OFF indicating light with MCB, test terminal block set, circuits as per standard practice, auxiliary contacts for positive interlocking of the breakers as required.				
	(v) Shunt trip coil 220 V A.C.				
	(vi) 1No. Over Voltage Relay				
	(vii) 1No. Under Voltage Relay				
	(viii) 1No. Reverse Power Relay (RPR)				
(II)	Bus Bars :				
	TPN aluminium bus bars of minimum of 400 Amps capacity with heat shrinkable coloured sleeves and i/c DMC/SMC bus bar cross section, size supports & their spacing etc. for withstanding fault level of 31 MVA for 1 Sec.				
(III)	Interlocking :				
	Electrical through advance contacts in MCCB's (incomers) and mechanical (castel key) interlocking should be provided to ensure that only one supply is available at a time on section of bus and to eliminate any possibility of accidentally approaching two supplies at one bus section.				
(IV)	Outgoings :				
	NOTE : (i) All outgoing MCCB (except spare as per SLD) shall be with rotary operating handle, thermal magnetic release up to 250A & above 250A Shall be microprocessor based for over current and short circuit protection, digital type Ammeter with selector switch CT's and ON/OFF LED indication lamps as per CPWD specifications				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	1 Nos. - 400 Amps. 50KA, 4P, MCCB (Ics = Icu at 415 V)				
	2 No. - 200 Amps. 36KA, TP MCCB (Ics = Icu at 415 V)				
	1 Nos. - 100 Amps. 36KA, 4P, MCCB (Ics = Icu at 415 V)				
	3 No. - 63 Amps. 36KA, 4P, MCCB (Ics = Icu at 415 V)				
	SITC OF LT PANEL AS DESCRIBED ABOVE AND AS PER CPWD SPECIFICATIONS. (Boys Hostel - 1)	1	set	369366	369366
120	Main L.T. PANEL IN ESS				
	Supplying, installation, testing & commissioning of cubical type, extensible, bolted construction LT Panel suitable for 415 V, 3 Phase, 4 wire 50 Hz AC supply system of suitable size fabricated in compartmentalized design from CRCA sheet steel of 2mm thick for frame work and covers & doors of 2mm thick sheet, 3mm thick for gland plates i/c cleaning & finishing complete with 8 tank process for powder coating in approved shade, having 3000 Amp capacity extensible type TPN Aluminium bus bars of high conductivity, DMC/SMC bus bar supports, with short circuit withstand capacity of 31 MVA for 1 Sec., bottom base channel of MS section not less than 100mm x 50mm x 3mm thick. Fabrication shall be done in trasportable sections, entire panel shall have an common copper earth bar of suitable size at the rear with 2 Nos. earth stud, solid connections from main bus bar to switch gears with required size of aluminium bus bars and control wiring with 2.5 Sq.mm. PVC insulated copper conductor S/C cable for voltage & Current respectively, cable alleys, cable gland plates in two half, i/c providing following switch gears. Panel shall be suitable to recieve busduct entry from Transformer, DG Set & AC panel.				
	Note : ALL the Panels should be BMS Compatible as per the IO summary of the NIT and for this noting extra will be paid.				
	Main L.T. PANEL				
	INCOMING FROM TRANSFORMER (1600 KVA)				
a)	2 Nos.- 2500 Amps. (T/F Supply) each four pole horizontal drawout type air circuit breaker of fault breaking capacity 50 KA (Ics = Icu up to 433 V) EDO operated, fitted with interlocked door, automatic safety shutters, mechanical ON/OFF and service/test/ isolated position indicators and frame earthing contact, confirming to IS : 13947-2, 1993 as amended up to date complete with following accessories for each ACB.				
	(i) Independent Electrical spring closing mechanism - 1 No.				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	(ii) Microprocessor release (EMI & EMC Certified) for over current, earth fault & short circuit protection - 1 Set.				
	(iii) Intelligent multifunction digital meter to read V, A, KVA, KWH, PF Hz etc. having RS 485 port and compatible to PC with modbus protocol with 3 Nos. resin cast CTs of 1600/5 A class 1.0 accuracy and 15 VA burden. - No.				
	(iv) 3 Nos.- Phase indication LED lamps with 2 Amps.back up MCB, breaker ON/OFF indicating light with MCB, test terminal block set, circuits as per standard practice, auxiliary contacts for positive interlocking of the breakers as required.				
	(v) Shunt trip coil 220 V A.C.				
	(vi) 1No. Over Voltage Relay				
	(vii) 1No. Under Voltage Relay				
	(viii) 1No. Rest. Earth fault relay				
	(ix) 3No. CT's for APFC Relay for each phase				
	INCOMING FROM TRANSFORMER (500 KVA)				
b)	2 Nos.- 1000 Amps.(from DG) each three pole horizontal drawout type air circuit breaker of fault breaking capacity 50 KA (Ics = Icu up to 433 V) EDO operated, fitted with interlocked door, automatic safety shutters, mechanical ON/OFF and service/test/ isolated position indicators and frame earthing contact, confirming to IS : 13947-2, 1993 as amended up to date complete with following accessories for each ACB.				
	185A TP Contactor for neutral isolation.				
	(i) Independent Electrical spring closing mechanism - 1 No.				
	(ii) Microprocessor release (EMI & EMC Certified) for over current, earth fault & short circuit protection - 1 Set.				
	(iii) Intelligent multifunction digital meter to read V, A, KVA, KWH, PF Hz etc. having RS 485 port and compatible to PC with modbus protocol with 3 Nos. resin cast CTs of 1000/5 A class 1.0 accuracy and 15 VA burden. - No.				
	(iv) 3 Nos.- Phase indication LED lamps with 2 Amps.back up MCB, breaker ON/OFF indicating light with MCB, test terminal block set, circuits as per standard practice, auxiliary contacts for positive interlocking of the breakers as required.				
	(v) Shunt trip coil 220 V A.C.				
	(vi) 1No. Over Voltage Relay				
	(vii) 1No. Under Voltage Relay				
	(viii) 1No. Reverse Power Relay (RPR)				
(II)	BUS COUPLER				
	1 Nos. ACB 2500 Amps four pole horizontal drawout type air circuit breaker (without				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	Protection Release) of fault breaking capacity 50 KA (Ics = Icu up to 433 V) EDO operated, fitted with interlocked door, automatic safety shutters, mechanical ON/OFF and service/test/ isolated position indicators and frame earthing contact, confirming to IS : 13947-2, 1993 as amended up to date complete with following accessories for each ACB.				
	(i) Independent Electrical spring closing mechanism - 1 No.				
	(ii) Shunt trip coil 220 V A.C.				
	(iii) Breaker 'ON' indicating light with back up MCB, test terminal block, circuits as per standard practice, auxiliary contact contactors for positive electrical interlocking of breakers etc. as required. - 1 Set.				
(III)	BUS BAR				
	a) TPN Aluminium bus bars (having 100% Neutral) of minimum of 3000A Amps. capacity with heat shrinkable coloured sleeves and i/c DMC/SMC bus bar supports at required intervals complete for cross section, size supports & their spacing etc. for withstanding fault level of 31 MVA for 1 Sec. - 1 Set.				
(IV)	INTERLOCKING				
	Electrical through advance contacts in ACB's (Incomers & Bus couplers so that only two breakers will operate at a time) and mechanical (Castel key) interlocking should be provided.				
(V)	OUTGOINGS :				
	NOTE : (i) All outgoing ACB panels shall be with Microprocessor release (EMI & EMC Certified) for over current, short circuit & Earth Fault protection, digital type Ammeter with selector switch, CT's and ON/OFF LED indication lamps and All outgoing MCCB panels shall be with rotary operating handle, thermal magnetic release for over current and short circuit protection, digital type Ammeter with selector switch CT's and ON/OFF LED indication lamps				
	SECTION - I				
b)	630 amp, 50KA FP MCCB - 3 Nos. (Ics = Icu at 415 V)				
c)	400 amp, 50KA FP MCCB - 7 Nos. (Ics = Icu at 415 V)				
d)	200 amp, 50KA FP MCCB - 3 No. (Ics = Icu at 415 V)				
	SECTION - II				
c)	1250 amp, 50KA FP ACB - EDO - 2 Nos. (Ics = Icu at 415 V)				
d)	630 amp, 50KA FP MCCB - 2 Nos. (Ics = Icu at 415 V)				
e)	400 amp, 50KA FP MCCB - 2 Nos. (Ics = Icu at				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	415 V)				
	200 amp, 50KA FP MCCB - 3 No. (Ics = Icu at 415 V)				
	SITC of Main LT Panel as described above as per specifications.				
	PLC Panel				
	PLC based panel for Auto Start, Auto Load Sharing and Logic Load Management and Synchronization Panel complete with Control / Power wiring and necessary hardware as required for 2 Nos. 1600 KVA T/R, 2 Nos. 500 KVA DG Sets and 1 Couplers. It shall be supervised and integrated to BMS				
	Main LT Panel as per specifications and details above complete as required. (Academic -1)	1	panel	3563353	3563353
121	Supply, installation, testing and commissioning of LT panel boards of 2mm thick sheet steel cubical design for indoor mounting factory fabricated suitable for operation on 440V 3 phase, 50 Hz, AC supply with MCCBs / MCB and other accessories complete in all respects including internal wiring, lables, ferrules, cable termination gland plates, earth terminals, painting etc. conforming to specification. All MCCB shall be with rotary handle.				
a	UPS Panel (AB-04) & (AB-03)				
	Incoming:				
	400 A, TPN MCCB 50 KA - 1 No.				
	500 A TPN AL. bus bar with coloured heat shrinkable PVC sleeve -1 Set				
	Outgoings:				
	200 A TPN MCCB, 36 KA - 2 Nos.				
	100 A TPN MCCB, 36 KA - 1 Nos.				
	Instruments:				
	Multi Function Meter (MFM) -1 No.				
	Indication lamp RYB with selector switch etc as req.				
	SITC of Panel of above details & specifications	2	set	110240	220480
b	Main Lift Panel				
	Incoming:				
	400 A, TPN MCCB 50 KA - 1 No.				
	500 A TPN AL. bus bar with coloured heat shrinkable PVC sleeve -1 Set				
	Outgoings:				
	125 A TPN MCCB, 36 KA - 5 Nos.				
	Instruments:				
	Multi Function Meter (MFM) -1 No.				
	Indication lamp RYB with selector switch etc as				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	req.				
	SITC of Panel of above details & specifications (Academics - 1)	1	set	121261	121261
c	Service Panel				
	Incoming:				
	630 A, TPN MCCB 50 KA - 1 No.				
	700 A TPN AL. bus bar with coloured heat shrinkable PVC sleeve -1 Set				
	Outgoings:				
	400 A TPN MCCB, 36 KA - 1 Nos.				
	200 A TPN MCCB, 36 KA - 2 Nos.				
	100 A TPN MCCB, 36 KA - 1 Nos.				
	63 A TPN MCCB, 36 KA - 1 Nos.				
	Instruments:				
	Multi Function Meter (MFM) -1 No.				
	Indication lamp RYB with selector switch etc as req.				
	SITC of Panel of above details & specifications (Academics - 1)	1	set	151605	151605
d	ACDB-1 & 2 (SOLAR)				
	Incomer				
	3 nos 125 Amps, and 1 no. 100Amps, 25 kA TPN, MCCB with suitable incomer and outgoing bus bar link with integral protection as per PRMB-2 mentioned in Preamble				
	incomer shall be equipped.				
	1 set of R,Y,B phase indicating lamps each with 3 nos. 2A Fuses.				
	1 Set- of ON/OFF indicating lamps.				
	Class- B transient voltage surge suppression devices suitable for 3 phases as per specification.				
	BUS BARS				
	Electrolytic high conductivity Aluminium three phase and neutral busbars rated at 600 amps 25 KA for 1 sec. having a maximum current density of 1 amp per sq mm suitable to withstand symmetrical fault level of 25 kA at 415 volts. The neutral busbar is to be of 50% capacity.				
	OUTGOINGS.				
	1 Nos. 400 A TPN MCCB				
	Supply, receiving, fixing, testing & commissioning for ACDB-1 & 2 (SOLAR) as described above. (Academics - 1)	2	Set	107802	215604
123	AUTOMATIC POWER FACTOR CORRECTION PANEL (APFC) (300 KVar)				
	Supplying, installation, testing & commissioning				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	of factory built floor mounted auto-manual power factor correction system panel of 300 KVAR capacity having 3 phase, Heavy Duty, MPP- H type, (total power loss not exceeding 0.50 W/ KVAR) power capacitor in 8 steps, resin filled, Electronic Thyristor switching Module and detuned filters to suppress switching of inrush current and reducing harmonics to improve capacitor life.				
	The system shall have microprocessor based power factor controller with power conditioner savers using rapid instruction semi conductor micro controller provided in the command module for target P.F. setting with digital P.F. display. The Controller consists: VAR / FIFO / BINARY mode, all three powers, i.e. KVA, KW and KVAR phase wise and system Harmonic in all three phases. All three voltages, phase to phase to neutral, Supports MODBUS - RTU Protocol with RS 485 Port with communication card communicate with IBMS System on BACNET / MODBUS Protocol. The controller graphical LCD display window shall be as per manufacturer's standard and good engineering practice .				
	The system Shall be provided with required capacity master MCCB, to check its main operating parameters such as over loads, short circuit, etc.				
	The panel shall be fabricated in compartmentalized design from sheet steel of 2mm thick for frame work and 1.6 mm thick for covers, i/c cleaning & surface treatment with 7 tank process powder coating in approved shade, having 800 Amp capacity extensible type TPN Aluminium Alloy bus bars of high conductivity, SMC bus bar supports, with short circuit withstand capacity of 50kA A for 1 Sec., bottom base channel of MS section not less than 100mm x 50mm x 5mm thick, fabrication shall be done in transportable sections, entire panel shall have a common Alu earth bar of size 50mm x 6mm at the rear with 2 Nos. earth stud, solid connections from main bus bar to switch gears/ accessories with required size of Al. bus bars and control wiring with 2.5 sq.mm. PVC insulated FRLS copper conductor Single Core cable, gland plates of 2 mm thick MS Sheet, provided with exhaust fans (with thermostat) and grills for proper ventilation, interconnections with suitable size conductor cables & lugs and accommodating the following switchgears, capacitor banks, auxiliary equipments & accessories				
	INCOMER:-				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	1 No. - 630 Amp 3 Pole, MCCB with micro processor base O/c, S/C & E/F release, with fault breaking capacity 50KA,433V (Ics=Icu =Icw for 1 second) and shall be with following accessories:-				
	A One numbers binary type automatic power factor sensing and correction relay (16 stages) with inbuilt power factor meter complete with its all accessories etc. as required				
	1 Set - Digital Ammeter with in built ASS, metering C.T.s "CAST RESIN" type, 15VA, and accuracy class-1, of 1000/5A for measuring current in each phase				
	1 Set - 3 Nos. Phase indication LED lamps with 2Amp back up MCB, Breaker 'ON/OFF' / TRIP' indicating light with 2A MCB, test terminal block set, circuits as per standard practice, auxiliary contacts for positive interlocking of the breakers as required.				
	Bus Bar:-				
	TPN aluminium extensible type main bus bars of minimum of 800 A capacity (As per capacity of corresponding incoming / Bus couplers) , and auxilliary bus bars of suitable capacity with heat shrunk coloured sleeves and i/c DMC bus bars supports at required intervals complete for cross section, size supports & their spacing etc. for withstanding fault level of 50kA for 1 Sec.				
	CAPACITOR BANKS				
	ii. 1 Nos. - Capacitor Bank of 10 KVAR rating				
	iii. 1 Nos. - Capacitor Bank of 15 KVAR rating				
	iv. 1 Nos. - Capacitor Bank of 25 KVAR rating				
	v. 1 Nos. - Capacitor Bank of 50 KVAR rating				
	vi.1 Nos. - Capacitor Bank of (2x100) 200 KVAR rating				
	each capacitor bank shall be provided with following				
i)	1 Set - L.T. Power factor improving capacitor (MPP-H) with 7% detuned reactor(copper wound) of indoor type suitable for operation on 415 volts AC 3 phase 50 Hz complete with banking arrangement, discharge resistance etc. control through suitable rating TP power contactor and one no. MCCB TP, Ics = 35ka, as back up protection, with interconnections with suitable size of copper conductor PVC insulated PVC sheathed unarmoured cable,as required.				
ii)	1 Set - Digital ammeter with inbuilt ASS, metering CTs"CAST RESIN" type, 15VA, and accuracy class-1 suitable for respective capacitor bank				
iii)	1 Set - Push Button for ON/OFF				
iv)	1 Set - LED Indicating light - Red/ Green				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	Auto / Manual Selector Switch, Timers, Relays as required				
	Supply, receiving, fixing, testing & commissioning of APFC Panel (300 KVAR) as described above. (Academics - 1)	2	Set	532734	1065468
124	CAPACITOR PANEL (100 KVAR)				
	SITC of Automatic Power Factor Control panel of capacity 100 KVAR , Standard panel of 2x25+2x15+2x10 Super Heavy duty capacitors with APFC relay, suitable switchgear for branch & main protection, Earth busbar etc. complete as required with following and as per specifications. One unit of 10 KVAR capacitor will always remain in line.				
	Incoming				
	1-Nos. 200 A, TP MCCB (36 KA) with microprocessor based O/L, S/C and E/F release				
	1 no. 7-Stage APFC relay suitable for sequential operation of Cap. banks				
	24V DC shunt trip coil – 1 set.				
	1 set ON/OFF push button with 2A SP MCB 10kA.				
	Multifunction meter (consisting of Voltage ,Current , Frequency, PF ,kVA parameter) with RS-485 Port.EM6400) or Equivalent				
	1 set of breaker ON/OFF/Trip indicating lights with control MCB's.				
	1 set of R,Y,B phase indicating light (LED type) with 2A SP MCB, 10kA.				
	Bus Bar				
	250 Amp, TPN Electrolytic grade Aluminium Bus Bar of suitable length to withstand fault current of 36 KA for 1 Sec. (Current density - 1.2A/Sq. mm)				
	Outgoings:				
	2 Nos. - 63 amp TP MCCB complete each with the following				
	i) 3 pole power contactor suitable for automatic switching of 25 kVAR capacitor bank				
	ii) Indicating lamp to give status of the circuit				
	iii) Manual/auto changeover switch				
	iv) 25 kVAR 440 V hermetically sealed metallized polypropylene capacitor units complete with fuse protection, discharge resistors, interconnections etc complete as required.				
	v) 1 Set of MCB 10KA for control Ckt				
	2 Nos. - 40 amp TP MCCB complete each with the following				
	i) 3 pole power contactor suitable for automatic switching of 15 kVAR capacitor bank				
	ii) Indicating lamp to give status of the circuit				
	iii) Manual/auto changeover switch				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	iv) 15 kVAR 440 V hermetically sealed metallized polypropylene capacitor units complete with fuse protection, discharge resistors, interconnections etc complete as required.				
	v) 1 Set of MCB 10KA for control Ckt				
	2 Nos. - 40 amp TP MCCB complete each with the following				
	i) 3 pole power contactor suitable for automatic switching of 10 kVAR capacitor bank				
	ii) Indicating lamp to give status of the circuit				
	iii) Manual/auto changeover switch				
	iv) 10 kVAR 440 V hermetically sealed metallized polypropylene capacitor units complete with fuse protection, discharge resistors, interconnections etc complete as required.				
	v) 1 Set of MCB 10KA for control Ckt				
	SITC OF APFC PANEL AS DESCRIBED ABOVE AND AS PER CPWD SPECIFICATIONS. (Boys Hostel -1, Girls Hostel - 2)	3	set	176740	530220
	BUS DUCT, CABLING & TERMINATION				
128	Supplying, installing suspension on ceiling, testing and commissioning of following capacity Sandwich Type Bus Trunking for use on 3 phase 4 wire 415 volts, 50Hz A.C. supply with metal clad enclosure made of 1.6mm thick steel sheet duly powder coated in convenient sections complete with 4 Nos aluminium bus bars, necessary joints, elbow joints & expansion joints, fire barrier at each floor/wall, continuous earthing with 2 Nos aluminium strip of suitable size (one on each side) including, G.I. clamping brackets, suspenders, angle iron bracket, steel fasteners, connecting to earthing system etc. as required				
	2500 A 50kA SC for 1 sec (From Transformers to LT Panel) (Academics -40)	40	mtr	35688	1427520
	BUS DUCT (OUTDOOR TYPE-IP 65) (As per IEC 61439-6)				
129	Supplying, installing suspension on ceiling, testing and commissioning of following capacity Air Insulated Compact Type Bus Trunking for use on 3 phase 4 wire 415 volts, 50Hz A.C. supply with metal clad enclosure made of 1.6mm thick steel sheet duly powder coated in convenient sections complete with 4 Nos aluminium bus bars, necessary joints, elbow joints & expansion joints, fire barrier at each floor/wall, continuous earthing with 2 Nos aluminium strip of suitable size (one on each side) including, G.I. clamping brackets, suspenders, angle iron bracket, steel fasteners, connecting to earthing system etc. as required				
	800A TPN Bus Duct (500 kvA DG to Main LT panel) (Academics -60)	60	mtr	14875	892500

No. of Correction –C NIL
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No. of Insertions –I NIL

	SUPPLY OF HT CABLES				
130	Supply of un-earthed aluminium conductor XLPE insulated power cable of 11KV grade conforming to IS 7098 (Part-II) amended up to date as per following sizes, cable to be laid in trench/ surface as required:				
	3C X 185 Sqmm (Boys Hostel - 25)	25	Meter	1271	31775
	3C X 300 Sqmm (Hostel - 180, Academics - 1300)	1480	Meter	1719	2544120
	Perforated type Cable Tray, Pipes				
131	Providing, laying and fixing following dia RCC pipe NP2 class (light duty) in ground complete with RCC collars, jointing with cement mortar 1:2 (1 cement : 2 fine sand) including trenching (75cm deep) and refilling etc. as required.				
	250 mm dia	20	Meter	701	14020
132	Supplying and installing following size of perforated pre-painted M.S. cable trays with perforation not more than 17.5%, in convenient sections, joined with connectors, suspended from the ceiling with M.S. suspenders including bolts & nuts, painting suspenders etc as required.				
a	300 mm width X 62.5 mm depth X 2.0 mm thickness (Academics - 30)	30	mtr	599	17970
b	450 mm width X 62.5 mm depth X 2.0 mm thickness (Academics - 30)	30	mtr	778	23340
133	Supplying and making cable route marker with cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) of size 60 cm X 60 cm at the bottom and 50 cm X 50 cm at the top with a thickness of 10cm including inscription duly engraved as required. (Academics - 6)	6	each	530	3180
134	Supplying and laying of following size DWC HDPE pipe ISI marked along with all accessories like socket, bend, couplers etc. conforming to IS 14930, Part II complete with fitting and cutting, jointing etc.direct in ground (75 cm below ground level) including excavation and refilling the trench but excluding sand cushioning and protective covering etc., complete as required.				
a	120 mm dia (OD-120 mm & ID-103 mm nominal) (Academics - 200)	200	mtr	341	68200
	LAYING OF HT CABLES				
135	Laying of 11KV grade cable of following size direct in ground including excavation, sand cushioning Protective covering and refilling in trench as required to be laid in trench/ surface as required:				
a	Above 120 sq. mm and upto 400 sq. mm (Hostel - 165, Academics - 1100)	1265	Meter	482	609730
136	Laying of one number PVC insulated and PVC sheathed / XLPE power cable of 11KV grade of				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	following size in the existing RCC/HUME /METEL pipe as required.				
	Above 120 sq. mm and upto 400 sq. mm (Hostel - 20, Academics - 150)	170	Meter	112	19040
137	Laying of one number additional PVC insulated and PVC sheathed / XLPE power cable of 11 KV grade of following size in the existing masonry open duct as required.				
	Above 120 sq. mm and upto 400 sq. mm (Boys Hostel - 10)	10	Meter	96	960
138	supplying and making indoor cable end termination with heat shrinkable jointing kit complete with all accessories including lugs suitable for following size of 3 core, XLPE aluminium conductor cable of 11 kV grade as required.				
a	185 sq. mm (Hostel - 02)	2	each	11681	23362
b	300 sq. mm (Academics -8)	8	each	11681	93448
139	Supplying and making straight through cable jointing with heat shrinkable jointing kit complete with all accessories including ferrules suitable for following size of 3 core, XLPE aluminium conductor cable of 11 kV grade as required.				
a	300 sq. mm (Academics -2)	2	each	19314	38628
	SUPPLY OF LT CABLES				
140	Supplying of 1.1KV graded PVC insulated and PVC sheathed/XLPE Armoured Aluminium conductor cable of following sizes in Hume pipes, Cable trays, underground complete with all accessories as required and as per specifications.				
	4C X 10 sqmm (Hostel - 500, Academics - 135)	635	Meter	108	68580
	4C X 35 sqmm (Hostel - 560)	560	Meter	207	115920
	3.5C X 50 sqmm (Hostel - 380)	380	Meter	241	91580
	3.5 Core, 95 sq.mm. XLPE Aluminium Cable (Academics - 494)	494	mtr	396	195624
	3.5C X 120 sqmm (Hostel - 255, Academics -618)	873	Meter	495	432135
	3.5C X 185 sqmm (Hostel - 1210, Academics - 912)	2122	Meter	731	1551182
	3.5C X 300 sqmm (Hostel - 180, Academics - 1407)	1587	Meter	1128	1790136
141	Supplying, laying, testing and commissioning of the following sizes of 1.1 KV grade PVC insulated copper conductor armoured stranded control cable complete as required and as per specifications.				
	4 core, 2.5 sq,mm Cu. Cable (Hostel - 60)	60	Meter	102	6120
	12 core, 2.5 sq,mm Cu. Cable (Hostel - 60)	60	Meter	280	16800
	LAYING OF LT CABLES				
142	Laying of one number PVC insulated and PVC sheathed / XLPE power cable of 1.1 KV grade of				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	following size direct in ground including excavation, sand cushioning, protective covering and refilling the trench etc as required.				
	upto 35 sq. mm (Hostel - 700, Academics - 950)	1650	Meter	323	532950
	Above 35 sq. mm and upto 95 sq. mm (Hostel - 270, Academics - 180)	450	Meter	338	152100
	Above 95 sq. mm and upto 185 sq. mm (Hostel - 1000, Academics - 1000)	2000	Meter	352	704000
	Above 185 sq. mm and upto 400 sq. mm (Hostel - 100, Academics - 2000)	2100	Meter	396	831600
143	Laying of one number additional PVC insulated and PVC sheathed / XLPE power cable of 1.1 KV grade of following size direct in ground in the same trench in one tier horizontal formation including excavation, sand cushioning, protective covering and refilling the trench etc as required.				
a	Above 95 sq. mm & upto 185 sq. mm (Academics - 200)	200	mtr	251	50200
b	Above 185 sq. mm & upto 400 sq. mm (Academics - 200)	200	mtr	294	58800
144	Laying of one number PVC insulated and PVC sheathed / XLPE power cable of 1.1 KV grade of following size in the existing RCC/ HUME/ METAL/DWC/pipe/DUCT as required.				
a	Upto 35 sq. mm (Academics - 50)	50	mtr	31	1550
b	Above 35 sq. mm & upto 95 sq. mm (Academics - 20)	20	mtr	47	940
c	Above 95 sq. mm & upto 185 sq. mm (Academics - 200)	200	mtr	64	12800
d	Above 185 sq. mm & upto 400 sq. mm (Academics - 200)	200	mtr	112	22400
145	Laying of one number additional PVC insulated and PVC sheathed / XLPE power cable of 1.1 KV grade of following size direct in ground in the same trench in one tier horizontal formation including excavation and refilling the trench etc as required, but excluding sand cushioning and protective covering.				
	Above 185 sq. mm and upto 400 sq. mm (Hostel - 200)	200	Meter	178	35600
146	Laying and fixing of one number PVC insulated and PVC sheathed / XLPE power cable of 1.1 KV grade of following size on cable tray as required upto 35 SQM				
a	upto 35 sq. mm (clamped with 1mm thick saddle) (Hostel - 350)	350	Meter	33	11550
b	Above 35 sq. mm and upto 95 sq. mm (clamped with 25x3mm MS flat clamp) (Hostel - 80, Academics - 20)	100	Meter	74	7400
c	Above 95 sq. mm and upto 185 sq. mm (clamped with 25/40x3mm MS flat clamp) (Hostel - 345, Academics - 200)	545	Meter	93	50685
d	Above 185 sq. mm and upto 400 sq. mm	670	Meter	150	100500

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	(clamped with 40x3mm MS flat clamp) (Hostel - 70, Academics - 600)				
	END TERMINATIONS OF LT CABLES				
147	Supplying and making end termination with brass compression gland and aluminium lugs for following size of PVC insulated and PVC sheathed / XLPE aluminium conductor cable of 1.1 KV grade as required.				
a	4C X 10 sqmm (25mm) (Hostel - 40, Academics - 72)	112	Each	219	24528
b	3½ X 35 sq. mm (32mm) (Hostel - 18)	18	Each	300	5400
c	3½ X 50 sq. mm (35mm) (Hostel - 8)	8	Each	329	2632
d	3½ X 95 sq. mm (45mm) (Academics - 4)	4	each	473	1892
e	3.5C X 120 sqmm (45mm) (Hostel - 4, Academics - 16)	20	Each	473	9460
f	3½ X 185 sq. mm (57mm) (Hostel - 36, Academics - 14)	50	Each	702	35100
g	3.5C X 300 sqmm (70mm) (Hostel - 12, Academics - 48)	60	Each	936	56160
148	Termination of the following sizes of PVC insulated Copper conductor cable including providing terminal lugs, single compression gland, crimping the joints, providing insulation tape, effecting terminal connections to the equipment complete as required.				
	4 core, 2.5 sq.mm Cu. Cable (Hostel - 4)	4	Each	304	1216
	12 core, 2.5 sq.mm Cu. Cable (Hostel - 4)	4	Each	386	1544
	EARTHING & LIGHTNING CONDUCTOR				
149	Earthing with G.I. earth pipe 4.5 metre long, 40 mm dia including accessories, and providing masonry enclosure with cover plate having locking arrangement and watering pipe etc.with charcoal/ coke and salt as required. (Hostel - 4, Academics - 8)	12	set	5308	63696
150	Earthing with G.I. earth plate 600 mm X 600 mm X 6 mm thick including accessories, and providing masonry enclosure with cover plate having locking arrangement and watering pipe of 2.7 metre long etc. with charcoal/ coke and salt as required. (Hostel - 38, Academics - 35)	73	set	6216	453768
151	Earthing with copper earth plate 600 mm X 600 mm X 3 mm thick including accessories, and providing masonry enclosure with cover plate having locking arrangement and watering pipe of 2.7 metre long etc. with charcoal/ coke and salt as required. (Hostel - 8, Academics - 12)	20	set	11794	235880
152	Providing and fixing 25 mm X 5 mm copper strip in 40 mm dia G.I. pipe from earth electrode including connection with brass nut, bolt, spring, washer excavation and re-filling etc. as required. (Hostel - 40, Academics - 140)	180	Meter	1224	220320
153	Providing and fixing 25 mm X 5 mm G.I. strip in 40 mm dia G.I. pipe from earth electrode	470	Meter	483	227010

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	including connection with G.I. nut, bolt, spring, washer excavation and re-filling etc. as required. (Hostel - 265, Academics - 205)				
154	Providing and laying earth connection from earth electrode with 6 SWG dia G.I. Wire in 15 mm dia G.I. pipe from earth electrode including connection with G.I. thimble excavation and re-filling as required. (Hostel - 40, Academics - 40)	80	Meter	188	15040
155	Providing and fixing 25 mm X 5 mm copper strip on surface or in recess for connections etc. as required. (Hostel - 100, Academics - 140)	240	Meter	1009	242160
156	Providing and fixing 25 mm X 5 mm G.I. strip on surface or in recess for connections etc. as required. (Hostel - 370, Academics - 290)	660	Meter	206	135960
157	Providing and fixing 6 SWG dia G.I. wire on surface or in recess for loop earthing along with existing surface/ recessed conduit/submain wiring/ cable as required. (Hostel - 500, Academics - 1000)	1500	Meter	37	55500
158	Providing and fixing earth bus of 50 mm X 5 mm copper strip on surface for connections etc. as required. (Hostel - 60, Academics - 30)	90	mtr	1844	165960
159	Providing & fixing 6 SWG dia G.I. Wire on surface or recess for loop earthing as required. (Hostel - 160, Academics - 1460)	1620	metre	57	92340
160	Providing and fixing of lightning conductor finial, made of 25 mm dia 300 mm long, GI tube, having single prong at top, with 85 mm dia 6 mm thick copper base plate including holes etc. complete as required. (Hostel - 5, Academics - 11)	16	each	448	7168
161	Providing & fixing of G.I. tape 20 mm X 3 mm thick on parapet or surface of wall for lightning conductor complete as required.(For horizontal run) (Hostel - 580, Academics - 1050)	1630	metre	104	169520
162	Providing & fixing of G.I. tape 20 mm X 3 mm thick on parapet or surface of wall for lightning conductor complete as required.(For vertical run) (Hostel - 500, Academics - 440)	940	metre	163	153220
163	Providing and fixing testing joint, made of 20 mm X 3 mm thick GI strip, 125 mm long, with 4 nos. of tinned GI bolts, nuts, chuck nuts and spring washers etc. complete as required. (Hostel - 10, Academics - 11)	21	each	102	2142
	SAFETY EQUIPMENT				
164	Providing and fixing danger plates made of mild steel at least 2mm thick & vitreous enameled white on both sides & with inscriptions in signal red colour on front side as reqd.				
	(a) High voltge - size 250 mm x 200 mm (Hostel - 6, Academics - 6)	12	each	244	2928
	(b) Medium voltage- size 200 mm x150 mm (Hostel - 6, Academics - 6)	12	each	226	2712
165	Providing and fixing of Carbon-di-oxide (CO2) type fire extinguishers confirming to IS 2878-				

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	1976 and cylinders fully charged of following capacity.				
	(a) 4.5 kg (Hostel - 10, Academics - 6)	16	each	8266	132256
166	Supply and fixing of foam fire extinguishers, portable type 9 liters capacity hanged on wall with bracket complete as required (Hostel - 10, Academics - 6)	16	each	3214	51424
167	Supply and fixing safety instruction chart in word duly framed with 5 mm thick glass as required.(approx. front area 1.20 sq. mt.) (Hostel - 4, Academics - 6)	10	each	638	6380
168	Providing of set of 4 no. 9.5 liter capacity GI bucket painted in post office red colour with prior coat of red oxide paint and written with white paint 'FIRE' and mounted on m.s. angle iron framed with bracket of appropriate size and capacity I/c filling sand etc. (Hostel - 4, Academics - 12)	16	set	1728	27648
169	Providing First aid box as approved by St. John ambulance Brigade/Indian Red Cross conforming to IS 2217-1963. (Hostel - 4, Academics - 3)	7	each	589	4123
170	Supply and Fixing shock treatment chart duly mounted on a wooden frame with 5mm thick glass (Approximate front area 1.20Sq Meter) (Hostel - 4, Academics - 6)	10	each	658	6580
171	Providing of rubbermat 1 meter wide and 3 mm thick to withstand 15 KV di-electric strength as per IS 15652:2006 (Hostel - 20, Academics -10)	30	metre	935	28050
172	Providing of rubbermat 1 meter wide and 2 mm thick to withstand 3.3 KV di-electric strength as per IS 15652:2006 (Hostel - 10, Academics - 48)	58	metre	737	42746
173	Supply, fixing, testing and commissioning of Automatic Linear pneumatic Tube Detection based on clean agent fire suppression system for Electrical Panels (consisting of the following components: Electrical Panels (BOQ Attached) Like- LT, HT, Cap., DG synch., lighting ,Lift & Fire Fighting Panels. MAKES: Firetrex, Tracefire, Safefire				
	5Lb Novec 1230/ FK5-1-12, DLP Assembly with automatic valve mounted on DOT approved cylinder, push in connector for tube, 2 Kg Novec 1230/ FK5-1-12 gas, mounting bracket, End of Line adopter and low pressure switch for monitoring system activation. MAKES: Firetrex, Tracefire, Safefire (Hostel - 4, Academics - 2)	6	each	92512	555072
	10 Lb Novec 1230/ FK5-1-12, DLP Assembly with automatic valve mounted on DOT approved cylinder, push in connector for tube, 4 Kg Novec 1230/ FK5-1-12 gas, mounting bracket, End of Line adopter and low pressure switch for monitoring system activation. MAKES: Firetrex, Tracefire, Safefire (Hostel - 4,	8	each	112382	899056

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	Academics - 4)				
	Linear pneumatic heat Detection Tube with all necessary fittings & supports. MAKES: Firetrex, Tracefire, Safefire (Hostel - 150, Academics - 250)	400	mtr	2290	916000
	Master Control Unit with Audio Visual Alarm with wiring to make complete system operational. The Control Panel should have provision for integration with Fire Alarm/SCADA/BMS System. MAKES: Firetrex, Tracefire, Safefire (Hostel - 8, Academics - 6)	14	each	16844	235816
	EXTERNAL LIGHTING				
174	Supplying, Installation, Testing and commissioning of 6 mtr high GI Octagonal pole with Single overhang bracket of length upto 2 metre, duly primed and painted. The column shall be provided with inbuilt loop box with 4 way 32Amp Heavy duty connector, 1 No SPMCB with wiring from MCB to fitting with 3x2.5 sq.mm PVC insulated single core wires and shall have matching flush door, fabricated painted complete with RCC foundation including foundation bolts, suitable DWC / PVC pipe laid within the foundation for incoming and outgoing cables as per the Department's requirement.				
	Top dia - 70mm. Length 4000mm				
	Bottom dia - 130mm. Length 2000mm				
	Base plate - 220 x 220 x 16mm thick duly welded in column.				
	RCC foundation 750 x 750 x 1200mm (Hostel - 20, Academics - 30)	50	each	12760	638000
175	Supply, Installation, Testing and Commissioning of 65 - 70 W LED street light luminaries IP:66 made out of die cast Aluminium housing and head frame, powder coated in approved color, high purity Aluminium pot reflector electrochemically brightened and anodized, heat resistant and toughened glass cover, gasket including accessories like copper ballast, electronic igniter, PF improvement Capacitor, duly wired as required (Similar to Philips - GreenLine - BRP 409 LED 065 CW HE MR FG S1 PSU GR, LIGHTING TECHNOLOGIES - Adornis Min - 70 W - A07057M000, HAVELLS - Endura Pearl Plus - ENDURPEARLPLUSL70WLED757PASYPOTPC or similar equivalent make as approved.) (Hostel - 20, Academics - 30)	50	each	7700	385000
176	Supply and fixing of floor mounting, totally enclosed, compartmentalized, cubical, dust, vermin proof and outdoor type ROAD LIGHTING PILLAR fabricated out of 2mm thick cold rolled carbon annealed CRCA, sheet steel, internally				

No. of Correction - C NIL
No. of Omissions - O NIL
No. of Insertions - I NIL

	strengthened with angle iron frame work with following incoming and outgoing feeders (fabricated out of 2mm CRCA sheet steel) including supplying and mounting including making connectins / interconnections with lugs / glands crimping tools, testing and commissioning of following items inside the panel/pillar. The pillar shall be suitable for automatic operation of external lighting.				
	Incoming				
	63/100 A TP MCCB(25KA) -1 No.				
	63 A, TP Contactor -1 No.				
	Time Switch with daily dial suitable for operation on 230V single phase 50Hz AC supply -1No.				
	Auto Manual Selector Switch -1 No.				
	Bus Bars				
	TPN bus bar of 100A rating				
	Outgoings				
	20A TP MCB 4 No.				
	32A TP MCB 4 No.				
	Indication lamps (LED Type) 3 No.				
	Road lighting Pillar of above details & specifications (Hostel - 2, Academics - 1)	3	each	47880	143640
	SUB HEAD-VIII :- PART B- DG SET				
125	Providing, Installing, Testing and Commissioning of 'Silent Type' Diesel Generating set alongwith having Prime Power Rating of 250 KVA, 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 and consisting of the followings:				
(a)	Diesel Engine:				
	Diesel engine 4 stroke radiator cooled, electric start, of suitable BHP at 1500 RPM suitable for above output of alternator at 40 Degree C, 50% RH & at 1000 Meter MSL and conforming to BS 5514, BS 649, IS 10000, capable of taking 10% over loading for one hour after 12 hours of continuous operation. The engine will be fitted complete with all the required accessories.				
(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				
	(vi) RPM indication				
	(vii) Over speed indication				

No. of Correction –C NIL
No. of Omissions – O NIL
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	(viii) Low lub. Oil trip indication				
	(ix) Engine Hours indication				
(c)	Alternator :				
	Synchronous alternator rated at 250 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 SPDP enclosure, brushless, continuous duty, self-excited and self-regulated through AVR conforming to IS: 4722/BS 2613 suitable for tropical conditions and with class- F/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 990 liters capacity 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 exhaust silencer.				
(g)	Starting System:				
	12V/24V DC starting system comprising of starter motors; voltage regulator and arrangement for initial excitation complete with suitable nos. of batteries (25 plates, 180 Amp. Hour capacity lead acid type) as required as per specifications.				
(h)	Enclosure				
	Accoustic and weather proof enclosure with arrangement for fresh air intake for cooling of the engine & alternator, extraction, discharging hot air in to the atmosphere as per specifications.				
(i)	PCC CONTROLLER				
	The DG Set shall be complete with PCC (Power Command Control) or equivalent DG Controller module suitable for AMF (auto-mains failure), Auto Load Sharing, electro-mechanical interlock & Interface with Main LT panel for ACB/MCCB switching, Auto load sensing , including communication card and networking gateway and software as required.				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	SITC OF 250 KVA DG SET AS DESCRIBED ABOVE AND AS PER CPWD SPECIFICATIONS. (Boys Hostel -1)	1	set	1512075	1512075
126	Providing, Installing, Testing and Commissioning of 'Silent Type' Diesel Generating set alongwith having Prime Power Rating of 380 KVA, 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 and consisting of the followings:				
(a)	Diesel Engine:				
	Diesel engine 4 stroke radiator cooled, electric start, of suitable BHP at 1500 RPM suitable for above output of alternator at 40 Degree C, 50% RH & at 1000 Meter MSL and conforming to BS 5514, BS 649, IS 10000, capable of taking 10% over loading for one hour after 12 hours of continuous operation. The engine will be fitted complete with all the required accessories.				
(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				
	(vi) RPM indication				
	(vii) Over speed indication				
	(viii) Low lub. Oil trip indication				
	(ix) Engine Hours indication				
(c)	Alternator :				
	Synchronous alternator rated at 380 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 SPDP enclosure, brushless, continuous duty, self-excited and self-regulated through AVR conforming to IS: 4722/BS 2613 suitable for tropical conditions and with class- F/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 990 liters capacity fabricated out of 3 mm thick M.S. sheet				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	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 exhaust silencer.				
(g)	Starting System:				
	12V/24V DC starting system comprising of starter motors; voltage regulator and arrangement for initial excitation complete with suitable nos. of batteries (25 plates, 180 Amp. Hour capacity lead acid type) as required as per specifications.				
(h)	Enclosure				
	Accoustic and weather proof enclosure with arrangement for fresh air intake for cooling of the engine & alternator, extraction, discharging hot air in to the atmosphere as per specifications.				
(i)	PCC CONTROLLER				
	The DG Set shall be complete with PCC (Power Command Control) or equivalent DG Controller module suitable for AMF (auto-mains failure), Auto Load Sharing, electro-mechanical interlock & Interface with Main LT panel for ACB/MCCB switching, Auto load sensing , including communication card and networking gateway and software as required.				
(j)	Exhaust Gas Piping				
	Supplying and fixing exhaust gas piping of suitable dia. welded black MS, B Class pipe conforming to IS:3589 cut to required lengths and installed with necessary bends, supports and clamps, anti-vibration mountings, insulation of exhaust system with mineral wool/Rockwool, 50 mm thick wiremesh & aluminum cladding etc., as required as per specifications. (Appro. length 8 mtrs)				
	SITC OF APFC PANEL AS DESCRIBED ABOVE AND AS PER CPWD SPECIFICATIONS. (Girls Hostel - 1)	1	set	2281723	2281723
127	SITC of 500 KVA 'Silent Type' Diesel Generating set having PCC 3.3 controller alongwith modbus connectivity having Prime Power Rating of following capacity, 415V at 1500RPM, 0.8 lagging power factor at 415V suitable for 50Hz, 3 Phase system & for 0.8 Load Factor and consisting of following:				
	Diesel Engine				
	Diesel engine 4 stroke water cooled, electric				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	start, of suitable BHP at 1500RPM suitable for above output of alternator at 40 degree C, 50%RH & at 1000 meter MSL and conforming to BS 5514, BS 649, IS 10000, capable of taking 10% overloading for 1 hour after 12 hour of continuous operation. The engine will be fitted complete with all accessories.				
	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				
	vi) RPM indication				
	vii) Overspeed indication				
	viii) Low lubricant oil trip indication				
	ix) Engine hours indication				
	Alternator				
	Synchronous alternator for following rated DG sets , 415V at 1500 RPM, 3 Phase 50Hz AC Supply with 0.8 lagging power factor at 40 degree celcius, 50% RH and at 1000 Meter MSL. The alternator shall be having SPDPEnclosure, crushless continuous duty, self excited and self regulated through AVR conforming to IS 4722/ BS 2613 suitable for tropical condition and of class F/H insulation.				
	Base Frame and Foundation shall be as per manufacturer standard & design				
	Both the Engine and alternator shall be mounted on suitable base frame made of M.S. channel with necessary re-inforcement which shall be installed on suitable cement-concrete foundation and vibration isolation arrangements as per recommendation of manufacturer.				
	Fuel Tank shall be built in type with self contained piping				
	Daily service fuel tank of 500 liters for 250 KVA & 990 liters for 1010 KVA capacity DG Sets, fabricated out of 3mm thick M.S. sheet complete with all standard accessories and fuel piping between fuel tank and diesel engine with M.S. class 'C' pipes of suitable dia. Complete with valves, level indication and accessories as required as per specification.				
	Exhaust Systems				
	Dry Exhaust main fold with hospital exhaust silencer and catalytic converter.				
	Starting Systems				
	12 volt/ 24 volts DC Starting system comprising of starter motors, voltage regulator and				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	arrangement of initial excitation complete with suitable no. of batteries (25 Plates, 180A hour capacity, lead Acid Type) as required as per specifications.				
	Enclosure				
	Accoustic and weatherproof enclosure with arrangement of fresh air intake for cooling of engine and alternator, extraction, discharging hot air in to the atmosphere and suitable arrangement for busduct/cable arrangements, as per specification.				
	Exhaust Gas Piping				
	Supply and fixing exhaust gas piping of suitable Dia welded black M.S. 'B' Class pipe, confirming to IS:3589 cut to required length and insulated with necessary bends, support and clamps, anti vibration mounting, insulation exhaust system and normal wool/ rock wool, 50m thick wiremesh and aluminium cladding etc. length as required				
	SITC of 500 KVA DG Set as per the above mentioned specification complete as required. (Academics -02)	2	set	3014317	6028634
119	AMF PANEL				
	Fabrication, installation, testing & commissioning of Automatic Mains Failure control including auto by-pass panel, suitable for silent type DG set, complete with relays, timers, set of CT's for metering and protection and energy analyser to indicate currents, phase & line voltages, frequency, Power factor & KWH, KVARH & provision for overload, short circuit, restricted earth fault, under frequency, control cabling from AMF panel to diesel engine and elsewhere if required, all complete and interlocking as required including following: -				
	a) Auto/Manual/Test off selector switch with indicator.				
	b) 15VA Class - 1 for metering (to be installed at output side of the Alternator at suitable location.				
	c) Energy analyser unit to indicate current, voltage, frequency, power factor, KWH.				
	d) Indicating lamps for load on mains and load on set.				
	e) Fuses for instruments.				
	f) Battery charger shall be of SMPS Type as per manufacturer recommendations				
	g) Main supply failure monitor.				
	h) Supply failure timer.				
	I) Restoration timer.				
	j) Microprocessor based AMF Logic Relay.				
	k) Control Unit with 3 impulse automatic engine				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	start/stop and failure to start lock out.				
	l) Impulse counter with locking and reset facility.				
	m) ON/OFF/Control Circuit switch with indicator.				
	n) Audio/Video annunciator shall include the following.				
	I) High water temperature.				
	II) Low lubricating oil pressure.				
	III) High lubricating oil temperature.				
	IV) Engine over speed.				
	V) Over current & earth fault.				
	VI) Engine fails to start.				
	VII) Full load/maximum load warning.				
	SITC of AMF panel complete as described above and as required as per the tender specifications. (Boys Hostel - 1)	1	set	317541	317541
	SH-IX HVAC				
	SUB HEAD 'A'- MACHINERY				
1	Water Cooled Chilling Units.				
	Supply, Installation, Testing & Commissioning of AHRI certified Water Cooled screw chillers of following capacity each at Design Conditions. The chiller assembly shall be installed on a fabricated mild steel base frame factory assembled to form a compact assembly. Compressor motor shall be suitable for operation on 415V+/- 10%, 50 Hz, 3 phase. The cooler and condenser shall be designed with even pass water connections for ease of piping connections. The chiller package shall also be complete with copper piping, R-134a refrigerant gas, Lubricants automatic & safety controls including electronic thermostatic expansion valve. The scope also includes the following:				
a)	Mono/Twin Screw helical rotary low noise compressor semi hermetic complete with automatic step less capacity control 100%-20%, safety switches, forced feed lubrication system etc.				
b)	Unit shall be complete with incoming suitable electrical isolator, star delta starter complete with ammeter with CTs, overload protection, under voltage protection, protection against phase reversal & independent single phase preventors etc as required.				
c)	Refrigerant piping i/c fittings, valves and accessories to inter connect compressor, condenser, chillers and expansion valve, safety valves, etc. Suction line and chiller insulation with minimum 19 mm thick polyvinyl nitrile rubber insulation. complete as required.				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

d)	Microprocessor based control panel with automatic controls and display module compatible to BMS operation and with BACnet/MODBUS/J Bus communication card etc. including sensors, factory manufactured and tested. All Control function including start up and shut down leaving chilled water temperature Control, Compressor and Electronic Expansion Valve modulation, anti re-cycle logic, automatic Compressor and load limiting. it shall also be equipped with the following protection and monitoring devices :- i) High (Condenser) & Low (Evaporator) pressure protection. ii) Low oil level & pressure protection. iii) Chilled/Condenser Water flow loss. iv) Chiller Water Freeze protection. v) Sensor error protection. vi) Motor load control and overload. vii) High motor temperature protection. viii) High oil temperature protection. ix) Chiller inlet and outlet Water temperature. x) Condenser inlet / Outlet water temperature xi) Suction and discharge Compressor pressure.				
e)	Water flow switches, water drain and air purge valves etc. complete wherever required.				
f)	Matching shell and tube ASME/GB stamped water cooled condenser of M.S. shell and both side integrally finned copper tubes having max. two passes.				
g)	Matching shell & tube as per ASME/GB/BIS flooded type chiller for screw type units of MS shell and both side integrally finned copper tubes having max. two passes. The chiller shall be duly insulated with 19 mm thick elastomeric nitrile insulation at factory.				
h)	Frame work for mounting the above condenser, chiller compressor and motor with base plate complete with antivibration pads/springs etc. complete as required.				
i)	Initial / first charge of refrigerant gas and compressor oil etc. as required.				
j)	Dial type thermometers and pressure gauges at inlet and outlet of condenser and chiller.				
k)	Anti-vibration mountings as per mfgs recommendations				
l)	Suitable RCC/Cement concrete foundation for the chilling unit installation complete as required.				
m)	DP switches at inlet and outlet of condenser & chiller, water drain & air purge valves, cable termination box, wherever required.				
n)	Design parameters are as under: 1. Type of Refrigerant : R-134a				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	2. Chilled Water 'In' : 54 Deg F (12.2 DeG C) 3. Chilled Water 'Out' : 44 Deg F (6.7 Deg C) 4. Chiller Fouling Factor (FPS) : 0.0005 5. Water Side Pressure Drop in Chiller : max 5m 6. Condenser Water 'In' : 90 Deg F (32.2 Deg C) 7. Condenser Water 'Out' : 97.8 Deg F (36.4 Deg C) 8. Condenser Fouling Factor (FPS) : 0.001 9. Water Side Pressure Drop in condenser: Max 8m OEM provided software selection sheet in accordance with ARI 550/590 at above mentioned parameters shall be submitted with the bid. The scope also includes the following:				
	The Chiller manufacturer shall submit Chiller run test report from factory for each machine and standard test certificates of tests conducted in line for each chiller during manufacturing"				
1.1	Minimum 390 TR actual capacity at above mentioned Design Conditions and not less than 400 TR capacity at AHRI conditions chilled water circulation rate: 960 US GPM (@2.4USGPM/TR) Condenser Water circulation rate: 1600 US GPM (@ 4USGPM/TR) Minimum COP at AHRI conditions shall be as per ECBC: 5.75 NPLV shall be <= 0.5 IKW/TR Max IKW/TR at design conditions: less than 0.65	1	each	6236280	6236280
1.2	Minimum 200 TR actual capacity as above mentioned Design Conditions chilled water circulation rate: 480 US GPM (@2.4USGPM/TR) Condenser Water circulation rate: 800 US GPM (@ 4USGPM/TR) Minimum COP at AHRI conditions shall be as per ECBC: 5.4 NPLV shall be <= 0.5 IKW/TR Max IKW/TR at design conditions: less than 0.7	3	each	3535004	10605012
2	COOLING TOWER				
	Supply, installation, testing and commissioning of CTI Certified, FRP/ Steel Induced draft, Cross flow, belt/ direct driven or driven through reduction gear box, site erected cooling tower of capacity at				
i	Water Temp. IN :36.4°C				

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

ii	Water Temp. OUT :32.2°C				
iii	and according to the parameters (Flow) as described below.				
iv	approach less than 2.8°C at Wet bulb 29.4 Deg C.				
v	Cooling tower shall be complete with PVC Fills, Louvers , Drift Eliminators with flame spread rating of 5 as per ASTM E84, Weather Proof IP 55 TEAO (Totally Enclosed Air Over) Motor, statically and dynamically balanced Propeller Fan, FRP/ Steel Basin in the bottom of the basin, Hot dip galvanised / powder coated Steel Ladder, Perimeter handrail, Steel hardware including nut, bolt, washer etc., suction screen, make-up quick fill arrangement, overflow and drain connections with necessary valves, access arrangement for cooling tower interior / fan, cement concrete foundation, steel/ masonry supporting structure, anti-vibration mountings etc. For longer life of the product Hot dip galvanization / powder coating on the steel frame and ladder other hardware shall be with minimum G-235 / Powder coated.				
vii	Tower fan motor shall be suitable for VFD operation The scope shall include VFD (to be installed in electrical panel) suitable for operation on 415 + 10% volts, 50 Hz. AC supply, Cooling Tower sump temperature sensor, controller to modulate the cooling tower fan speed based on sump temperature. Scope shall include suitable electrical isolator suitable for outdoor application near cooling towers.				
vii	Software generated curves to be submitted by manufacturer.				
2.1	Water Flow 6048 LPM (1600USGPM) Cooling tower of capacity 15,24,096 K.CAL/Hr	1	each	720340	720340
2.2	Water Flow 3024 LPM (800USGPM) Cooling tower of capacity 4,19,126.4 K.CAL/Hr	3	each	408614	1225842
3	Supply, installation, testing and commissioning of 250KW BMS compactable package type electric Hot Water generator having top open-able cover for easy access and removal of heaters. The HWG shall be constructed out Shell Sheet : 08mm thick Mild Steel Dish end Sheet : 10mm thick Mild Steel Panel Sheet : 16 Gauge thick CRC Skin Pass Paneling Sheet : 18 Gauge thick CRC Skin Pass Enclosure : I.P-54 (Indoor Unit)	3	each	393168	1179504

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	<p>Insulation : Resin Bonded Fiber Glass wool (50mm thick - 24 kg Density)</p> <p>Clading : Aluminum Sheet (0.8mm Thick)</p> <p>Inlet-Outlet : 03 inch Pipe Flange ends.</p> <p>Heaters: Electric Resistance Immersion type</p> <p>Heater Material : Copper Tube chrome plated</p> <p>Power Supply : 3 phase, 415 Volt, 50 Hz. AC supply.</p> <p>Capacity : 25KW X 2 Nos. INTO 05 Steps = 250KW</p> <p>Controls : Step Controller with PLC display</p> <p>Working Pressure: 100 P.S.I.G</p> <p>Test Pressure : 250 P.S.I.G</p> <p>Pressure Gauges with Ball Valves, Pressure Relief Valve at Inlet - 100 P.S.I.G, Level Switch with Electronic controller for Low Level cutout</p> <p>Master Thermostat for High Temperature Cutout</p> <p>The generator shall be complete with Internally Factory wired complete with Electrical Panel with with PLC display, Auto Air Purging Valve, float valve, pressure gauge with ball valve, master and bank thermostats, etc. The generator shall complete with self-contained incoming isolation, ammeter, voltmeter, contactors for heater banks in Three steps complete with manual/auto rotary switches.</p>				
4	<p>Supply, erection, testing and commissioning of Vertical split casing / Vertical Inline Split Coupled (Long coupled) centrifugal Condenser water pump set capable of delivering following capacity of water, each comprising of the following and complete with TEFC squirrel cage induction motor, efficiency IE3 with class 'F' insulation. 1450 rpm synchronous speed, operating on 415+ 10% volts, 3 phase, 50 Hz A.C. supply, BMS compatible. pump shall have CI body, SS/Bronze impeller, spacer coupling and coupling guard, The mechanical seal shall be outside type, The internal components of pumps including mechanical seal shall be suitable to sustain a temperature of 122 degree Fahrenheit. Vendor shall provide antivibration arrangement for pumps as per Manufacturers recommendation . Minimum efficiency of pump shall be 70%. The scope also shall include following.</p>				
a	<p>19mm thick polyvinyl nitrile rubber insulation duly cladded between aluminium sheets of</p>				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	0.5mm thickness and properly clamped to pump.				
b	2 Nos. - 150 mm dia dial type pressure gauges				
c	Mounting frame with antivibration pads (In case pumps are inline, anti vibration system shall be as per Manufacturers recommendation)				
d	RCC/cement concrete foundation for the pump unit. (In case pumps are inline, foundation shall be as per Manufacturers recommendation)				
	Pump capacity are as under:				
4.1.1	For 400 TR capacity unit not less than 6048LPM of water at 30 mtr head each	1	each	343460	343460
4.1.2	Triple duty valve	1	each	86126	86126
4.1.3	End suction guide	1	each	41738	41738
4.2.1	For 200 TR capacity unit not less than 3024 LPM of water at 30 mtr head each	3	each	227325	681975
4.2.2	Triple duty valve	3	each	35587	106761
4.2.3	End suction guide	3	each	27841	83523
5	Supply, erection, testing and commissioning of end suction / Vertical Inline Split Coupled (Long coupled) centrifugal primary chilled water pump set capable of delivering following capacity of water, each comprising of the following and complete with TEFC squirrel cage induction motor, efficiency IE3 with class 'F' insulation. 1450 rpm synchronous speed, operating on 415+ 10% volts, 3 phase, 50 Hz A.C. supply, BMS compatible. pump shall have CI body, SS/Bronze impeller, spacer coupling and coupling guard, The mechanical seal shall be outside type, The internal components of pumps including mechanical seal shall be suitable to sustain a temperature of 122 degree Fahrenheit. Vendor shall be provide antivibration arrangement for pumps . Pumps shall have minimum efficiency of pump shall be 70%. The scope also shall include following.				
a	19mm thick polyvinyl nitrile rubber insulation duly cladded between aluminium sheets of 0.5mm thickness and properly clamped to pump.				
b	2 Nos. - 150 mm dia dial type pressure gauges				
c	Mounting frame with antivibration pads (In case pumps are inline, anti vibration system shall be as per Manufacturers recommendation)				
d	RCC/cement concrete foundation for the pump unit. (In case pumps are inline, foundation shall be as per Manufacturers recommendation)				
	Pump capacity are as under:				
5.1.1	For 400 TR capacity unit not less than 3780	1	each	137625	137625

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	LPM of water at 12 mtr head each				
5.1.2	Triple duty valve	1	each	47096	47096
5.1.3	End suction guide	1	each	27841	27841
5.2.1	For 200 TR capacity unit not less than 1890 LPM of water at 12 mtr head each	3	each	115511	346533
5.2.2	Triple duty valve	3	each	29556	88668
5.2.3	End suction guide	3	each	21153	63459
6	Supply, erection, testing and commissioning of BMS compatible variable speed Secondary Chilled Water Vertical split casing / Vertical in line Split Long Coupled centrifugal pumps Pumps - 4 Nos. (3W + 1 SB) unit mounted IP55 adjustable frequency drives with built in DC Choke for Variable speed Pumping with pump controller from factory, VFD Shall be capable of displaying operating Head and Flow for better and precise control. The pump shall be capable of delivering capacity as mentioned below, complete with TEFC induction motor with class 'F' insulation to operate on 415+ 10% volts, 3 phase, 50 Hz A.C supply for each pump The pump motor shall be 1440 rpm of IE-3 class efficiency and DPT (Sensors) Supplied by pump Manufacturers or Sensorless Controls in Pump. The variable pump controller shall be capable of operating on DPT based control methodology or sensorless control.(2 Nos DPT to be considered for each zone in sace of DPT based methodology) Each pump shall have CI body, SS/Bronze impeller, spacer coupling and coupling guard, The internal components of pumps including mechanical seal shall be suitable to sustain a temperature of 122 degree Fahrenheit. Vendor shall be provide antivibration arrangement for pumps . Pumps shall be suitable for PN-16 rating, minimum efficiency of pump shall be 70%. The scope also shall include following.				
a	Electrical by pass stater for pumps				
b	19mm thick polyviny nitrile rubber insulation duly cladded between aluminium sheets of 0.5mm thickness and properly clamped to pump.				
c	2 Nos. - 150 mm dia dial type pressure gauges				
d	Mounting frame with antivibration pads (In case pumps are inline, anti vibration system shall be as per Manufacturers recommendation)				
e	RCC/cement concrete foundation for the pump unit. (In case pumps are inline, foundation shall be as per Manufacturers recommendation)				
	Pump capacity are as under:				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

6.1.1	For 400 TR capacity unit not less than 3780 LPM of water at 22 mtr head each	1	each	561057	561057
6.1.2	Triple duty valve	1	each	47096	47096
6.1.3	End suction guide	1	each	27841	27841
6.2.1	For 200 TR capacity unit not less than 1890 LPM of water at 22 mtr head each	3	each	563770	1691310
6.2.2	Triple duty valve	3	each	29556	88668
6.2.3	End suction guide	3	each	21153	63459
7	Air Handling units (AHUs)				
	Supply, Installation, Testing and commissioning of factory built floor mounted chilled water double skin type horizontal/vertical air handling units made of 25mm thick panels consisting of pre plasticized G.I. casing of thickness 0.8mm outside layer and 0.8 mm inside layer with polyurethane foam (PUF) insulation factory injected between them by injection moulding machine, complete with blower section with blower suitable for static pressure as required, minimum 2 bend GSS/PVC eliminators, cooling coil section with aluminium finned copper tubes (tubes thickness not less than 0.5mm) cooling coil of 6 row deep, filter section with 50mm thick metal viscous/ washable synthetic type air prefilters, belt drive package with TEFC drive motor of efficiency class IE3 suitable for $415 \pm 10\%$ volts, 50Hz, 3 Phase AC supply suitably designed for variable frequency drive applications, drain connections, stainless steel (18G) drain pan with PUF insulation, 150 mm dia. dial type pressure gauges (2 nos.) and industrial type thermometers (2 nos.) at the inlet and outlet of coil, auto purge valve wherever required, necessary vibration isolation arrangement etc. complete as per specification and of following capacities.				
	The scope shall include master controller with sensor to monitor CO2 level, capable to modulate fresh air damper to increase or decrease volume as per set value. The scope shall also includes AHU mounted VFD drive complete with incoming electrical isolator in enclosure				
	Type CFM TR St.pr				
	Academic				
	with 6 Row deep cooling coil with suitable static pressure as required				
	Type Capacity				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

7.1	C/s	3400CMH	1	each	98906	98906
7.2	C/s	5100CMH	2	each	116360	232720
7.3	F/M	5100CMH	2	each	116360	232720
7.4	F/M	6800CMH	11	each	130757	1438327
7.5	F/M	8500CMH	1	each	161985	161985
7.6	F/M	10200CMH	5	each	186811	934055
7.7	F/M	13600CMH	19	each	228038	4332722
7.8	F/M	17000CMH	13	each	273533	3555929
7.9	F/M	20400CMH	7	each	324757	2273299
7.10	F/M	28900CMH	7	each	376079	2632553
8	Supply, Installation, Testing and Commissioning of following sizes electronic, self-balancing, pressure independent type dynamic balancing valve with integrated 2 way modulating control valve in a single body. The actuator shall be capable of accepting upto 10V DC and upto 20mA electric signal and shall provide similar transduced feedback output to control system. Maximum close off pressure shall not be less than 6 Bar for upto 50 mm valves and 7 Bar for 65 mm & above. Valves should have pressure rating of 25 Bar minimum.					
8.1	100 mm Ø		5	each	108454	542270
8.2	80 mm Ø		36	each	64151	2309436
8.3	65 mm Ø		22	each	50405	1108910
8.4	50 mm Ø		3	each	32649	97947
8.5	40 mm Ø		2	each	29785	59570
9	Supply, Installation, Testing and commissioning of AMCA certified long casing Tube / Vane Axial fans, Complete fan with casing, impeller with adjustable blade angles, wire guard, fire retardant flexible connection, necessary nut bolts and directly coupled with TEFC Sq.cage induction motor suitable for 415V±10%, 50 Hz. 3 phase electric supply (Class H insulation). Fan & motor assembly shall be suitable for operation upto 250°C temp. for 2hrs fire/smoke conditions. Fan to have safety wire mesh screen on any exposed face. Fan Speed Not exceeding 1450 rpm. The Scope shall include CO sensor, controller, electrical isolator & BMS compactable VFD capable of receiving signal from fire panel / CO sensor controller.					
9.1	Basement Exhaust - Car Parking Area - Girls Hostel					
i	Air Qty. 3200 CFM, Static Pressure 25 mm Wg		1	each	36073	36073
ii	Air Qty. 2500 CFM, Static Pressure 25 mm Wg		1	each	28013	28013

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

iii	Air Qty. 2000 CFM, Static Pressure 25 mm Wg	4	each	25851	103404
iv	Air Qty. 1500 CFM, Static Pressure 25 mm Wg	1	each	25851	25851
v	Air Qty. 1400 CFM, Static Pressure 25 mm Wg	1	each	25851	25851
9.2	Basement Supply - Car Parking Area - Girls Hostel				
i	Air Qty. 4600 CFM, Static Pressure 25 mm Wg	1	each	36073	36073
ii	Air Qty. 4000 CFM, Static Pressure 25 mm Wg	1	each	36073	36073
iii	Air Qty. 2000 CFM, Static Pressure 25 mm Wg	2	each	28013	56026
9.3	Basement Exhaust - Car Parking Area - Boys Hostel				
i	Air Qty. 5000 CFM, Static Pressure 25 mm Wg	1	each	39710	39710
ii	Air Qty. 3500 CFM, Static Pressure 25 mm Wg	1	each	36073	36073
9.4	Basement Supply - Car Parking Area - Boys Hostel				
i	Air Qty. 5000 CFM, Static Pressure 25 mm Wg	1	each	39710	39710
ii	Air Qty. 3500 CFM, Static Pressure 25 mm Wg	1	each	36073	36073
10	Supply, Installation, Testing and commissioning of AMCA certified long casing Tube / Vane Axial fans, Complete fan with casing, impeller with adjustable blade angles, wire guard, fire retardant flexible connection, necessary nut bolts and directly coupled with TEFC Sq.cage induction motor suitable for 415V±10%, 50 Hz. 3 phase electric supply (Class H insulation). Fan & motor assembly shall be suitable for operation upto 250°C temp. for 2hrs fire/smoke conditions. Fan to have safety wire mesh screen on any exposed face. Fan Speed Not exceeding 1450 rpm. The Scope shall include electrical isolator capable of receiving signal from fire panel.				
10.1	Lift wells - (8# Academic + 4# Girls + 2# Boys)				
	Air Qty. 6,000 CFM, Static Pressure 5 mm Wg	14	each	33911	474754
10.2	Basement Lift lobby pressurization - (2# Girls + 1# Boys)				
	Air Qty. 26,000 CFM, Static Pressure 12 mm Wg	3	each	75881	227643
11	Supply, installation, testing and commissioning of Duct mounted in-line exhaust air fans comprising of Housing made out of heavy gauge galvanized sheets, DIDW forward curved centrifugal fan complete with internal rotor motor suitable for single phase, 230 volts, 50 Hz required for the exhaust. The fan shall be complete with speed regulator, external gravity				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	louvers, thermal overload release for the motor as well as terminal box for termination of external power supply for the following Capacities.				
11.1	800cfm 12mm (Academic Toilet)	36	each	11518	414648
11.2	700cfm 12mm (Girls - Toilet)	22	each	10145	223190
11.3	600cfm 12mm (22# Boys - Toilet)	22	each	10145	223190
11.4	500cfm 12mm (36# Academic + 22# Girls - Toilet)	58	each	10145	588410
12	Supply, installation, testing and commissioning of axial flow exhaust air fans (Propeller fan) with gravity louvers, frame, etc complete with motor suitable for 1 Phase, 230 volts, 50 Hz.				
12.1	200CFM (1# Girls +1# Boys)	2	each	5000	10000
12.2	150CFM Girls	4	each	5000	20000
12.3	100CFM Girls	2	each	5000	10000
12.4	50CFM Boys	1	each	5000	5000
13	Scrubber				
	Supply, Installation, Testing and commissioning of Dry scrubber for kitchen exhaust consisting of Electrostatic Precipitator, backward curve SISW centrifugal fan with elongated shaft having bearing & drive package out of exhaust air stream, TEFC induction motor, common channel base frame for Fan and motor, vibration isolation arrangement by means of spring type vibration isolators or turret mounts, fire retardent flexible canvass connections made out of canvass sleeve and the scope includes unit mounted stater panel in enclosure. The Electrostatic section shall be 90-95% in single pass as per DOP test method. Electrostatic Precipitator should be able to charge particles from 0.01 micron to 10 micron through solid state power supply. Collector cell shall be of permanent type and slide out facility for easy removal for cleaning. Operating voltage shall be 220+6 % volts, 50 Hz/1Ph, power consumption shall not exceeding 50 watts per unit upto 7500 Cfm. System should be fitted with interlock switch for safety. Velocity across the air cleaner shall not be more than 500 FPM. Scrubber shall be provided with pre-filters as required, pressure drop across ESP with pre filter should not be more than 12mm of Water gauge, . ESPs shall be provided with UV & Ozone Odours removers. ESP Modules shall have necessary provision in terms of flanges to facilitate Ducts/Plenum connections. The Scrubber shall be of following capacity.				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

13.1	Air Qty. - 3000Cfm, Pressure Drop - 50mmWG	1	each	190967	190967
13.2	Air Qty. - 1500Cfm, Pressure Drop - 50mmWG	1	each	125322	125322
14	Supplying, installation, testing and commissioning of fan coil units having following capacities, ceiling/ wall mounted complete with copper tubes, 3 row deep chilled water cooling coils having aluminium fins and auxiliaries including ball valve set (one with strainer), insulation of drain pan, drain connections, blower, TEFC slow speed (3 speeds) squirrel cage induction motor suitable for operation on 230 volts, single phase, 50 Hz, A.C. supply, controls for fan coil units comprising solenoid valve or 2 way valve with actuator, three speed selector switch, BMS compactable room thermostat with ON/ OFF switch, electrical wiring etc complete as required.				
14.1	FCU 400 1	2	each	10447	20894
14.2	FCU 600 1.5	1	each	11458	11458
14.3	FCU 800 2	1	each	12581	12581
	SUB HEAD 'B' PLUMBING				
1	Supplying, fixing, testing and commissioning of condenser water pipes of following sizes of MS 'C' class along with necessary clamps, vibration isolators and fittings such as bends, tees etc. but excluding valves, strainers, gauges etc. adequately supported on rigid supports duly painted/buried in ground excavation and refilling etc. as per specification and as required complete in all respect.				
	Note:-The Pipes size 150mm & below shall be M.S. 'C' class as per IS : 1239 and pipes size above 150mm shall be welded black steel pipe heavy class as per IS: 3589, from minimum 6.35mm thick M.S. Sheet for pipes upto 350 mm dia. And from minimum 7mm thick MS sheet for pipes of 400 mm dia and above.				
a	450 mm Dia	350	Mtr	8789	3076150
b	300 mm Dia	25	Mtr	5270	131750
c	200 mm Dia	66	Mtr	3705	244530
d	100 mm Dia	20	Mtr	1784	35680
e	50 mm Dia	15	Mtr	447	6705
2	Supplying , fixing , testing and commissioning of following valves, gauges and strainers for condenser water circulation as per specifications.				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

2	Supplying, fixing, testing and commissioning of following diameter valves(Complete with Flanges integral or welded, fittings, Nuts, Bolts & Gaskets (PN-16 Rating), strainers(Complete with flanges integral or welded, fittings, Nuts, Bolts & Gaskets (PN-16 Rating), gauges etc for condenser water circulation as per specifications.				
2.1	Butterfly Valve (Manual) with CI body SS disc nitrile sheet & O ring, & PN 16 pressure rating as specified.				
e	450 mm Ø Butterfly Valve	3	Nos	75504	226512
e	300 mm Ø Butterfly Valve	3	Nos	23600	70800
a	200 mm Ø Butterfly Valve	9	Nos	11531	103779
b	150 mm Ø Butterfly Valve	1	Nos	5442	5442
c	100mm Ø Butterfly Valve	1	Nos	4120	4120
d	50mm Ø Butterfly Valve	4	Nos	2544	10176
2.2	Supplying, fixing, testing and commissioning of following sizes Motorized Butter fly Valves with CI Body, SS Disc,O - ring and minimum PN-16 pressure rating , conforming to BS 5155, IS 13095, with IP-55 actuator, capable of accepting upto 10V DC and upto 20mA electric signal and providing similar transduced feedback output to control system as required.				
a	300mm	2	Nos	94059	188118
b	200mm	6	Nos	51795	310770
2.3.1	Flexible connection complete with control unit PN16 - 300mmØ	2	Nos	13613	27226
2.3.2	Flexible connection complete with control unit PN16 - 200mmØ	6	Nos	6959	41754
2.4	Supplying, fixing, testing and commissioning of following diameter valves(Complete with Flanges integral or welded, fittings, Nuts, Bolts & Gaskets (PN-16 Rating), strainers(Complete with flanges integral or welded, fittings, Nuts, Bolts & Gaskets (PN-16 Rating), gauges etc for condenser water circulation as per specifications.				
a	Fully automatic balancing valve - 300 mm Ø	2	Nos	326831	653662
b	Fully automatic balancing valve - 200 mm Ø	6	Nos	138543	831258
2.5	Providing and fixing in position the industrial type pressure gauges with gun metal / brass valves complete as required	140	Nos	1094	153160
2.6	Providing & fixing in position the mercury in glass industrial type thermometers.	124	Nos	957	118668

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

2.7.1	SITC of Pot strainer as per Specification. - 450 mm Ø (pipe size) - As per CPWD Specification	1	Nos	420641	420641
2.8	SITC of Plug valves - 25mm diameter Plug valves in dirt legs	114	Nos	1848	210672
2.9	Supplying, fixing, testing and commissioning of following Y- STRAINER of Ductile CI Body flanged ends with stainless steel as specified.				
2.9.1	300 mm dia	1	Nos	40201	40201
2.9.2	200 mm dia	3	Nos	20214	60642
3.1	Supplying, laying, fixing, testing and commissioning of following nominal sizes of pre insulated chilled water piping inside the building / outside the building along the wall/ roof (with necessary clamps, vibration isolators and fittings but excluding valves, strainers, gauges etc.) pipe insulation shall be polyurethane foam with 36 kg/cu m minimum density, minimum compressive strength of 40 psi and thermal conductivity of 0.14 Btu-in/hr/ft2/OF. The insulation shall completely fill the annular space between the service pipe and jacket and-shall be bonded to both, the service pipe & jacket. The minimum thickness of insulation shall be 30mm for pipes diameter less than 150mm & shall be 50mm for pipe diameter 150 to 300mm. The pipe cladding shall be with 24 gauge Aluminium sheet. Lock seam spiral Jackets for metallic jackets must be made on a spiral duct forming machine. The lock seam jackets should have zero leakage at the seams.				
	Note:-The Pipes of sizes 150mm & below shall be M.S. 'C' class as per IS: 1239 and pipes size above 150mm shall be welded black steel pipe heavy class as per IS: 3589, from minimum 6.35mm thick M.S. Sheet for pipes upto 350 mm dia. and from minimum 7mm thick MS sheet for pipes of 400 mm dia and above.				
	Note:- For pipes up to 125mm dia. the thickness of insulation shall be 50mm and for pipes above 125mm dia. the thickness of insulation shall be 75mm				
a	300 mm Ø Piping	420	Mtr	4679	1965180
b	250 mm Ø Piping	40	Mtr	4305	172200
c	200 mm Ø Piping	150	Mtr	3303	495450
d	150 mm Ø Piping	130	Mtr	1966	255580
e	125 mm Ø Piping	147	Mtr	1789	262983
f	100 mm Ø Piping	180	Mtr	1504	270720
g	80 mm Ø Piping	628	Mtr	1160	728480
h	65 mm Ø Piping	375	Mtr	924	346500

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

i	50 mm Ø Piping	178	Mtr	727	129406
j	40 mm Ø Piping	55	Mtr	570	31350
k	32 mm Ø Piping	30	Mtr	550	16500
l	25 mm Ø Piping	60	Mtr	462	27720
3.2	Supplying, laying, fixing, testing and commissioning of following nominal sizes of pre insulated chilled water piping to be laid direct in trench including excavation and refilling the trench as required. (The scope shall include excavation, re-filling of trench after completion of pipe laying, sand bed shall be prepared by laying 50mm thick sand layer in the trench, standard brick shall be placed over sand bed then the pipe shall be laid over brick). Pipe insulation shall be polyurethane foam with 36 kg/cu m minimum density, minimum compressive strength of 40 psi and thermal conductivity of 0.14 Btu-in/hr/ft ² /OF. The insulation shall completely fill the annular space between the service pipe and jacket and-shall be bonded to both, the service pipe & jacket. The minimum thickness of insulation shall be 30mm for pipes diameter less than 150mm & shall be 50mm for pipe diameter 150 to 300mm. The pipe cladding shall be with 24 gauge Aluminium sheet. Lock seam spiral Jackets for metallic jackets must be made on a spiral duct forming machine. The lock seam jackets should have zero leakage at the seams.				
a	300 mm Ø Piping	80	Mtr	7971	637680
b	200 mm Ø Piping	1430	Mtr	5298	7576140
c	125 mm Ø Piping	660	Mtr	2300	1518000
4	INSULATED VALVES				
	Supplying, fixing, testing and commissioning of following valves, strainers, gauges in the chilled water plumbing duly insulated to the same specifications as the connected piping and adequately supported as per specifications.				
4.1	BUTTERFLY VALVE (MANUAL) with C I body SS Disc, Nitrile Rubber Seal & O- Ring PN 16 pressure rating for chilled water/hot eater circulation as specified				
a	300 mm Ø	6	Nos	15534	93204
b	250 mm Ø	3	Nos	14122	42366
c	200 mm Ø	1	Nos	12838	12838
d	150 mm Ø	11	Nos	6556	72116
e	125 mm Ø	1	Nos	5861	5861
f	100 mm Ø	15	Nos	5169	77535
g	80 mm Ø	64	Nos	3691	236224

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

h	65 mm Ø	30	Nos	3436	103080
i	50 mm Ø	4	Nos	3167	12668
j	40 mm Ø	3	Nos	2925	8775
4.2	Supplying, fixing, testing and commissioning of following sizes Motorized Butter fly Valve with CI Body, SS Disc,O - ring and minimum PN-16 pressure rating , conforming to BS 5155, IS 13095, with IP-55 actuator, capable of accepting upto 10V DC , and upto 20mA electric signal and providing similar transduced feedback output to control system as required				
4.2.1	250 mm Ø	1	Nos	67718	67718
4.2.2	150 mm Ø	3	Nos	40154	120462
4.2.3	100 mm Ø	3	Nos	39070	117210
4.3	BALANCING VALVE WITH BUILT IN MEASURING FACILITY with C I body flanged construction with EPDM coated disc with long pitch with protected out pipe insulation & PN 16 pressure rating for chilled / hot water circulation as specified.				
4.3.1	Fully automatic balancing valve.				
a	250 mm Ø	1	Nos	194579	194579
b	150 mm Ø	3	Nos	89121	267363
c	100 mm Ø	3	Nos	48930	146790
4.4.1	Manual balancing valve.				
a	300 mm Ø	1	Nos	78634	78634
b	200 mm Ø	1	Nos	52635	52635
c	125 mm Ø	1	Nos	19996	19996
4.5	Y - STRAINER of Ductile CI Body flanged ends with stainless steel strainer for chilled / hot water circulation including insulation as specified.				
a	250 mm Ø	1	Nos	25000	25000
b	150 mm Ø	3	Nos	14758	44274
c	100 mm Ø	8	Nos	9821	78568
d	80 mm Ø	36	Nos	7123	256428
e	65 mm Ø	22	Nos	6207	136554
f	50 mm Ø	3	Nos	5033	15099
g	40 mm Ø	2	Nos	3565	7130
4.6	SITC of Flexible connection complete with control unit -				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

a	250 mm Ø	2	Nos	11657	23314
b	150 mm Ø	6	Nos	5160	30960
5.1	<p>Supply, Installation, Testing and commissioning of INSULATED PRESSURISED CLOSED WATER EXPANSION TANK suitable for total volume of water in chilled water circuit along with necessary accessories such as 2 Nos pumps (1working +1standby) with Pressure Transmitter and interconnecting Pipe & Isolating Valve complete with piping connections, safety relief valve, drain valve, pressure gauge, automatic air purging arrangement, etc. The tank shall be pre-charged. Expansion tank Shall be with replaceable heavy duty butyl rubber bladder. The tank shall have 50 MM system connection and 20 mm drain and charging valve connection to facilitate the on site charging of nitrogen in the tank. The tank shall be fitted with lifting rings and a floor mounting skirt for vertical installation. The tank must be constructed in accordance with IS-STANDARD 2825-1969 suitable for 125 PSI working pressure. The complete system shall be sourced from single manufacturer and supplied and installed with all accessories and safety fixtures required for proper functioning of the complete hydronic system. The tank shall be duly painted in approved colour shall be complete with pressure switches and power distribution and control panel IP55 Control Panel, Pressure Transmitter, interconnecting piping & wiring. (tank capacity 2000 Lts)</p> <p>Chilled water closed vessel pressurized expansion tank as described above shall be duly insulated with 50 mm thick EPS insulating material and clad with aluminium Sheet (20G)</p>	1	Nos	580969	580969
5.2	<p>Supply, Installation, Testing and commissioning of INSULATED PRESSURISED CLOSED WATER EXPANSION TANK suitable for out door application to be kept on terrace for total volume of water in chilled water circuit and interconnecting Pipe & Isolating Valve complete with piping connections, safety relief valve, drain valve, pressure gauge, automatic air purging arrangement, etc. The tank shall be pre-charged. Expansion tank Shall be with replaceable heavy duty butyl rubber bladder. The tank shall have 50 MM system connection and 20 mm drain and charging valve connection to facilitate the on site charging of nitrogen in the tank. The tank shall be fitted with lifting rings and a floor mounting skirt for vertical installation. The tank must be</p>	1	Nos	144594	144594

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	constructed in accordance with IS-STANDARD 2825-1969 suitable for 125 PSI working pressure. The complete system shall be sourced from single manufacturer and supplied and installed with all accessories and safety fixtures required for proper functioning of the complete hydronic system. The tank shall be duly painted in approved colour shall be complete with pressure switches. (tank capacity 500 Lts) Chilled water closed vessel pressurized expansion tank as described above shall be duly insulated with 50 mm thick EPS insulating material and clad with aluminium Sheet (20G)				
6	Supply, installation, testing and commissioning of Centrifugal type Air separator with pot type strainer for flanged connection 300mm pipe line, automatic air purging arrangement etc. The design parameters for the air separator of efficiency 96-98 %. Suitable for PN16 rating, complete with super vent as required. and duly insulated with 50 mm thick EPS insulated material and clad with aluminium sheet	1	Nos	105207	105207
7	Supply, installation, testing and commissioning of 20mm Automatic Air Vent valve suitable to purge out the trapped air in the water pipe line complete as required.	20	Nos	2602	52040
8	Supplying, fixing, testing and commissioning of medium class G.I. condensate drain pipes on wall/floor/roof of following size/diameters duly insulated with 9 mm thick closed cell nitrile rubber insulation in the form of pre-formed pipe sections and along with necessary clamps, fittings such as bends, tees etc. adequately supported as per specifications and as required.				
a	50 mm Ø	320	Nos	469	150080
b	40 mm Ø	260	Nos	350	91000
c	32 mm Ø	40	Nos	314	12560
d	25 mm Ø	55	Nos	291	16005
	SUB HEAD 'C' DUCTING AND GRILLS				
1	Supply, installation, balancing and commissioning of factory fabricated GSS sheet metal rectangular/round ducting complete with neoprene rubber gaskets, elbows, splitter dampers, vanes, hangers, supports etc. as per approved drawings and specifications of following sheet thickness complete as required.				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

1.1	Thickness 1.25mm Sheet	5	Sq.m	1677	8385
1.2	Thickness 1.00mm Sheet	345	Sq.m	1273	439185
1.3	Thickness 0.80mm Sheet	4753	Sq.m	1154	5484962
1.4	Thickness 0.63mm Sheet	12253	Sq.m	983	12044699
2	Supplying and fixing of following thickness duly laminated aluminium foil of mat finish closed cell Nitrile rubber (class "O") insulation on existing duct after applying two coats of cold setting adhesive (CPR X compound). The joints shall sealed with 50 mm wide and 3 mm thick self adhesive nitrile rubber tape insulation complete as per specifications and as required.	14680	Sq.m	432	6341760
2.1	25 mm				
3	Supplying and fixing 50mm thick aluminium foil faced resin bonded fibre glass insulation (on duct) of density 24 kg/cu.m or mineral wool insulation(non combustible) of density 44 kg/cum after applying two coats of cold setting adhesive (CPRX compound) sealing all joints with self adhesive aluminium tape & covering with 0.63mmx19mm GI wire mesh netting & butting all joints and laced with GI wire complete and finally covered with one layer of tar felt stuck with hot bitumen as per specifications and as required. (for outdoor applications)	5	Sq.m	510	2550
4	Supply, Installation, Testing Balancing & Commissioning of square/ rectangular Kitchen exhaust duct constructed out of min 1.6 mm thick black metal sheets complete with bends, vanes, inspection doors as required, gaskets for inspection door, supports, etc as required. The duct joints shall be welded type. The scope shall include making connection with kitchen hood and painting of kitchen exhaust duct.	116	Sq.m	1670	193720
5	Supply, installation, testing and commissioning of GI volume control duct damper complete with neoprene rubber gaskets, nuts, bolts, screws linkages, flanges etc, as per specifications.	85	Sq.m	6500	552500
6	Supplying & fixing of powder coated extruded aluminium Supply Air Grills with aluminium volume control dampers as per specifications.	190	Sq.m	8480	1611200
7	Supplying & fixing of powder coated extruded aluminium Return Air Grills with louvers but without volume control dampers complete as required.	230	Sq.m	5507	1266610

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

8	Supplying, fixing testing commissioning of supply air diffusers of powder coated aluminium with aluminium volume control dampers with anti smudge ring & removable core.	61	Sq.m	11363	693143
9	Supplying, fixing testing commissioning of Return air diffusers of powder coated aluminium without volume control dampers with anti smudge ring & removable core.	10	Sq.m	7559	75590
10	Double layered Flexible canvass connection made of fibreglass weave having silver grey silicon rubber coating, Flexible connection shall be air tight & water proof and withstand high temperature application, non flammable and does not support combustion. Flexible connection shall be complete with flanges made out of 22G G.S.S sheet on both sides for connection to unit and duct complete with nuts, bolts etc.	465	Mtr	1043	484995
11	Supplying, fixing, testing & commissioning of powder coated extruded aluminium section fresh air louvers in weather maker room with aluminium volume control dampers, bird screen etc completed as required.	51	Sq.m	9052	461652
12	Supply and fixing of acoustic lining of supply air duct and plenum with 25 mm thick resin bonded glass wool having density of 2 kg/m ³ , with 25 mm X 25 mm GI section of 1.25 mm thick, at 600 mm centre to centre covered with Reinforced Plastic tissue paper and 0.5 mm thick perforated aluminum sheet fixed to inside surface of ducts with cadmium plated nuts, bolts, stick pins, CPRX compound etc. complete as required and as per specifications.	207	Sq.m	647	133929
13	Supply, installation, testing and commissioning of Motorized (ON-OFF Type) duct mounted GI volume control damper with enthalpy sensor and necessary control wire (minimum 1.5 sqmm) for integration within AHU room				
i	Damper	42	Sq.m	7951	333942
ii	Motorised Actuator	238	Nos	7960	1894480
14	Supplying, Fixing,testing and commissioning of fire dampers in supply air duct/main branch and return air path as and where required of required sizes i/c control wiring,the damper				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	shall be motorized and spring return so as to close the damper in the event of power failure automatically and open the same in case of power being restored. The spring return action shall be inbuilt mechanism and not externally mounted. The damper shall also be closed in the event of fire signal complete as required and as per specifications.				
i	Fire Damper	171	Sq.m	9883	1689993
ii	Motorised Actuator	122	Sq.m	9212	1123864
	SUB HEAD 'D' ELECTRIC WORKS				
1	MAIN LT PANEL(HVAC) - Acad building plant room				
	Supplying, installation, testing & commissioning of cubical type wall / floor mounted Distribution Panel suitable for 433 V, 3 Phase, 4Wire 50 Hz AC supply system fabricated in compartmentalized design from CRCA sheet steel of 2mm thick for frame work and covers, 3 mm thick for gland plates i/c cleaning & finishing complete with 7 tank process for powder coating in approved shade, having Suitable Amp capacity extensible type FP Aluminium Alloy bus bars of high conductivity, SMC bus bar supports, with short circuit withstand capacity of 35kA for I Sec. with entire panel shall have a common Alu earth bus of size 32x6mm at the rear with 2 Nos earth stud, solid connections from main bus bar to switch gears with required size of Al. bus bars and control wiring with 2.5 sq.mm. PVC insulated FRLS copper conductor Single Core cable, cable alleys, cable gland plates in two half, i/c additional NO/NC contacts in all outgoing starters for automatic operation through BMS and providing & fixing following switch gears:-				
1.1.1	Incomer - 1				
i	1 No. - 1200 Amps Four Pole, 50k KA (ICU=ICS) for 1 sec, ACB with Microprocessor release with O/C, S/C & E/F protection release, each MCCB each shall be with following:-				
1.1.2	Incomer - 2				
i	1 No. - 1200 Amps Four Pole, 50 KA (ICU=ICS) for 1 sec, ACB with Microprocessor release with O/C, S/C & E/F protection release, each MCCB each shall be with following:-				
1.1.3	Incomer - 3 (from DG)				
i	1 No. - 200 Amps Four Pole, 50 KA (ICU=ICS) for 1 sec, MCCB with Microprocessor release with O/C, S/C & E/F protection release, each MCCB each shall be with following:-				
1.1.4	Buscoupler - 1				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

i	1 No. - 1200 Amps Four Pole, 50k KA (ICU=ICS) for 1 sec, ACB with Microprocessor release with O/C, S/C & E/F protection release, each MCCB each shall be with following:-				
1.1.5	Buscoupler - 2				
A	1 No. - 1200 Amps Four Pole, 50k KA (ICU=ICS) for 1 sec, ACB with Microprocessor release with O/C, S/C & E/F protection release, each MCCB each shall be with following:-				
1.1.6	Buscoupler - 3				
A	1 No. - 1200 Amps Four Pole, 50k KA (ICU=ICS) for 1 sec, ACB with Microprocessor release with O/C, S/C & E/F protection release, each MCCB each shall be with following:-				
i	Extended Rotary Operating Handle, Phase Spreader links and Phase barriers				
ii	Electrical & mechanical interlocking of above MCCBS so that only one MCCB can be switch on at one time.				
iii	1 Set - Digital Ammeter with in built ASS, metering C.T.s "CAST RESIN" type, 15VA, and accuracy class-1of 630/5A for measuring current in each phase				
iv	1 Set - Digital Voltmeter with in built VSS, with 2Amp. Back up MCB				
v	1 Set - 3 Nos. Phase indication LED lamps with 2Amp back up MCB, Breaker 'ON/OFF' indicating light with 2A MCB, test terminal block set, circuits as per standard practice, auxiliary contacts for positive interlocking of the breakers as required. - 2 Set				
1.2.1	Bus Bar 1, 2, 3 & 4 :- (All bus bars shall be of same capacity)				
	TPN aluminium extensible type main bus bars of minimum of 1600 A capacity (As per capacity of corresponding incoming / Bus couplers) , and auxiliary bus bars of suitable capacity with heat shrunk coloured sleeves and i/c SMC bus bars supports at required intervals complete for cross section, size supports & their spacing etc. for withstanding fault level of 35kA for 1 Sec.				
1.3.1	Outgoings basbar - 1				
1.3.1 .1	Supplying and fixing following outgoing MCCB / MCB complete connection, inter-connection etc. with suitable size of solid links / wires (2A backup SP MCB) complete as required.				
i	1 Nos- 1000A 50 KA TPN ACB with Microprocessor release (plug setting 812Amps) (1# Chiller 400TR)				
ii	1 Nos. - 150A 36 KA TPN MCCB with Star delta starter and single phase preventor (1# Cond pump 45kw)				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

iii	1 Nos 63Amps 25 KA TPN MCCB incommer for 1 Lot of VFDs for 400TR Cooling tower (Lot may have 4 fans each of 7.5hp capacity, the scope shall include VFD for each fan)				
iv	1 Nos. - 500A 50 KA 4P MCCB for 250KW HWG				
1.3.2	Outgoings basbar - 2				
1.3.2 .1	Supplying and fixing following outgoing MCCB / MCB complete connection, inter-connection etc. with suitable size of solid links / wires (2A backup SP MCB) complete as required.				
i	2 Nos- 630A 50KA TPN ACB with Microprocessor release (plug setting 812Amps) (1# Chiller 200TR)				
ii	2 Nos. - 100A 36 KA TPN MCCB with Star delta starter and single phase preventor (1# Cond pump 22kw)				
iii	2 Nos 32Amps 36 KA TPN MCCB incommer for 1 Lot of VFDs for 200TR Cooling tower (Lot may have 2 fans each of 7.5hp capacity, the scope shall include VFD for each fan)				
iv	1 Nos. - 500A 36 KA 4P MCCB for 250KW HWG				
1.3.3	Outgoings basbar - 3 (DG Supply)				
1.3.3 .1	Supplying and fixing following outgoing MCCB / MCB complete connection, inter-connection etc. with suitable size of solid links / wires (2A backup SP MCB) complete as required.				
i	1 Nos. - 40A 36KA TPN MCB (Motor duty) with Star delta starter and single phase preventor (1# primary pump 11kw)				
ii	3 Nos. - 40A 36KA TPN MCB (Motor duty) with DO starter and single phase preventor (3# primary pump 5.5kw)				
iii	1 Nos. - 63A 36 KA TPN MCB (Motor duty) for secondary pump VFD(22kw)				
iv	3 Nos. - 40A 36KA TPN MCB (Motor duty) for secondary pump VFD(11kw)				
1.3.4	Outgoings basbar -4				
1.3.4 .1	Supplying and fixing following outgoing MCCB / MCB complete connection, inter-connection etc. with suitable size of solid links / wires (2A backup SP MCB) complete as required.				
i	1 Nos- 630A 50KA TPN ACB with Microprocessor release (plug setting 812Amps) (1# Chiller 200TR)				
ii	1 Nos. - 100A 36KA TPN MCCB with Star delta starter and single phase preventor (1# Cond pump 22kw)				
iii	1 Nos 32Amps 36KA TPN MCB incommer for 1 Lot of VFDs for 200TR Cooling tower (Lot may have 2 fans each of 7.5hp capacity, the scope				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	shall include VFD for each fan)				
iv	1 Nos. - 500A 36KA 4P MCCB for 250KW HWG	1	Nos	2345670	2345670
2.1	Emergency panel 1, 2 & 3 (2#Academic block +1 Girls Hostel). - Suitable for out door application - Terrace				
I	100 Amp 3P MCCB 36K with Extended Rotary Operating Handle, Phase Spreader links and Phase barriers. The Scope shall include electrical isolator capable of receiving signal from fire panel.				
II	Bus Bar:-				
	TPN aluminium extensible type main bus bars of minimum of 125 A capacity (As per capacity of corresponding incoming / Bus couplers) , and auxilliary bus bars of suitable capacity with heat shrunk coloured sleeves and i/c SMC bus bars supports at required intervals complete for cross section, size supports & their spacing etc. for withstanding fault level of 35kA for 1 Sec.				
III	Outgoings				
	Supplying and fixing following outgoing MCCB complete connection, inter-connection etc. with suitable size of solid links / wires (2A backup SP MCB) complete as required.				
a)	4 Nos. - 15 A TPN MCB with DOL stater (Lift well)	3	Nos	109525	328575
2.2	Emergency panel 4 (Boys Hostel) . - Suitable for out door application - Terrace				
I	50 Amp 3P MCCB with Extended Rotary Operating Handle, Phase Spreader links and Phase barriers. The Scope shall include electrical isolator capable of receiving signal from fire panel.				
II	Bus Bar:-				
	TPN aluminium extensible type main bus bars of minimum of 100 A capacity (As per capacity of corresponding incoming / Bus couplers) , and auxilliary bus bars of suitable capacity with heat shrunk coloured sleeves and i/c SMC bus bars supports at required intervals complete for cross section, size supports & their spacing etc. for withstanding fault level of 35kA for 1 Sec.				
III	Outgoings				
	Supplying and fixing following outgoing MCCB complete connection, inter-connection etc. with suitable size of solid links / wires (2A backup SP MCB) complete as required.				
a)	2 Nos. - 15 A TPN MCB with DOL stater (Lift well)	1	Nos	100398	100398

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

3.1	Emergency panel 5 (Girls Hostel basement).				
I	300 Amp 3P MCCB with Extended Rotary Operating Handle, Phase Spreader links and Phase barriers The Scope shall include electrical isolator capable of receiving signal from fire panel.				
II	Bus Bar:-				
	TPN aluminium extensible type main bus bars of minimum of 400 A capacity (As per capacity of corresponding incoming / Bus couplers) , and auxilliary bus bars of suitable capacity with heat shrunk coloured sleeves and i/c SMC bus bars supports at required intervals complete for cross section, size supports & their spacing etc. for withstanding fault level of 35kA for 1 Sec.				
III	Outgoings				
	Supplying and fixing following outgoing MCCB complete connection, inter-connection etc. with suitable size of solid links / wires (2A backup SP MCB) complete as required.				
a)	14 Nos. - 15/ 20/ 25A 10 KA TPN MCB with DOL stater (Basement ventilation)	1	Nos	228178	228178
3.2	Emergency panel 6 (Boys Hostel basement).				
I	200 Amp 3P MCCB with Extended Rotary Operating Handle, Phase Spreader links and Phase barriers The Scope shall include electrical isolator capable of receiving signal from fire panel.				
II	Bus Bar:-				
	TPN aluminium extensible type main bus bars of minimum of 300 A capacity (As per capacity of corresponding incoming / Bus couplers) , and auxilliary bus bars of suitable capacity with heat shrunk coloured sleeves and i/c SMC bus bars supports at required intervals complete for cross section, size supports & their spacing etc. for withstanding fault level of 35kA for 1 Sec.				
III	Outgoings				
	Supplying and fixing following outgoing MCCB complete connection, inter-connection etc. with suitable size of solid links / wires (2A backup SP MCB) complete as required.				
a)	5 Nos. - 15/ 20/ 25A 10 KA TPN MCB with DOL stater (Basement ventilation)	1	Nos	118653	118653
4	L.T. CABLES				
A	Supply of following size XLPE insulated and PVC sheathed aluminium conductor armoured cable of 1.1 KV grade complete as required.				
i	3.5C x 400 sqmm (400TR Chiller)	40	Mtr	1224	48960

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

ii	3.5C x 185 sq.mm. (200TR chillers)	120	Mtr	624	74880
iii	4C x 150 sq.mm. (250KW HWG)	120	Mtr	567	68040
iv	3C x 35 sq.mm. (Cond water pump 45KW)	40	Mtr	141	5640
v	3C x 16 sq.mm. (Cond water pump 22KW)	120	Mtr	88	10560
vi	3.5C x 16 sq.mm. (Sec pump 22KW)	40	Mtr	105	4200
vii	3.5C x 10 sq.mm. (Sec pump 11KW)	120	Mtr	94	11280
viii	3C x 6 sq.mm. (Pr. pump 11KW & 5.5KW)	100	Mtr	66	6600
ix	3C x 4 sq.mm. (CT)	320	Mtr	56	17920
x	3.5C x 4 sq.mm. (Vent fans & AHUS)	765	Mtr	65	49725
7.8	Laying and fixing of one number PVC insulated and PVC sheathed / XLPE power cable of 1.1 kV grade of following size on cable tray as required.				
7.8.1	Upto 35 sq. mm (clamped with 1mm thick saddle)	1505	Mtr	33	49665
7.8.3	Above 95 sq. mm and upto 185 sq. mm (clamped with 25/ 40x3mm MS flat clamp)	240	Mtr	93	22320
7.8.4	Above 185 sq. mm and upto 400 sq. mm (clamped with 40x3mm MS flat clamp)	40	Mtr	150	6000
9.1	Supplying and making end termination with brass compression gland and aluminium lugs for following size of PVC insulated and PVC sheathed / XLPE aluminium conductor cable of 1.1 kV grade as required				
i	3½ X 400 sq. mm (82mm)	2	Each	1209	2418
ii	3½ X 185 sq. mm (57mm)	6	Each	702	4212
iii	4 X 150 sq. mm (57 mm)	6	Each	702	4212
iv	3 X 35 sq. mm (28mm)	2	Each	283	566
v	3 X 16 sq. mm (25 mm)	6	Each	222	1332
vi	4 x 16 sq.mm. (28mm)	2	Each	250	500
vii	4C x 10 sq.mm. (25 mm)	6	Each	219	1314
viii	3C x 6 sq.mm. (22 mm)	8	Each	211	1688
ix	3C x 4 sq.mm. (19 mm)	8	Each	198	1584
x	4C x 4 sq.mm. (22 mm)	206	Each	212	43672
B	Supplying and installing following size of perforated painted with powder coating M.S. cable trays with perforation not more than 17.5%, in convenient sections, joined with connectors, suspended from the ceiling with M.S. suspenders including bolts & nuts, painting suspenders etc as required.				
i	100 mm width X 50 mm depth X 1.6 mm thickness	60	mtr	476	28560
ii	150 mm width X 50 mm depth X 1.6 mm thickness	200	mtr	531	106200
iii	300 mm width X 50 mm depth X 1.6 mm	100	mtr	621	62100

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	thickness				
C	Supplying and installing following size of perforated painted with powder coating M.S. cable trays bends with perforation not more than 17.5%, joined with connectors, suspended from the ceiling with M.S. suspenders including bolts & nuts, painting suspenders etc as required.				
	100 mm width X 50 mm depth X 1.6 mm thickness	10	each	808	8080
	150 mm width X 50 mm depth X 1.6 mm thickness	10	each	947	9470
	300 mm width X 50 mm depth X 1.6 mm thickness	10	each	1340	13400
D	Supplying and installing following size of perforated painted with powder coating M.S. cable trays Tee with perforation not more than 17.5%, joined with connectors, suspended from the ceiling with M.S. suspenders including bolts & nuts, painting suspenders etc as required.				
i	100 mm width X 50 mm depth X 1.6 mm thickness	10	each	909	9090
ii	150 mm width X 50 mm depth X 1.6 mm thickness	10	each	1072	10720
iii	300 mm width X 50 mm depth X 1.6 mm thickness	10	each	1549	15490
	Providing and fixing 25 mm X 5 mm G.I. strip on surface or in recess for connections etc. as required.	560	Mtr	206	115360
	Providing and fixing 6 SWG dia G.I. wire on surface or in recess for loop earthing as required.	3570	Mtr	37	132090
	SH-X IBMS				
1	Supply, installation, testing and commissioning of BMS system, the BMS system shall be web enabled (We should be able to control & monitor from remote location). The BMS system should be suitable for following operations, also refer to attached data point summary. 1. HVAC plant room - Plant manager for efficient operation- monitoring and control. 2. HVAC low side monitoring and control. 3. Ventilation fan monitoring and control. 4. Monitoring system for Fire detection, fire fighting, water tank levels, PHE pumps & Submersible pumps. 5. Monitoring of HT/LT panels, UPS, DG & Lifts. Note: Chilled water Plant room is in Academic building, Girls hostel is 600m on one side and boys hostel is 400m on other side of academic building.	1	Nos	69507	69507

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

1.01	Software and Operator Workstation				
1.02	Supply, installation, testing and commissioning of core i7 processor, Memory of 16 GB or higher, 4TB Hard disk size, Giga speed Network card with 2 GB Graphic card, Windows 8.1 or higher, 64 bit Edition and original anti virus software.				
1.03	40 Inch HD Color LED Monitor.	1	Nos	34753	34753
1.04	Laser jet Printer (A4 size, B/W)	1	Nos	12901	12901
1.05	Supply, installation, testing and commissioning of Layer 2 switch with 8 or 16 ports (RJ-45) port. rack mountable & other termination accessories (Like Pigtailed/LIUs/ Convertors, Patch panel, Patch Cord, Etc) complete as required for BMS DDC Panel Networking. The switch to switch & DDC to Switch distance shall not exceed beyond 80 meters.	14	Nos	55289	774046
2	BUILDING MANAGEMENT SYSTEM WEB-BASED SERVER SOFTWARE				
2.01	Supply, Installation, Testing & Commissioning of software for Building Management Software with features like 3D vector dynamic graphics with Autocad import of plan with Zoom In & Zoom Out facility, Graphic Builder, Plant Viewer, Trend Viewer, Object Viewer, Report Viewer, Alarm router, Log Viewer. The Web-Based Server software shall permit use of Standard Web-Browsers such as Microsoft Internet Explorer, Netscape Navigator, etc. The software shall be capable of integration third-party systems and should supports latest IP technology (IP V4/V6). The Management Stations shall match the BACnet Profile B-AWS (Advanced workstation) as per the BTL Listing. The Web based software shall include 1 Client License for remote viewing. The same includes the necessary dongles as required for each of the workstation. Sms/Email feature for accessing critical alarms on mobile phone & Mobile App and Web Service sessions. Number of IO points shall be considered as per the IO summary considering 15% spares.	1	Set	1125475	1125475
2.02	Supply, Installation, Testing & Commissioning of High-quality CAPACTIVE touch 7.0" panels for technical on-site operation of plants as well as room operation. The Touch Panel shall have integrated web server and a BACnet/ IP web interface to connect a HTML5 browser to a device on the network. Generic operation and monitoring of plant functions (alarms, schedulers, calendars, set point changes, display of actual values, etc.)	1	Set	118439	118439

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

3	PROGRAMMABLE & APPLICATION SPECIFIC CONTROLLER (DDC) - UL LISTED/BTL certified.				
	Supply, Installation, Testing & Commissioning of True IP Based Standalone 32 Bit Intelligent, BTL Listed & UL certified interoperable DDC as per the specification. Each DDC Controller shall have inbuilt IP port & shall directly connect to the Network switches. No Supervisory Controller/Router shall be acceptable for IP conversion. The DDC shall be Programmable and Application specific with Real Time clock. The Controller shall have minimum 18 onboard points and can be expandable upto max of 52 points. The DDC must support trending & scheduling at Controller level. All trend data must be created and saved to the automation station to achieve gap-free trend documentation during communication failure.				
	The above shall be housed in vandal proof, lockable & secure MS Cabinets to be supplied along with all necessary switchgear protections as required. Number of controllers shall have spare capacity of 15% for future expansion.				
A	HVAC & Ventilation system				
#RE F!	DDC for Chilled Plant Manager includes Chiller, Primary, Secondary, Condensor, Cooling Tower, Hot water generator	1	Set	515121	515121
#RE F!	DDC for Air Handling Units/CSU (Max 1 AHU per DDC)	68	Set	56198	3821464
3.03	DDC for Basement Ventilation System (Max 2 fans per DDC)	5	Set	228335	1141675
B	Electrical System				
3.04	DDC for Transformer /HT/LT	3	Set	325186	975558
C	Plumbing System				
3.05	DDC for Pumps	3	Set	78403	235209
3.06	DDC for Tanks	3	Set	78403	235209
4	SYSTEM INTEGRATION UNITS for 3rd party integrations - UL listed Controllers & BTL label				
	Supply, Installation, Testing & Commissioning of True IP Based System Integration unit consisting of microprocessor based controller units BTL & UL Listed for third party integration. The same should support operations/ monitoring via portable operator terminal. The controller shall be Native BACnet type with communication via BACnet/LonTalk, Integration platforms and system controllers for third-party devices and systems via KNX, Modbus, M-Bus and other protocols into the automation level via BACnet. The same shall Support operation via local or network-compatible operator units. It should				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	store trend logs and event buffer for a typical duration of up to 30 Days. All the Integrators shall be separate. Note: No 3rd party make integrator shall be accepted.				
4.01	Chillers & Sec. Pump VFD Integartion on Modbus Protocol - 30 Points per Chiller	1	Set	105693	105693
4.02	AHUs VFD Integartion on Modbus RTU with RS 485 Communication Port - 10 Points per VFD	4	Set	105693	422772
4.03	UPS & Lift Integartion on Modbus Protocol - 15 Points per UPS	3	Set	218770	656310
4.04	Energy Meters to be on Modbus RTU with RS 485 Communication Port - 10 Points per Meter	3	Set	105693	317079
4.05	Fire Alarm System Integartion on Bacnet/IP - 3000 Points	3	Set	147438	442314
4.06	FCU's Thermostat to be on Modbus RTU with RS 485 Communication Port - 5 Points per Thermostat.	2	Set	105693	211386
5	Field instruments				
	Supplying, installing, testing and commissioning of the following sensors / transducers / transmitters.				
5.01	Supply, Installation, Testing & Commissioning of Immersion temperature sensor 100 mm Pt1000 with Brass Thermowell.	14	Set	3374	47236
5.02	Supply, Installation, Testing & Commissioning of Outside air temperature + humidity sensors for measuring outside air temperature. It should be provided with sun sheild and rain protection having	1	Nos	35130	35130
5.03	Supply, Installation, Testing & Commissioning of In line Type Electromagnetic Water Flow Meter.	1	Nos	313306	313306
5.04	Supply, Installation, Testing & Commissioning of Differential Pressure Switch Water	12	Nos	14364	172368
5.05	Supply, Installation, Testing & Commissioning of Water Differential pressure sensor for liquids (0...10 V)	4	Nos	32662	130648
5.06	Supply, Installation, Testing & Commissioning of Current Relay	19	Nos	2089	39691
5.07	Supply, Installation, Testing & Commissioning of Differential pressure switch for Blower Status (Pa Range 50...300 Pa)	68	Nos	3124	212432
5.08	Supply, Installation, Testing & Commissioning of Differential pressure switch Filter Status (Pa Range 50...500 Pa)	68	Nos	3124	212432
5.09	Supply, Installation, Testing & Commissioning of Duct Temperature Sensor.	68	Nos	1577	107236
5.1	Supply, Installation, Testing & Commissioning of CO2 Sensor.	68	Nos	25454	1730872
5.11	Supply, Installation, Testing & Commissioning of Duct Static Pressure Sensor.	68	Nos	13085	889780
5.12	Supply, Installation, Testing & Commissioning of Carbon Monoxide Sensor for Basement. (Range 0	5	Nos	11488	57440

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	to 300 ppm)				
5.13	Supply, Installation, Testing & Commissioning of Flameproof Level Switch.	4	Nos	12287	49148
5.14	Supply, Installation, Testing & Commissioning of Level Switch	20	Nos	8601	172020
5.15	Supply, Installation, Testing & Commissioning of Pressure sensor for neutral and slightly aggressive liquids.	3	Nos	14104	42312
6	Cabling and Conduiting				
6.01	Supplying, Installing, Testing & Termination of Signal & communication Cable 2core x 1.5 sq.mm Multistranded Annealed Tinned Electrolytic Grade High Conductivity Copper Conductor, Shielded, PVC insulated, and Inner sheathed PVC sheathed cable.	19000	Rmt	58	1102000
6.02	Supplying and drawing of UTP 4 pair CAT 6 LAN Cable with RJ 45 Connector in the existing surface/ recessed Steel/ PVC conduit as required.	10000	Rmt	49	490000
6.03	Supplying and fixing of following sizes of steel conduit along with accessories in surface/recess including painting in case of surface conduit, or cutting the wall and making good the same in case of recessed conduit as required. 25 mm	15000	Rmt	165	2475000
6.04	Supply & Laying of Industrial grade Steel flexible conduit of 25 mm size.	1200	Rmt	138	165600
6.05	Supply & Laying of 6 core armoured multimode fibre optic cable along with all accessories as required.	3000	Rmt	168	504000
	SH-XI Fire Fighting System				
	Sub Head : Fire Fighting System				
1	Supply, installation, testing & commissioning of electric driven main fire pump suitable for automatic operation and consisting of following: complete in all respect as required.				
a)	Horizontal type, multistage, centrifugal, split casing pump of cast iron body & bronze impeller with stainless steel shaft, mechanical seal to ensure a minimum pressure of 3.5 kg/sp.cm. at highest and farthest outlet at specified flow of 2850 lpm at 100m. head conforming to IS 1520.				
b)	Suitable HP SQ cage induction motor, TEFC, synchronous speed 1500 RPM, suitable for operation on 415 volts, 3 phase 50 Hz. AC with IP 55 protection for enclosure, horizontal foot mounted type with Class-'F' insulation, conforming to IS-325.				
c)	M.S. fabricated Common base plate, coupling, coupling guard, foundation bolts etc. as required.				
d)	Suitable cement concrete foundation duly plastered with anti vibration pads.	4	Set	493884	1975536

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

2	Supplying, Installation, Testing and Commissioning of diesel engine driven main fire pump suitable for automatic operation and consisting of following: complete in all respect as required.				
a)	Horizontal type, multistage, centrifugal, split casing pump of cast iron body & bronze impeller with stainless steel shaft, mechanical seal to ensure a minimum pressure of 3.5 kg/sp.cm. at highest and farthest outlet at specified flow of 2850 lpm at 100 m. head conforming to IS 1520.				
b)	Suitable HP, 1500 RPM water cooled with radiator, diesel engine conforming to relevant BS & IS standard complete with auto starting mechanism, 12 volts/24 Volts electric starting equipment, sealed maintenance free batteries, Diesel Tank, exhaust pipe extended upto 1 m. outside pump house duly insulated with 50 mm. thick glass wool with 1.0 mm. thick aluminium sheet cladding, residential silencer, instruments and protection as per specification, stop solenoid for auto stop in the event of fault with audio indications, painted with post office red colour etc. as required.				
c)	M.S. fabricated Common base plate, coupling, coupling guard, foundation bolts etc. as required.				
d)	Suitable cement concrete foundation duly plastered with anti vibration pads.	3	Set	764783	2294349
3	Supplying, Installation, Testing and Commissioning of electric driven pressurisation pump suitable for automatic operation and consisting of following: complete in all respect as required.				
a)	Horizontal type, multistage, centrifugal pump of cast iron body and bronze impeller with stainless steel shaft, mechanical seal and flow of 180 lpm, at 100m head conforming to IS:1520.				
b)	Suitable HP SQ cage induction motor, TEFC, synchronous speed 1500 RPM, suitable for operation on 415 volts, 3 phase 50 Hz. AC with IP 55 protection for enclosure, horizontal foot mounted type with Class-'F' insulation, conforming to IS-325.				
c)	M.S. fabricated Common base plate, coupling, coupling guard, foundation bolts etc. as required.				
d)	Suitable cement concrete foundation duly plastered with anti vibration pads.	4	Set	91442	365768
4	Fabrication, Supplying, Installation, Testing & Commissioning of electrical control panel of cubical construction, floor mounted type, fabricated out of 2mm thick CRCA sheet, compartmentalised with hinged lockable doors,				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	dust and vermin proof, powder coated of approved shade after 7 tank treatment process, cable alley, inter-connection, having switchgears and accessories mounting and internal wiring, earth terminals, numbering etc. complete in all respect, suitable for operation on 415 V, 3 phase, 50 HZ. AC supply with enclosure protection class IP 42 as required.				
	COMMON PANEL IN FIRE PUMP HOUSE				
	INCOMER				
	a) 400 Amps. TP & MCCB 50 KA				
	b) Voltmeter (0-500 Volts) with selector switch				
	c) Ameter (0-300 Amps.) with selector switch & CT's etc				
	d) Set of 3 Phase indicating lamp.				
	e) Set of Al. bus bar 500 Amps.				
	OUTGOING : (Electrical Fire / Sprinkler Pump)				
	2 Nos Electrical Driven fire Pump. 250 Amps. TP& MCCB-35K with suitable HP fully automatic star/delta starter with over load protection, current sensing type single phase preventor complete with all accessories and internal wiring required for automatic operation, selector switch for local/remote, auto/manual/OFF operation.				
	2 Nos Jockey pump. 100 Amps. TP & N MCCB-25 KA with suitable HP fully automatic star/delta starter with over load protection, current sensing type single phase preventor complete with all accessories and internal wiring required for automatic operation, selector switch for local/remote, auto/munual/OFF operation.				
	DIESEL ENGINE CONTROL				
	Control for Diesel Engine comprising:-				
	Auto/Manual selector switch & 3 attempt starting device, timers and relays as required, push buttons, start/stop in manual mode.				
	Indication lamp for High/Low Lub. Oil pressure, High Water Temp. and Engine ON indication.				
	Battery charger suitable for 12 V/24V DC with boost and tickle selector switch, 0-15 V/ 0-30 V Dcvolt merer, 0-20A DC Ammeter.				
	All standard relays and accessories for automatic operation of diesel engine.				
	SYSTEM CONTROLLER				
	Designing, Supply, Installation, Testing and Commissioning of system controller to control operation of Main Electric Fire Pump, Diesel Pump, Pressurisation Pump, in sequence as per specification consisting of relays, times, sensors, annunciation window for fault indication, complete as per specification.	3	Set	378998	1136994
5	Supplying and Laying of XLPE insulated, PVC				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	sheathed alluminium conductor 1.1 KV grade armoured U.G Cable of following sizes on surface/ in existing cable tray suitably clamped as required				
a)	3x120 sq.mm	300	metre	535	160500
b)	3x25 sq.mm	300	metre	171	51300
6	Supplying and laying of XLPE/PVC insulated stranded copper conductor 1.1 KV grade (un-armoured) of following size on existing cable tray suitably clamped including termination with copper lugs at both ends as required.				
a)	3 core 95 sq.mm	150	metre	2758	413700
b)	4 core 16 sq.mm	150	metre	634	95100
7	Supplying and making end termination with brass compression gland & Al.lugs for following sizes of PVC insulated, PVC sheathed/XLPE Al.conductor cables of 1.1 KV grade as required				
a)	3x120 sq.mm	6	each	489	2934
b)	4x25 sq.mm	6	each	205	1230
8	Earthing with GI Earth plate 600 mm x 600 mm x 6 mm th.including accessories and providing masonry enclosure with cover plate having locking arrangement and watering pipe with charcoal or coke and salt complete as required.	6	Set	4327	25962
9	Providing & fixing 25 mm x 5 mm G.I. Strip in 40 mm dia GI pipe from earth electrode including connections with GI nut, bolt, spring, washer excavation and re-filling etc. as required.	30	metre	351	10530
10	Providing & fixing 25 mm x 5 mm G.I. Strip in on surface or in recess for connections etc as required.	75	metre	129	9675
11	Providing and fixing 6 SWG dia G.I wire on surface or in recess for loop earthing as required.	210	metre	37	7770
12	Supplying and installing following size of perforated painted with powder coating M.S. cable trays with perforation not more than 17.5%, in convenient sections, joined with connectors, suspended from the ceiling with M.S. suspenders including bolts & nuts, painting suspenders etc. as required.				
a)	300 mm (W) x 50 mm (D) x 1.6 mm (T)	110	metre	526	57860
13	Providing laying, testing & commissioning of 'C' class heavy duty MS Pipe conforming to IS 1239/3589 i/c fittings like elbows, tees, flanges, tapers, nuts bolts, gaskets etc. in ground including excavation & providing cement concrete blocks as supports, anticorrosive treatment with coaltar/asphalt tape as per IS 10221, refilling the trench etc. of following sizes complete as required				
a)	150 mm dia	1600	metre	1690	2704000
b)	80 mm dia	140	metre	950	133000

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

14	Providing, laying, testing & commissioning of 'C' class heavy duty MS pipe conforming to IS 3589 and 1239 including fittings like elbows, tees, flanges, tapers, nuts bolts, gaskets etc., fixing the pipe on the wall/ceiling with suitable clamps and painting with two or more coats of synthetic enamel paint of required shade complete as required.				
a)	200 mm dia	55	metre	2219	122045
b)	150 mm dia	1150	metre	1521	1749150
c)	100 mm dia	1180	metre	1080	1274400
d)	80 mm dia	1130	metre	776	876880
e)	65 mm dia	325	metre	668	217100
f)	50 mm dia	1830	metre	541	990030
g)	32 mm dia	2785	metre	377	1049945
h)	25 mm dia	3590	metre	323	1159570
15	Supplying and fixing single headed internal hydrant valve with instantaneous Gun metal couplings of 63mm dia with cast iron wheel ISI marked conforming to IS 5290 (Type-A) with blank Gunmetal cap and chain as required	142	each	7027	997834
16	Supplying and fixing Single headed external yard hydrant valve with 1 No. 63 mm dia instantaneous FM Gun metal coupling and cast iron wheel, ISI marked, conforming to IS 5290 (type A) with blank Gunmetal cap and chain as required.	39	each	7027	274053
17	Supplying, fixing, testing and commissioning of following size butterfly valve (manual) with CI body SS disc nitrile sheet & O-ring & PN 16 pressure rating as specified.				
a)	200 mm dia	10	each	10261	102610
b)	150 mm dia	32	each	5914	189248
c)	80 mm dia	45	each	3302	148590
d)	40 mm dia	142	each	2357	334694
18	Supplying, fixing, testing and commissioning of following size non return valve with dual plate of CI body SS plates vulcanized NBR seal flanged end & PN 16 pressure rating as specified.				
a)	150 mm dia	23	each	5772	132756
b)	80 mm dia	36	each	2392	86112
19	Supplying and fixing orifice plate made of 6 mm thick stainless steel with orifice of required size in between flange & landing value of external and internal hydrant to reduce pressure to working pressure of 3.5 kg/cm ² complete as per specifications as required.	142	Nos.	1411	200362
20	Supplying, fixing, testing and commissioning of following size Y-Strainer of ductile CI body flanged ends with stainless steel strainer as specified.				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

a)	200 mm dia	6	each	18958	113748
21	Supplying and fixing 63mm dia, 15mtr. Long RRL hose pipe with 63mm dia Male and Female Gun metal couplings duly binded with GI wire, rivets etc. conforming to IS 636 (type-A) as required.	362	each	4610	1668820
22	Supplying and fixing First-Aid-Hose Reel with MS construction spray painted in Post office Red, conforming to IS 884 with upto date amendments, complete with the following as required.				
a)	30 m long 20mm (nominal internal) dia water hose Thermoplastic (Textile reinforced) Type-2 as per IS: 12585				
b)	20 mm (nominal internal) dia gun metal globe valve & nozzle.				
c)	Drum and brackets for fixing the equipments on wall.				
d)	Connections from riser with 40 mm dia stop valve (gun metal) & M.S. Pipe	142	each	11358	1612836
23	Supplying and fixing of hose cabinet of size 900 mm x 600 mm x 500 mm made of 2 mm thick MS Sheet with 6 mm thick glazed glass doors i/c necessary locking arrangemnt suitable to accommodate external hydrant with butterfly value, 2 Nos. 15 mtr. Long Hose pipe, 1 No. branch pipe, mounted on wall OR raised brick platform & duly painted with Post office red externally and white internally with synthetic enamel paint complete in all respect, for external hydrant, as required.	37	each	3331	123247
24	Supply and fixing 63mm dia Gun Metal branch pipe with 20mm (nominal internal diameter) size Gun Metal nozzle conforming to IS 903, suitable for instantaneous connection to interconnect hose pipe coupling as required.	180	each	2306	415080
25	Supplying and fixing following fire brigade connection of cast iron body with Gun metal male instantaneous inlet couplings complete with cap and chain as required for 150mm dia MS pipe connection, conforming to IS 904 as required.				
a)	4 Way FBC of CI body	3	each	10323	30969
b)	2 Way FBC of CI body	13	each	3912	50856
26	Supplying and fixing air vessel made of 250 mm dia, 8 mm thick MS sheet, 1200 mm in height with air release valve on top and flanged connection to riser, drain arrangement with 25 mm dia Gun metal wheel valve, with required accessories, pressure gauge and painting with synthetic enamel pain of approved shade as required.	20	each	9247	184940
27	Providing fixing testing & commissioning of 15 mm size quartzoid bulb type sprinklers, of rating	2516	each	280	704480

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL







	68 degree C. pendent with required accessories.				
28	Providing & fixing flow switches in 100 mm dia MS pipe.	22	each	3799	83578
29	Providing & fixing flow switches in 150 mm dia MS pipe.	3	each	4091	12273
30	Providing & fixing angle iron (40 mmx 40mm x 5 mm) door frame and M.S. sheet (2 mm thick) cum glass shutter of size 2.1 mtr. X 1.2mtr. (N.S) with 25mm x 25mm x 3mm angle frame all around & stiffened in between i/c hinges, handle, locking arrangement, painting with approved synthetic enamel paint i/c sign writing on glass at internal hydrant including providing & fixing M.S. sheet 2 mm thick on remaining portion above door to close opening i/c painting etc. as required.	142	each	4448	631616
31	Providing and fixing in position the industrial type pressure gauges with gun metal / brass valves complete as required	168	each	973	163464
32	Providing and fixing standard Fireman's Axe with heavy insulated rubber handle.	142	each	442	62764
33	Supply, installation, testing and commissioning of 150 mm dia Installation Control Valve inclusive of 2 nos 150 mm dia Butterfly Valve, strainer, Alarm Valve with Water Motor Gong, Pressure Gauges, Test Lines with Ball Valves with necessary MS Class "C" piping with threaded fittings of required sizes. It should be complete as per manufacturer's specifications & as directed by Engineer- in-charge.	3	each	44540	133620
34	Providing, installing, testing & commisioning of fire brigade draw out connection (fire department connection) with suction pipe MS class 'C' 100 mm dia. & 100 mm dia. foot valve & steel chain including wall mounted box M.S. construction made out of 16 gauge MS Sheet with glass door to house the above mentioned componenets. It should be complete as per manufacturer's specifications & as directed by Engineer- in-charge. (to be connected to static water tank) It should be complete as per manufacturer's specifications & as directed by Engineer- in-charge.	3	each	3329	9987
35	Providing and fixing mechanical foam type(ISI marked) fire extinguishers consisting of welded M.S. cylindrical body squeeze lever discharge valve 30 cm long high pressure discharge hose, discharge nozzle suspension bracket ISI marked as per IS 933 finished externally with red enamel paint and fixed to wall with brackets complete with internal charger.				
a)	9 litres capacity I.S.I. Marked.	142	each	3281	465902
36	Providing and fixing Carbon-di-oxide fire extinguishers consisting of welded M.S cylindrical body,squeeze lever discharge valve				

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

	fitted with internal discharge tube, 30cms long high pressure discharge hose, discharge nozzle, suspension bracket, confirming to IS : 934 finished externally with red enamel paint and fixed to wall with brackets with rawl plug/dash fasteners complete with internal charge.				
a)	Capacity 4.5 kg. I.S.I. Marked.	142	each	5321	755582
37	SITC of annunciation panel made out of not less than 1.6mm thick CRCA sheet powder coated approved colour with locking arrangement , audio and visual indication of fault and operation of automatic sprinkler , system monitoring including providing and fixing the following , connection, interconnection etc complete as required. the panel shall be microprocessor type ,				
	Monitoring of flow switches				
	Monitoring open circuit , short circuit and earth fault in control cable between panel and flow switches				
	Battery charger trickle cum boost to take complete load of annunciation panel with indication of low battery , mains failure and other accessories including 2 Nos 12 V , 24 AH , SMF Batteries				
a)	For 28 Nos Flow switch	1	each	31463	31463
b)	For 8 Nos Flow switch	2	each	14429	28858
				Total (B)	452242342
				Total A+B	2301153307

No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

SAMPLE PHOTOS OF FURNITURE ITEMS

<p style="text-align: center;">Item No.1 Classroom Bench</p> 	<p style="text-align: center;">Item No.2 HOD Table</p> 
<p style="text-align: center;">Item No.3 Meeting Room Table</p> 	<p style="text-align: center;">Item No.4 & 5 HOD Cabin 2 & 3 Seater Sofa</p> 
<p style="text-align: center;">Item No.6 HOD Cabin Centre Table</p> 	<p style="text-align: center;">Item No.7 PROFESSOR ROOM TABLE</p> 

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

AE-I
(EPD-4)

EE
(EPD-4)

AE (P)
(CPM Housing)

EE(P)
(CPM Housing)

**Item No.8 ASSISTANT PROFESSOR
TABLE/HODPA Table**



**Item No.9 COMPUTER LAB TABLE BACK
TO BACK 4 PERSON CLUSTER**



**Item No.10 RESEARCH SCHOLAR CABIN
TABLE**



**Item No.11 EXECUTIVE CHAIRS -
REVOLVING HIGH BACK**



**Item No.12 VISITORS CHAIRS – REVOLVING
MEDIUM BACK**



Item No.13 Hostel Block Study Table



No. of Correction –C NIL
No. of Omissions – O NIL
No. of Insertions –I NIL

AE-I
(EPD-4)

EE
(EPD-4)

AE (P)
(CPM Housing)

EE(P)
(CPM Housing)

Item No.14 Hostel Block Study Chair**Item No.15 Hostel Block Beds****Item No.16 Hostel Block Wooden Storage Cabinet****Item No.17 Bed Mattress**

No. of Correction –C NIL
 No. of Omissions – O NIL
 No. of Insertions –I NIL

AE-I
 (EPD-4)

EE
 (EPD-4)

AE (P)
 (CPM Housing)

EE(P)
 (CPM Housing)